



ENGINEERING REVIEW COMMENTS IN BLUE BOXES WITH BLUE TEXT

Additional comments will be provided upon approval of deviations, clarification and revisions to the drainage report Flying Horse North Filing No. 3

Final Drainage Report

July 27, 2023

Prepared For:

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PCD File No. SF-XXXX

SF2326



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Engineer's Statement

This report and plan for the drainage design of the development, Flying Horse North, was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the *El Paso County Drainage Criteria* Manual and is in conformity with the master plan of the drainage basin. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Richie Lyon, PE	Date	
State of Colorado No.	53921	
For and on behalf of H	R Green Development, LLC	
Developer's	Statement	
I, the developer, have	read and will comply with all c	of the requirements specified in this drainage report and plan.
Flying Horse Developr	nent, LLC	
Drew Balsick	Date	
Vice President / Project	ot Manager	
Flying Horse Developr 2138 Flying Horse Clu		
Colorado Springs, CO	80921	
El Paso Cou	unty:	
	th the requirements of the EI I d 2 and the Engineering Crite	Paso County Land Development Code, Drainage Criteria ria Manual, as amended.
Joshua Palmer, P.E.		Date
County Engineer/ECM	Administrator	



Final Drainage Report - Flying Horse North

I. General Purpose, Location and Description

a. Purpose and Scope

The Purpose of this Final Drainage Report (FDR) is to identify specific solutions to drainage concerns for onsite and offsite tributary areas resulting from the development of the subdivision to be platted. The FDR is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure as it relates to water quality and stormwater detention for any proposed or existing facilities, the planned storm water management for the Flying Horse North development for Filing No. 3.

Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1 is a combined Preliminary Drainage Report (PDR) and Final Drainage Report (FDR) that was developed by Classic Consulting, latest revision June 2018. The combined PDR/FDR was approved by the County in September of 2018 and is included in Appendix F. This approved report identifies the proposed Filing No. 3 area for the PDR and Preliminary Plan portion of the report and the Filing No. 1 area for the FDR portion.

A more recent Master Development Drainage Plan (MDDP) was prepared by HR Green Development, LLC. and was approved by the County in September of 2022, entitled *Flying Horse North Master Development Drainage Plan* latest revision date of September 9, 2022. This MDDP also referenced the Classic Consulting report from 2018 for master drainage design of the proposed Filing No. 3 area.

The items discussed in this FDR include final plat layout, land uses, and drainage patterns for Filing No. 3. Included in this report are final hydrologic and hydraulic drainage calculations and design as required for the final design of the development of the single-family residential estate lot areas with assumed conservative drainage analysis for a future flats area. This report references the aforementioned reports to compare and contrast findings in the final design to ensure that existing infrastructure and facilities are not negatively impacted by this development.

b. DBPS Investigations

Flying Horse North is split by the Arkansas River Basin and South Platte Basin. Within each of those river basins, the site stretches across the Black Squirrel Basin and East Cherry Creek Drainage Basins.

The Black Squirrel Drainage Basin Planning Study (DBPS) Preliminary Design Report prepared by URS Corporation was reviewed to determine existing plans and constraints that would influence the design of the Flying Horse North Development. The proposed plans for Flying Horse North are in general conformance with the DBPS.

Flying Horse North Filing No. 3 is located within a major portion of the Black Squirrel Creek Drainage Basin and there is a small portion to the east of the proposed development that is within the East Cherry Creek Drainage Basin. A Preliminary Drainage Report and Final Drainage Report for this area were prepared in June 2018 by Classic Consulting and approved by El Paso County in September of 2018, and a more recent MDDP by HR Green demonstrated the general drainage approach for this area where densities for the development will remain similar to the report.





For the portion of Flying Horse North which lies within the East Cherry Creek Drainage Basin, a DBPS does not currently exist, and this FDR is consistent with the 2022 MDDP which complies with standard El Paso County regulations regarding drainage within this corridor.

The majority of the Filing No. 3 area falls within the Black Squirrel Creek Basin which is to consist of 2.5-acre single-family residential estate lots, the existing golf course, and a portion of future flats development that is assumed at a conservative imperviousness for the purpose of this report. Proposed developed areas are provided with water quality and full spectrum detention prior to release offsite to the west. Areas that are tributary to Flying Horse Filing No. 1 have no increase in required stormwater quality or detention volumes. There is a relatively small area of 2.5-acre single-family lots that fall within the East Cherry Creek Basin that drain directly offsite. The future flats development area and the proposed roadway within the East Cherry Creek Drainage Basin are detained on site prior to release to the east golf course area. There is no proposed basin transfer and therefore the historical drainage patterns are to remain in place including at the roadway and lots at the major basin delineation.

c. Stakeholder Process

There are no amendments to the current DBPS.

d. Agency Jurisdictions

Listed below are the jurisdictions that this project will conform to:

El Paso County

Federal Emergency Management Agency

e. General Project Description

Flying Horse North Filing No. 3 is in El Paso County jurisdiction and is located within the larger Flying Horse North subdivision, adjacent to Filing No. 1 and the existing golf course. The larger Flying Horse North development is bordered by Highway 83 to the west, Black Forest Road to the east, Cathedral Pines to the south, and High Forest Ranch to the north. The greater Flying Horse North area contains approximately 1,459 acres within the whole Section 36, Township 11 South, Range 66 West of the Sixth Principal Meridian, and a portion of Section 30 and 31, Township 11 South, and Range 65 West of the Sixth Principal Meridian. The Flying Horse Filing No. 3 area is 166.4 acres in total.

This FDR covers Filing No. 3 and includes offsite upstream and downstream areas to analyze existing and proposed drainageways and facilities. The Filing No. 3 area includes 142.52 acres of 2.5-acre single-family residential estate lots totaling 50 lots. The development includes the single-family residential lots for future development, 60' width rights-of-way that include asphalt paved roadways with roadside swale sections and electric easements. There are basins to the east that are dedicated to future flats development, one sub-basin within the Black Squirrel Creek Basin that is tributary to an existing detention facility in Filing No. 1 and one sub-basin within the East Cherry Creek Basin that is tributary to a proposed detention pond as a part of this filing. The future flats area consists of 60' right-of-way similar to an urban local typical roadway section with tree lawn and detached sidewalk.

The Filing No. 3 area was previously assessed in the 2018 Classic Consulting report with a similar land use plan that included 2-acre single-family residential estate lots and roadways. This report assesses the lots as 2.5-acre lots. The layout shown in the developed conditions hydrology map of this report and the corresponding construction drawings differs slightly from the approved FDR/PDR with adjusted roadway



alignments and lot lines. However, the drainage patterns, typical roadway section, and land use densities are similar.

The existing vegetative cover is 90 percent as evidenced by a field survey and aerial imagery. The existing vegetation includes native grasses and weeds, shrubs, and pinyon pine trees. Previous clearing of future planned roadways was done several years ago, and native grass and weeds have covered those areas.

f. Data Sources

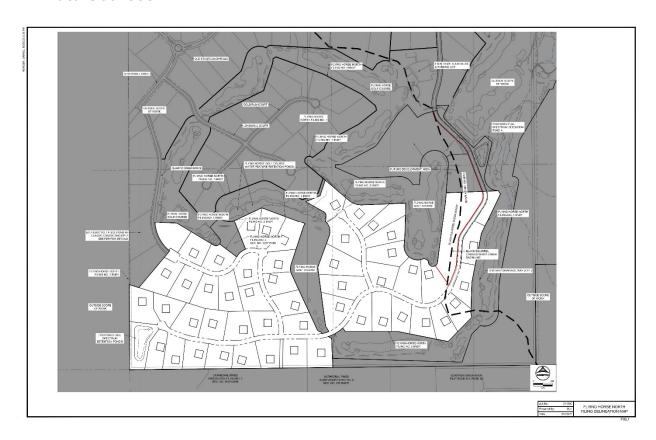


Figure 1 - Site Map

Listed Below are the technical resources reviewed in the preparation of this MDDP:

El Paso County Drainage Criteria Manual (DCM)

Mile High Flood District

NOAA Atlas 14

NRCS Soil Survey for El Paso County Area, Colorado

FEMA FIRM 08041C0305G and FIRM 08041C0315G (eff. 12/7/2018)

El Paso County Assessor Property Records





Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1 prepared by Classic Consulting - June 2018

Flying Horse North Master Development Drainage Report prepared by HR Green Development, LLC. - latest revision September 9, 2022

Flying Horse North Irrigation Reservoir Embankment Design Report – August 2018

g. Applicable Criteria and Standards

Per the DBPS and El Paso County Criteria Manual, flows from the proposed site will be limited to historic flows to maintain the stability of the existing channels within the drainage basins. The master plan follows the Drainage Criteria Manual for El Paso County which refers to the City of Colorado Springs Drainage Criteria Manuals as amended. Criteria within the County and City manuals refer to the Mile High Flood District manuals, particularly for extended detention basin design and runoff reduction calculations which are utilized in this report.

A distinct difference in the 2018 FDR/PDR and this report are the hydrologic methodologies utilized to compute peak runoff values. The 2018 Classic Consulting report utilized the NRCS Curve Number method in order to be consistent with their previous MDDP for the greater Flying Horse North master development. The NRCS Curve Number method was used for Filing No. 1 and the future development of Filing No. 3 for sub-basins that did not exceed 100 acres. Typically, the Rational Method is used for hydrologic computations when basin analysis is under 100 acres due to the NRCS Curve Number method yielding smaller minor and major storm event peak runoff values. The resultant hydraulics in this report are similar to that of the approved 2018 FDR/PDR on a basin-by-basin basis, however, any differences in calculated stormwater runoff will be discussed. The difference in methodologies between the 2018 report and this report result in larger cumulative stormwater runoff values reported for the minor and major storm events. Due to the more conservative nature of the Rational Method, cumulative peak flow rates are greater than that of the 2018 FDR/PDR for the minor and major storm events for downstream design points including existing channels and ponds that were designed and constructed as a part of the Filing No. 1 report and construction drawings.

HR Green has discussed this discrepancy in hydrologic methodology with El Paso County engineering staff and it has been expressed that the chosen method for hydrologic computations is the Rational Method for this report to ensure sound design of the storm infrastructure for Filing No. 3 including swales, channels, culvert pipes, inlets, and roadway capacities. It was discussed that no Filing No. 1 drainage infrastructure will require redesign or retrofits unless explicit discrepancies in detention volumes are discovered as the tributary areas and percent imperviousness for respective detention ponds have not changed significantly between the 2018 FDR/PDR and this report for Filing No. 3.

Verify and clearly state volumes and flows are the same of less than the 2018 FDR. Imperviousness alone does not signify if the ponds will have capacity for the new development. Engineer must confirm in II. Project Characteristics the Drainage Report that the existing offsite or onsite PBMPs that the site is tributary to are functioning as intended.

a. Location in Drainage Basin, Offsite Flows, Size

Flying Horse North is located within both the Black Squirrel Drainage Basin and East Cherry Creek Basin. The existing Filing No.1 and a large portion of the proposed Filing No. 3 is located within the Black Squirrel Drainage Basin. This drainage basin encompasses 10.9 square miles of mostly forested area and generally slopes from east to west and outfalls into Monument Creek. Black Squirrel is a sub-basin of



the Arkansas River. The remaining filings and a small part of Filing No. 3 is located within the East Cherry Creek Basin. There is not a current planning study of the drainage basin, but generally it slopes from southwest to northeast. The basin eventually flows into the South Platte River.

For the East Cherry Creek one drainage basin consisting of five sub-basins is conveyed to the proposed detention pond at Design Point 2, Pond A. Two offsite basins are tributary to this pond from the north near the existing club building. The respective contributing flow from the sub-basins is shown in the table below:

please label the

Basin Name	Acreage	5 Year Flow (cfs)	proposed inlets on
BS-34	2.22	3.6	8 the drainage plan
BS-34.1	10.80	4.2	20.6
BS-34.2	1.95	5.2	9.3
BS-34.3	1.16	1.6	4.2
BS-34.4	6.10	8.5	19.5
OS-1	2.70	2.8	8.2
OS-2	0.34	1.3	2.3

Provide the EPC Project number the

2.73 shown on plan

ponds were constructed undervelopment area west of the proposed roadway drains directly to the roadway via overland sheet flow and is channelized within the curb and gutter and conveyed into three public CDOT Type R inlets: a 10' CDOT Type R on-grade inlet, a 15' CDOT Type R on-grade inlet, and a 15' CDOT Type R curb sump inlet. These inlets ultimately drain to Pond A for water quality and detention. The area represented by the eastern half of the proposed roadway is channelized within the curb and gutter and makes its way down to a 10' CDOT Type R curb sump inlet which also is ultimately released into Pond A for water quality & detention. Areas within BS-34.1 drain directly offsite and are not directed to Pond A. These areas have 100 percent water quality runoff reduction as they are open space or 2.5 acre single family residential estate lots with grass buffers at the rear of the lots. Pond A has volume capacity for over-detention of these areas that drain directly offsite to the existing golf course to the east. label as pond 6 & 7 on the drainage plan. The northern basins of the filing follow natural drainageways, proposed roadside swales and proposed

The northern basins of the filing follow natural drainageways, proposed roadside swales and proposed public culvert pipes that are analyzed for capacity. The northern basins ultimately direct stormwater runoff to existing Filing No. 1 Pond 6, Pond 7, and Tract I which outfalls to Flying Horse North Detention Pond 8 (DP17 of the 2018 Classic Consulting PDR/FDR). There are offsite basins that drain to Pond B that are consistent with the previous FDR's assumptions. The 2018 Classic Consulting FDR/PDR represented this area as future development of 2-acre lots that would drain due east through the existing golf course with future culvert crossings.

Most of the Filing No. 3 area is within the Black Squirrel Creek Basin. Generally, the areas north of proposed roadways within the filing follows the historic drainage pattern and ultimately flows to Flying Horse North Detention Pond 8 as described in the 2018 Classic Consulting FDR/PDR which is represented as Design Point 10 in this report. The southern areas containing proposed roadways and most of the 2.5-acre single family residential estate lots drain due west to proposed detention Pond B. The Filing No. 3 area has offsite flow from the Cathedral Pines Filing No. 2 subdivision that drains to roadside swales that conveys the runoff to a proposed detention pond (DP19 of the 2018 Classic Consulting PDR/FDR).

The respective contributing flows from the sub-basins within the Black Squirrel Creek Basin are shown in the table below. The first table includes the onsite and offsite basins that contribute to Design Point 10

Runoff reduction calculations must be provided to support the claim. If the large lot exemption is proposed and the lots are less than 10% impervious, then RR calculations are not required for those large lots as the exemption applies. Verify what areas require treatment and what areas are excluded. Any areas that require treatment require detailed calculations to support the treatment. Verify what exclusion and what WQ design standards are proposed. See comments on the PBMP as well.



(Pond 8 of the Classic Consulting report) and the second table includes the onsite and offsite basins that contribute to Pond B within this filing.

Sub-basins contributing to existing Pond 8 (Design Point 10 of this report):

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
BS-18	33.90	12.6	6.1
BS-19	6.35	4.1	16.8
BS-20	23.79	9.6	48.5
BS-20.1	42.26	16.3	77.7
BS-20.2	4.32	2.5	10.1
BS-20.3	0.56	2.3	4.1
BS-21.1	15.24	8.5	34.3
BS-21.2	0.18	0.8	1.5
BS-21.3	50.92	17.7	85.0
BS-22	0.37	1.7	3.1
BS-22.1	16.62	8.6	37.8
BS-23	37.06	15.6	76.7
BS-23A	9.57	4.3	19.6
BS-23A.1	7.79	4.1	17.7

Sub-basins contributing to proposed Pond B, Design Point 17 of this report:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
BS-21	0.77	3.0	5.4
BS-26	4.90	1.7	10.6
BS-27	9.68	5.6	22.9
BS-28	24.03	12.3	50.6
BS-28.1	5.76	2.8	12.5
BS-28.2	19.47	9.0	41.0
BS-28.3	0.54	2.5	4.5
BS-29	22.93	8.3	39.7
BS-30	11.53	4.9	20.4
OS-17	15.8	9.9	40.6
OS-18	13.00	8.2	33.7

There are four sub-basins that drain directly offsite due to the natural drainage patterns. These sub-basins have relatively small areas within Filing No. 3 and include parts of the 2.5 acre single-family residential estate lots at the southeast & western edges of the development. These sub-basins have 100 percent water quality runoff reduction due to grass buffers as seen with the UDBMP (see appendix). The sub-basins are listed in the table below:

Provide supporting calculations

Basin Name	イ	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
BS-25		12.65	6.1	28.1
BS-31		8.40	3.2	18.6
BS-32		6.33	3.0	15.4
BS-33	1	ል 91	5.2	21 0

Please provide a comparison of these basins flows to existing/historic conditions. Although these basin may qualify for water quality exclusion increased flows from these filing 3 basins must be mitigated. Please provide justification and analysis of the downstream for increased developed flow leaving the site.





This Filing No. 3 FDR utilizes a similar naming convention for the sub-basins for comparison to the 2018 Classic Consulting FDR/PDR. The tributary basins have similar acreage, runoff coefficients (when comparing the NRCS Curve Number method and the Rational Method), and percent imperviousness for respective sub-basins and downstream detention facilities. Any deviation in the sub-basin area, coefficient, or percent imperviousness is due to slight roadway alignment adjustments for the final design as compared to the preliminary layout in the 2018 report. Any change in the peak runoff numbers as compared to the 2018 report are due to the change in hydrologic computation methodology as discussed in a previous section of this report.

b. Compliance with DBPS

This FDR is in general conformance with the guidelines outlined in the Black Squirrel DBPS and current drainage flows of the East Cherry Creek Basin. Flying Horse North will construct multiple full spectrum detention facilities to limit the effects of development and mimic natural flow patterns. The Filing No. 3 development will follow historic drainage patterns and utilize the existing natural swales throughout the area for conveyance of stormwater runoff toward respective proposed and existing detention facilities. The southeast area of the filing that consists of the major basin delineation between the Black Squirrel Creek Basin and the Cherry Creek Basin determines the drainage pattern of the roadway and future development grading of the lots within and along the basin delineation. The roadway is designed to drain according to the basin delineation (west for Black Squirrel Creek Basin and east for Cherry Creek Basin) and future single-family lot developments shall be graded to follow this drainage pattern at the plot plan level.

Existing downstream infrastructure is currently limited to the historic drainage channels and minimal downstream improvements exist. As such, the site follows the DBPS and restricts offsite flow rates to not exceed historic flow rates. The sites ultimate outfalls will generally be along the same historic tributaries. Although outfall rates will be at or below historic, the cumulative volume of runoff will increase and therefore downstream facilities may see an increase in the duration of flows. This may provide a net benefit to the downstream facilities by providing more water to assist with the sustenance of vegetation however it should be noted that increased volume may expedite potential erosion or channel movement. Any deviations from the approved 2018 Classic Consulting PDR/FDR in terms of runoff flow rate and water quality and detention volumes are assessed within this report to show compliance with the previously approved report in terms of capacities for drainage facilities including roadside swales, natural drainageways, and detention ponds (both onsite and offsite).

c. Site Characteristics

Per the NRCS web soil survey, the site is made up entirely of Type B soils. The ridge line between the Arkansas River and South Platte River Basins creates different soil environments for each. The portion of site that is within the Black Squirrel Drainage Basin, which includes Flying Horse Norse Filing No. 2 and No. 3, are predominately Elbeth sandy loam. The remaining filings are within the East Cherry Creek Basin which consists of Peyton sandy loam and Peyton-Pring complex. See Appendix A for the NRCS soil map.

Current ground cover varies between the two basins as well. Filings No. 2 and 3 are predominantly covered by Ponderosa Pine trees as a part of Black Forest and pasture. The remaining filings are short-to mid-grass prairie grasslands and former farmland which consists of non-native weeds and grasses. This portion of the site has very few, if any, trees and a minimal number of shrubs are found on the site.



d. Major Drainage Ways and Structures

No major drainage ways exist within the development; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries of the Black Squirrel Creek. These informal drainage ways are assessed within this report for stormwater runoff capacity and water surface elevations during the 100-year event as future development of single-family residential lots with basement or walkout conditions is considered. Roadside swales are included as a part of the typical roadway section and are assessed within sub-basins to ensure that swale and culvert pipe capacities are met and do not result in excessive pooling in the roadway sections per code.

The existing minor drainage channels within the site are planned to be maintained to the maximum extent possible. These will continue to be used for conveyance of storm drainage flows. The limits of construction and disturbance plan for no significant earthwork alterations to the existing minor drainage channels that would affect the drainage patterns or capacity of the sections throughout the filing as they are proven to have sufficient capacities for their respective tributary areas and to maintain the natural features of the site including existing trees and vegetation.

Drainageways of note including roadside swales are described within this report with parameters to demonstrate compliance with swale design criteria and capacities. Culvert pipes are sized to convey upstream flow under proposed roadways and maintain historic drainage patterns. Natural tertiary drainageways and roadside swales are prescribed matting products for various areas in order to minimize erosion and sediment runoff downstream per hydraulic analysis.

There are two areas in which storm sewer infrastructure is designed, beyond culvert pipes for driveway and roadway crossings. The first area is the future flats development area to the east where there is an urban roadway section. Conservative land use areas were utilized for the hydrologic and hydraulic calculations to plan for future design and development of this area including Pond A. Storm sewer infrastructure in this area consists of two public CDOT Type R on-grade inlets & two public CDOT Type R sump curb inlets with public and private storm sewer pipes that drain to the private concrete forebay of the proposed private detention facility to the east. The second area that consists of storm sewer infrastructure is the Allen Ranch Road cul-de-sac to the southwest of the site where cumulative stormwater runoff is conveyed on the north and south roadside swales that are expanded ditch sections to accommodate the cumulative flow from the upstream design points. The expanded ditch sections further convey the runoff via private culvert pipes, a private 48" RCP culvert pipe from the north (Section L-L) expanded ditch section and private dual 42" RCP storm culvert pipes from the south (Section M-M) expanded ditch section. These two culvert pipes daylight to a Rip-Rap Rundown Rock Chute that is designed for energy dissipation and capacity of the cumulative flow that enters the private concrete forebay for Pond B.

e. Existing and proposed land uses

The existing Filing No. 3 area is open rangeland within a forested area consisting of sparse native grasses, weeds, and pinyon pine trees as well as baren pervious soil. The existing Filing No. 3 area consists of no development other than a previously cut-in maintenance pathway that was originally planned as the future roadway corridor. As part of Filing No. 1, a road was constructed along with facilities to support a golf course. The Filing No. 3 development will connect to these existing roadways at the boundary between the two filings.



The 2018 Classic Consulting PDR/FDR assumed 2-acre single-family residential estate lot development with the same percent imperviousness within the filing area. This report includes the final design layout of 2.5-acre lots with rural roadway sections and a future flats area with an urban roadway section. Any deviations in basin areas, land use acreages, and resultant composite coefficients are shown within this report and demonstrated to meet downstream stormwater runoff and volume capacities for proposed and existing facilities. The proposed land use of future development for flats to the east of the filing differs from the assumed 2-acre residential lots in the same area. The downstream existing detention facility that this future development area is tributary to is assessed within this report to demonstrate that the existing pond has sufficient volume and requires no retrofitting.

III. Hydrologic Analysis

a. Major Basins and subbasinsMajor Basin Description

please also clearly state that there are no FEMA Floodplains within this filing.

- Previous basin study: Black Squirrel Drainage Basin Planning Study
- Per FEMA FIRM 08041C0305G and 08041C0315G (eff. 12/7/2018), Flying Horse North has the East Cherry Creek run through the northwest portion of the site. Currently, FEMA shows a LOMR effective April 4th, 2019 Base Flood Elevations and Zone A. Per the El Paso County Land Development Code Chapter 8 Section 8.4.2.B.1.e.i, the base flood elevations for Zone A will be determined once the platted lots are solidified and are confirmed within 300-ft of the current floodplain designation. Certification of the flood elevations will be via the FEMA CLOMR/LOMR process or Floodplain Certification Letter.

The site has been divided into several major drainage basins where **each basin** is tributary to a full spectrum detention pond facility. These basins and associated sub basins are described in more detail in the next section of this report.

This FDR utilizes a similar naming convention for the basins and sub-basin as the 2018 Classic Consulting PDR/FDR in order to more easily compare and contrast the final developed drainage conditions for the filling.

Existing Subbasin Description

not found

The existing conditions for Filing No. 3 are consistent with the conditions and hydrology map presented within the 2018 Classic Consulting FDR/PDR. The previous report's existing and developed conditions drainage maps are included in the appendix section of this report for reference. The developed conditions drainage map within the Filing No. 1 area are now the existing conditions of that area for this report and the existing conditions drainage map within the 2018 PDR/FDR within Filing No. 3 remain as is and is utilized as the existing conditions drainage map for this report.

The 2018 Classic Consulting FDR/PDR drainage maps represent the existing conditions for assessment of the Filing No. 3 development as there has been no disturbance outside of the previously developed Filing No. 1 area. Therefore, all existing topography and historical drainage patterns remain the same.





The onsite basins relevant to this report that are utilized in the 2018 report are the following: Basins BS-18, BS-19, BS-20, BS-21, BS-22, BS-23, BS-23A, BS-25, BS-26, BS-27, BS-28, BS-29, BS-30, BS-31, BS-32, and BS-33.

The offsite basins relevant to this report that are utilized in the 2018 report are the following: OS-17 and OS-18.

Proposed Subbasin Description

The net area of some basins described in this report may differ from the 2018 Classic Consulting FDR/PDR due to changes of alignment of proposed roads and slight adjustments of the delineations with new topographic survey information. The net Q_5 & Q_{100} values may differ in this report because of the different methodologies used between the reports. Classic Consulting's FDR had used a Curve Number Method to report 5-year and 100-year drainage flows while this report had used the Rational Method to report those values. The rational method yields higher minor and major storm peak runoff values. Because of these two discrepancies, the values reported in this FDR may be higher across all design points that had also been evaluated in Classic Consulting's FDR from 2018. After conversations with El Paso County, discrepancies in design, basin delineation, and calculation methodology do not require HR Green to redesign any existing storm infrastructure that has been built in Flying Horse North Filing No. 1 including culvert pipes, channels, and rock chutes. The existing Pond 8 (Design Point 10 of this report) is assessed for detention volumes as a result of the development of Filing No. 3 for areas that are tributary to the existing pond.

The following design points are presented on the Developed Conditions Drainage Map within the appendix and are described as follows:

Design Point 1 (Q_5 = **4.5 cfs**, Q_{100} = **12.4 cfs**) represents the developed flows from basins OS-1 & BS-34.3. These flows are captured at a 10' CDOT type R on-grade inlet. The on-grade inlet is capable of capturing 4.4 CFS (97%) of the 5-year flow and 8.0 CFS (64%) of the 100-year flow, leaving a total of 0.1 CFS & 4.4 CFS left as bypass, respectively, to be channelized in EPC type A curb and gutter and captured at design point 1.1. The captured flow will travel down to design point 1.1 as well via an 18" RCP storm sewer.

Design Point 1.1 (Q₅ = **4.1 cfs, Q**₁₀₀ = **19.1 cfs)** represents the developed direct basin flow from basin BS-34 as well as the bypass flow mentioned above in design point 1 and design point 1.2. These flows will be channelized into the streets curb and gutter to design point 1.1 where they will be captured by a 15' CDOT type R sump inlet. All flow will be captured and piped via 30" RCP storm sewer to converge with flows captured at design point 1.3, then down to Pond A at design point 2. Flows captured within this design point shall only be from the East side of the Black Squirrel Creek and Cherry Creek basin line so that drainage patterns stay consistent with pre-development flows.

Design Point 1.2 (Q₅ = **8.5 cfs, Q**₁₀₀ = **19.5 cfs)** represents the developed basin flows from basin BS-34.4. Flows from this basin have been calculated to be conservative to account for future development and will be directed via EPC type A curb and gutter to be captured by a 15' CDOT type R on-grade inlet. The on-grade inlet is capable of capturing 8.1 CFS (96%) of the 5-year flow and 13.5 CFS (69%) of the 100-year flow, leaving a total of 0.4 CFS and 6.0 CFS left as bypass, respectively, to be channelized and





captured at design point 1.1. The captured flow will travel down to design point 1.1 as well via a 24" RCP storm sewer.

Design Point 1.3 (Q₅ = **6.5 cfs, Q**₁₀₀ = **11.6 cfs)** represents the developed basin flows from basins BS-34.2 & OS-2. These basins represent the east side of the proposed roadway and are to be channelized via EPC type A curb and gutter. Channelized flows are directed to a low point at this design point and are captured with a 10' CDOT type R sump inlet. Captured runoff is combined with flows from design point 1.1, and are routed to Pond B via a 36" RCP storm sewer.

Design Point 2 (Q_5 = **27.2cfs**, Q_{100} = **72.6 cfs**) represents the developed flows from basins BS-34, BS-34.1, BS-34.2, BS-34.3, BS-34.4, OS-1 & OS-2. Developed flows will be routed to this location via the proposed public roadway curb and gutter to two public CDOT Type R curb sump inlets. The public storm infrastructure conveys the runoff to Pond A to meet WQCV, EURV, & 100-Year detention capacity and release pre-development flow quantities (see appendix D for pond calculations).

Design Point 4 (Q_5 = 8.5 cfs, Q_{100} = 34.3 cfs) represents the developed flows from basin BS-21.1. These flows are to channelize into channel section D-D and end up at design point 4 where a 36" RCP culvert has been sized to route the flows underneath Bourbon Court (see Appendix C for culvert design). These flows ultimately combine with basin BS-21.2, BS-21.3, BS-20, BS-20.1, & design point 5, which flow to a Flying Horse North golf course retention pond at design point 6.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, the basin that design point 4 contains, basin BS-21.1, was originally a part of basin BS-21 as seen in Classic Consulting's FDR (see appendix F). Classic's FDR reported a total basin area for BS-21 to be 69.5 acres with a Q_5 =23.9 CFS and a Q_{100} =103.0 CFS. The cumulative basin BS-21 (this includes basins BS-21 through BS-21.3) shown in this report have a net area of 66.34 acres, a net Q_5 = 30.1 CFS, and a net Q_{100} =126.3 CFS. See the statement preceding design point 1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Design Point 5 (Q_5 = **4.7 cfs**, Q_{100} = **14.2 cfs**) represents the developed flows from basins BS-20.2 & BS-20.3. Flows from these basins sheet flow into typical roadside ditch sections to the end of the cul-desac where the flows from each basin will converge at design point 5. At this design point, the flows will be channeled through a weir cutout section within the typical roadside ditch section (see weir calculations in appendix C) and ultimately be led to design point 6 via natural channels existing downstream.

Design Point 6 (Q_5 = 57.7 cfs, Q_{100} = 261.3 cfs) represents the cumulative developed & existing flows of the following basins: BS-20, BS-20.1, BS-20.2, BS-20.3, BS-21.1, BS-21.2, & BS-21.3. This design point is located within the Flying Horse North golf course and is currently an existing retention pond within the golf course to provide a water feature for the course. Flows from this design point are fed into the next retention pond located within the golf course, design point 7.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, the basins that design point 6 contain as mentioned above (Classic Consulting pond 6) were originally a part of basins BS-20 & BS-21 from Classic's FDR. Classic Consulting's FDR cumulative reporting of basins BS-20 & BS-21 were 143.4 acres with a net Q_5 =48.5 CFS and a net Q_{100} =215.4 CFS. The cumulative basins draining towards design point 6 shown in this report have a net area of 137.3 acres, a net Q_5 = 57.6 CFS, and a net Q_{100} =261.1 CFS. See the statement preceding design point 1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.



please discuss how flows from BS22 ans BS-22.1 are conveyeed to DP7. per the drainage plan it appears that a channel G-G will provide conveyance. Please discuss.

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Design Point $Q_5 = 72.2$ **cfs,** $Q_{100} = 318.9$ **cfs)** represents the cumulative developed flows of basins BS-19, BS-22, BS-22.1, and all basins associated with design point 6. This design point is located within the Flying Horse North golf course and is currently an existing retention pond within the golf course to provide a water feature to the course. Flows from this design point exit from the pond via an existing permanent turf reinforced mat (TRM) channel with reinforced rock check dams. This channel ultimately leads the flow down to two existing 60" RCP culverts at design point 8, to pass beneath Quartz Creek Drive and into design point 10 where an existing detention pond has been designed by Classic and is described within their FDR from 2018.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, the basins that design point 7 contain as mentioned above (Classic Consulting Pond 7) were originally a part of basins BS-19, BS-20, BS-21, BS-22 from Classic's FDR. Classic Consulting's FDR cumulative reporting of these basins was 167.8 acres with a net Q_5 =62.7 CFS and a net Q_{100} =266.9 CFS. The cumulative basins draining towards design point 7 shown in this report have a net area of 160.6 acres, a net Q_5 =72.0 CFS, and a net Q_{100} =318.7 CFS. See the statement preceding design point 1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Design Point 8 ($Q_5 = 100.3$ cfs, $Q_{100} = 455.8$ cfs) represents the cumulative developed flows from basins BS-18, BS-23, and all basins associated with design point 7. Flows leading to this design point converge at a low point where two 60" RCP culvert pipes are to lead the flow underneath Quartz Creek Drive and into the existing detention pond at design point 10 (see Appendix for culvert design).

From Classic Consulting's FDR for Flying Horse North Filing No. 1, the basins that design point 8 contain as mentioned above (Classic Consulting design point 16) were originally a part of basins BS-18, BS-19, BS-20, BS-21, BS-22, & BS-23 from Classic's FDR. Classic Consulting's FDR cumulative reporting of design point 16 was 238.7 acres with a net Q_5 =78 CFS and a net Q_{100} =390 CFS. The cumulative basins draining towards design point 8 shown in this report have a net area of 231.6 acres, a net Q_5 = 100.1 CFS, and a net Q_{100} =455.6 CFS. See the statement preceding design point 1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Design Point 9 ($Q_5 = 4.1$ cfs, $Q_{100} = 17.1$ cfs) represents the developed flows from basin BS-23A.1. Basin flows drain into a roadside ditch that will lead flows from the basin towards a low point within Quartz Creek Drive where an existing 24" RCP culvert will carry flows into an existing concrete forebay at design point 10, where an existing detention facility (Classic Consulting pond 8) will detain flows.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, the basins that design point 9 contain as mentioned above were originally a part of basin BS-23A from Classics FDR. Classic Consulting's FDR cumulative reporting of basin BS-23A was 16.3 acres with a net Q_5 =12 CFS and a net Q_{100} =38.3 CFS. Basin BS-23A.1 draining towards design point 9 shown in this report has a net area of 7.8 acres, a net Q_5 = 4.1 CFS, and a net Q_{100} =17.1 CFS. See the statement preceding design point 1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Design Point 10 (Q₅ = **108.7 cfs, Q**₁₀₀ = **492.5 cfs)** represents the developed and existing flows from basins BS-18 through BS-21.3, excluding basin BS-21.1. All basins that flows to this design point are to be captured in an existing detention facility that was constructed during FHN Filing No. 1 and is referenced in Classic Consulting's FDR as pond 8. Flows entering the facility from design points 8 and 9, which account for all basins except for basin BS-23A, are entering the concrete forebay via dual 60" RCP



provide the classic engineering designg Horse North flows design Horse North flows design Project No.: 211030.01 previous design points for comparison

culverts (DP8) and a single 24" RCP culvert (DP9). Run-off from BS-23A is entering the detention facility via sheet flow from the south.

A pond design description as provided by the 2018 Classic Consulting FDR is provided in section B of the proposed subbasin descriptions. The calculated tributary area entering the pond at design point 10 (Classic Consulting design point 17) reported in Classic Consulting's FDR was 255 acres. The calculated tributary area entering pond 8 as calculated in this report is 248.9 acres with total in-flow Q_5 =108.7 CFS & Q_{100} =492.5 CFS. See the statement preceding design point 1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Design Point 11 ($Q_5 = 3.0$ cfs, $Q_{100} = 5.4$ cfs) represents channelized developed flows from basin BS-21. These flows drain west towards an 18" RCP culvert that will cross underneath Bourbon Court (see Appendix C for culvert design). After passing through the culvert, the flows continue in a typical roadside ditch section west and converge with basin BS-28.1 at design point 12.

Design Point 12 (Q_5 = **5.9 cfs**, Q_{100} = **17.9 cfs**) represents the culmination of flows from design point 11 and basin BS-28.1. Continued flows from design point 11 are carried via a typical roadside ditch section down to design point 12. Run-off from basin BS-28.1 sheet flows down into the typical roadside ditch sections along Allen Ranch Road and a portion of Waterhole Way near the intersection of the two aforementioned roads. The cumulative flows enter a 24" RCP culvert at design point 12 where the flows will continue down to design point 14 via a modified roadside ditch section seen as Channel Section R-R and then into a wider Channel Section L-L (see Appendix C for channel section analysis & culvert design).

Design Point 13 (Q₅ = **9.0 cfs, Q**₁₀₀ = **41.0 cfs)** represents the developed flows from basin BS-28.2. Most of the run-off within the basin will be sheet flow, but as the water flows west, it will begin to channelize in a natural swale which has been analyzed in two locations within this subbasin as channel section E-E & F-F (see Appendix C for analysis). Flows from the basin, as well as the road run-off from the east side of Waterhole Way, which is captured in a typical roadside ditch section, will converge at design point 13 where a 36" RCP culvert will carry flows underneath Waterhole Way (see Appendix C for culvert design). These flows ultimately run through basin BS-28, into a modified roadside ditch section to design point 14, and are finally captured in a detention facility at design point 17.

Design Point 14 (Q_5 = **29.7 cfs**, Q_{100} = **114.0 cfs**) represents the cumulative developed flows from basins BS-28 through BS-28.3, and BS-21. Flows from basins BS-28.1 and BS-28.2 have already been described in design points 12 and 13 respectively. Flows from basin BS-28 are mostly sheet flow at the north east section of the subbasin until they collect into natural channels analyzed in channel sections K-K & J-J (see Appendix C for analysis). Run-off from basin BS-28.3 is sourced from the west side of street 2 and is captured in a typical roadside ditch and released via a weir cutout (see Appendix C for weir design) into a natural channel which has been assessed as channel section J-J. Design point 14 then converges all basin flows to a low point on the north-east side of the cul-de-sac at the end of Allen Ranch Road. At this low point where the modified roadside ditch section L-L ends, a 48" RCP culvert will direct flows to a rock chute designed to convey flows down into Pond B at design point 17 (Classic Consulting design point 19).

From Classic Consulting's FDR for Flying Horse North Filing No. 1, the basins that design point 14 contain (Classic Consulting design point 18) were originally a part of basin BS-28 from Classics FDR. Classic Consulting's FDR reporting of basin BS-28 was 36.9 acres with a Q_5 =9.3 CFS and a Q_{100} =49.4





CFS. Basins BS-28 through BS-28.3 as well as BS-21 now drain to design point 14 (Classic Consulting design point 18) as shown in this report and have a net area of 50.6 acres, a net Q_5 = 29.7 CFS, and a net Q_{100} =114.0 CFS. See the statement preceding design point 1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Design Point 15 (Q_5 = **21.4 cfs**, Q_{100} = **93.8 cfs**) represents the cumulative flows developed and existing flows from basins OS-18, BS-29, & BS-30. Run-off from basin BS-30 sheet flows north into the typical roadside ditch on the south side of Allen Ranch Road where the ditch section will evolve into Channel Section S-S to accommodate for larger driveway culverts as flow increases downstream (see Appendix C for analysis). Flows from basins OS-18 & BS-29 sheet flow into natural channel sections N-N & O-O where they will converge with the flows of BS-30 into a modified roadside ditch section analyzed as Channel Section Q-Q (see Appendix C for analysis). These flows ultimately continue west towards design point 16 where they are collected in dual 42" RCP culverts near the beginning of the cul-de-sac at the end of Allen Ranch Road to be discharged into a rock chute that will convey flows to Pond B at design point 17 (Classic Consulting design point 19).

Design Point 16 (Q_5 = 36.9 cfs, Q_{100} = 157.3 cfs) represents the cumulative flows from basins OS-17 & BS-27, and design point 15. Run-off from basins OS-17 flow through and channelize in BS-27. A portion of the flow from BS-27 sheets off into the modified roadside ditch section Channel Q-Q, while most flow from BS-27 channelizes and converges into the modified roadside ditch Channel M-M at the western end of Allen Ranch Road (see Appendix C for channel analysis). At the end of channel section M-M, flows will be captured in dual 42" RCP culvert pipes and released into a rock chute designed to convey flows into Pond B (Classic Consulting design point 19).

Design Point 17 ($Q_5 = 68.2$ cfs, $Q_{100} = 281.8$ cfs) represents the cumulative developed and existing flows from basin BS-26 and design points 14, & 16. Flows from basin BS-26 are direct sheet flow into the detention pond that is proposed at design point 17. Design points 14 & 16 enter the detention pond via a 48" RCP culvert, crossing the cul-de-sac at the end of Allen Ranch Road, and a pair of 42" RCP culverts at the western end of the modified roadside ditch section M-M, respectively. These culverts discharge into a rock chute that leads flows down into the pond's concrete forebay (see Appendix C for rock chute design). The proposed detention facility sizing is described in the following section.

According to Classic Consulting's FDR for Flying Horse North Filing No. 1, the basins that design point 17 contain (Classic Consulting design point 19) were originally a part of basins OS-17, OS-18, BS-28, BS-29, & BS-30 from Classics FDR. Classic Consulting's design point 19 did not originally contain basin OS-18, BS-29 or BS-30 but instead had those draining into a separate pond at design point 18 of Classics FDR. The proposed design being conveyed in this report now joins Classic Consulting's two separate ponds at design point 17 (Classic Consulting design point 18 & 19). The cumulative acreage of Classic's design points 18 and 19 were reported as 123.4 acres, the net Q_5 =38.4 CFS, and the net Q_{100} =241 CFS. Design point 17 contains a tributary area of 128.4 acres. For more explanation of the difference between Classic Consulting's 2018 FDR report values for these basins as compared to the values being reported in this FDR, see the statement preceding the design point 1 description.

Design Point 18 ($Q_5 = 3.2$ cfs, $Q_{100} = 18.6$ cfs), Design Point 19 ($Q_5 = 3.0$ cfs, $Q_{100} = 18.6$ cfs), Design Point 20 ($Q_5 = 5.2$ cfs, $Q_{100} = 21.9$ cfs) represent smaller basins that will continue to sheet flow off-site to the south. These basins represent mostly golf course development and a small portion of the proposed developed 2.5 acre lots. Given the lot size, no water quality is required. However, permanent sediment basins will be installed downstream of the golf course development to provide sediment control.



provide a comparison of pre-development and developed flows. Also see comment on page 7

see comment on
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Developed flows released from these basins will not be significantly different than the pre-development flows.

Design Point 21 (Q₅ = **6.1 cfs, Q**₁₀₀ = **28.1 cfs)** represents basin BS-25 which flows off-site to the west and converges with outfall flows from pond 8. This basin consists entirely of 2.5 acres residential lots that sheet flow into natural drainage ways. No detention will be required as the WQCV is negated by infiltration while flowing out of the basin (see Appendix D for UDBMP calculations).

b. Water Quality and Detention Facilities

There are two water quality and full spectrum detention ponds that are proposed within this filing. The detention ponds are designed to provide the required volume stages for Water Quality Capture Volume (WQCV), Excess Urban Runoff Volume (EURV), and the 100-year stage. The UD-Detention spreadsheet is utilized to determine basin sizing and create a stage-storage table to design the outlet structures with orifice plates and restrictor plates. The outlet structures and plates are designed to achieve the target release rates of the various stages: WQCV at 40 hours, EURV around 68 hours (may vary based on pond conditions), and the 100-year volume at 72 hours. The developed condition outlet flow rates are not to exceed predeveloped conditions. The ponds include the required infrastructure such as concrete forebays, an emergency spillway with rip-rap weirs, concrete trickle channels, and a 2.5-foot depth micropool attached to the outlet structure. Ponds include 15' width maintenance paths with vehicular access to the bottom of pond to access forebays and outlet structures for continued maintenance. The pathways have an access from the public right-of-way and proper turning radii and longitudinal and cross slopes for a maintenance vehicle. The ponds include 1.0' of freeboard to the emergency spillway berm of the pond with the crest elevation at or above the 100-year water surface elevation. The spillways are sized with a trapezoidal weir for the 100-year inflow with rip-rap prescribed for the outflow velocity.

The proposed ponds and assessment of an existing downstream pond are described below.

Pond A (Design Point 2, Classic Consulting Design Points 18, 19 Combined) provides water quality and full spectrum detention for the stormwater runoff from Basin 34, 34.1, 34.2, 34.3, 34.4, OS-1, and OS-2. These basins include offsite area of undeveloped area, future development of flats and the proposed urban roadway section located on the east side of the filing. As shown in the hydrology calculations summary table, Pond A has a tributary area of 25.3 acres with an imperviousness of 32.84% which includes roof, pavement, landscaped/lawn, and undeveloped land use categories. The impervious areas used in the future flats development area are conservative and are to be assessed in a future filing FDR. The pond includes 1.0-foot of freeboard to the top of berm and the 100-year water surface elevation is below the crest of the emergency spillway weir.



The MHFD UD-Detention spreadsheet yields the following pond sizing results:

Proposed Pond A - Flats Area

WQCV	EURV	100-year	Total Required	Total Required Volume (CY)	Total Design
(ac-ft)	(ac-ft)	(ac-ft)	Volume (ac-ft)		Volume (CY)
0.334	0.508	0.916	1.758	2,837	4,515

Pond hydraulics are described in the following table:

	Peak Inflow (cfs)	Rolosco/()uttlow		Time to Drain 99% of Inflow Volume (hrs)
Minor Storm (Q5)	24.2	4.0	10.9	77
Major Storm (Q100)	63.9	16.2	44.3	72

(Ownership and maintenance by the Flying Horse North HOA)

Pond A includes a concrete forebay sized for the required volume of the inflow, a 2-foot width concrete trickle channel with 6" vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that is designed as a single CDOT Type C Inletit that is to include a tap track orifice plate, and restrictor plate on the outlet pipe.

Pond B (Design Point 17) provides water quality evise accordingly to stormwater runoff from Basins BS-21, BS-26, BS-28, BS-28.1, BS-28.2, BS-28.3, BS-29, BS-30, OS-17, and OS-18. These basins include offsite area of undeveloped area assumed as future 2.5 acre lot development, future development of flats and the proposed urban and local roadway sections. As shown in the hydrology calculations summary table, Pond B has a tributary area of 128.4 acres with an imperviousness of 10.04% which includes roof, pavement, landscaped/lawn, and undeveloped land use categories. The pond includes 1.0-foot of freeboard to the top of berm and the 100-year water surface elevation is below the crest of the emergency spillway weir.

The MHFD UD-Detention spreadsheet yields the following pond sizing results:

Proposed Pond B – Estates Area

WQCV	EURV	100-year	Total Required	Total Required Volume (CY)	Total Design
(ac-ft)	(ac-ft)	(ac-ft)	Volume (ac-ft)		Volume (CY)
0.719	0.493	3.534	4.746	7,657	15,141

Pond hydraulics are described in the following table:

	Peak Inflow (cfs)	Design Release/Outflow (cfs)	Pre-Development Release(cfs)	Time to Drain 99% of Inflow Volume (hrs)
Minor Storm (Q5)	n (Q5) 73.1		60.3	72
Major Storm (Q100)	255.5	86.1	245.6	64



(Ownership and maintenance by the Flying Horse North HOA)

Pond B includes a concrete forebay sized for the required volume of the inflow, a 2-foot width concrete trickle channel with 6" vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that is designed as a dual CDOT Type C Inlet that is to include a top trash rack, orifice plate, and restrictor plate on the outlet pipe.

Existing FHN Pond 8 (HR Green Design Point 10, Classic Consulting Design Point 17) provides water quality and detention for the stormwater runoff from Filing No. 1 and part of Filing No. 3 as well as offsite basins as described in the 2018 Classic Consulting FDR/PDR for the full build-out conditions. These basins include offsite area of undeveloped area assumed as future 2.5 acre lot development, golf course areas, and the roadways. The 2018 report has hydrology calculations and lists the acreage and percent imperviousness for the final developed conditions for the full build out within the MHFD UD-Detention spreadsheet for the Pond 8 Full Buildout conditions which consists of assumed future developed conditions for 2-acre single-family residential estate lots within Filing No. 3 with assumed roadway alignments. The 2018 FDR/PDR calculation lists a tributary area of 255 acres at 10.0 percent impervious. The final developed conditions hydrology tabulations for Filing No. 3 are provided within this report and closely compare to that of the 2018 report with a slight decrease in the tributary area and imperviousness. The Existing FHN Pond 8 (Design Point 10) tributary area is 248.9 acres with a percent imperviousness of 8.79 percent. Due to the decrease in these figures, there is no expansion of volume required in the pond.

The WQCV, EURV, and 100-year volumes for the Existing FHN Pond 8 detention facility for as-built conditions and per calculations within this report are shown below for comparison:

Existing FHN Pond 8

	Tributary Area (ac)	Percent Impervious (%)	WQCV (ac-ft)	EURV (ac-ft)	100-year (ac-ft)	Total Required Volume (ac-ft)	Total Required Volume (CY)
2018 Classic Consulting FDR/PDR	255.00	10.00	1.424	0.973	7.011	9.408	15,178
2023 HR Green FDR	248.90	8.79	1.244	0.791	6.614	8.649	13,954

The existing downstream pond that was designed and constructed per the 2018 Classic Consulting FDR/PDR and Construction Drawings has sufficient capacity for the Filing No. 3 development. The 2018 report assumed a higher density of 2.0-acre single family residential estate lots within the Filing No. 3 area including the area now designated for future development of flats but did utilize the same 11 percent imperviousness figure for the lots. While the flats area within Filing No. 3 results in a higher imperviousness for its respective sub-basins, the overall imperviousness and tributary area to the downstream Existing Pond 8 within Filing No. 1 is decreased due to more of the Flats Area being tributary to proposed Detention Pond A. A UD-Detention spreadsheet with inputs for the final design parameters within this report (248.9 acres at 8.79 percent impervious) with the as-built conditions of the pond is provided within the appendix to demonstrate that the existing pond was built with sufficient volume and infrastructure for the final design conditions of Filing No. 3. The only potential retrofitting of the pond is a

please discuss and analyze the downstream of each of the proposed ponds.





swap out of a new orifice plate to maintain the WQCV release rate of 40 hours which has fallen to 37 hours for the time to drain 99% of inflow volume for the final design.

c. Methodology

Design rainfall was determined utilizing Table 6-2 from the City of Colorado Springs Drainage Criteria Manual to determine the 5-year and 100-year rainfall values for the 1-hour events. The 1-hour rainfall depths are 1.5 and 2.52 in/hr respectively.

The proposed development will consist of 50 2.5-acre single-family residential estate lots which are assumed at a percent imperviousness of 11% per the County ECM Table 3-1 Typical Values of Percent Impervious within Appendix L of the ECM which provides guidance for larger rural lot developments. Existing golf course areas are to remain undisturbed and utilize a land use category of "lawn" with a percent imperviousness of 2% per the County ECM Table 6-6 land use table. Composite coefficients, rainfall intensities, and runoff flow rates are calculated on a Rational Method spreadsheet and provided within the Appendix. As discussed previously, the Rational Method used in this report will result in higher peak flow rates for the minor and major storm events as compared to the 2018 Classic Consulting FDR/PDR which utilized the NRCS Curve Number Method. Design points within Filing No. 3 are designed per the findings of this report and existing Filing No. 1 storm infrastructure and design points are to remain as-is.

Mile High Flood District (MHFD) UD-BMP Runoff Reduction calculations are provided to demonstrate WQCV reduction for the sub-basins that drain directly offsite that have grass buffer to provide 100 percent runoff reduction. The MHFD UD-Detention spreadsheet is utilized for stormwater detention basin sizing and outlet structure design to meet standard release rates at or lower than historical drainage rates. The outlet structure orifice plate and restrictor plate for the proposed detention ponds located are designed to meet standard release rates of 40 hours for Water Quality Capture Volume (WQCV), as near 68 hours for Excess Urban Runoff Volume (EURV) as feasible, and 72 hours for the 100-year storm volume. Reference to the 2018 Classic Consulting PDR/FDR set of calculations and spreadsheets is included to demonstrate compliance and consistency with the previously approved report which anticipated similar land uses and basin acreages tributary to existing stormwater facilities.

IV. Hydraulic Analysis

a. Major Drainageways

There are no major drainageways that exist within the development of Filing No. 3; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries of the Black Squirrel Creek. These tertiary drainage ways are analyzed within this report to assess the water surface elevation within the swales during the 100-year storm event and determine buildability of lots adjacent to these sections. Roadside swales are to be constructed at a minimum to meet the typical roadway section (4:1 for 10' and 3:1 for 9' resulting in a total swale depth of 2.5'). The roadside swales are assessed along the roadways that capture sub-basins and result in cumulative flow. Downstream roadside swales to the north and south of Allen Ranch Road are expanded along the road to accommodate the cumulative flow from upstream tributary areas. A 30' width Drainage Easement is platted in the areas of Allen Ranch Road in which expanded ditch sections will be needed for County maintenance access.



Allen Ranch Road terminates at a cul-de-sac where private storm culvert pipes convey the stormwater runoff to a rip-rap rundown rock chute that drains directly to the concrete forebay of Pond B. The Rock Chute is designed per the National Resources Conservation Service Rock Chute Design Data spreadsheet, a publicly available design worksheet created by the U.S. Department of Agriculture last modified on July 17, 2023. The Rock Chute data sheets are provided within the Appendix. A portion of the rock chute falls within Lot 18. A Drainage Easement is platted within Lot 18 for continued access for maintenance by the HOA and/or the County.

b. Storm Sewer Infrastructure and Culvert Pipes

The Filing No. 3 development consists of an area of future flats development to the east of the filing with an urban roadway section that contains a public storm system to capture and convey stormwater runoff from the future developed areas that drain to the public roadway. The storm system is relatively small with a total of four CDOT Type R inlets, two on-grade inlets sized at 10' & 15', and two sump inlets sized at 10' & 15', as well as public and private storm sewer pipes that outfall to the concrete forebay of Pond A. UD-Inlet calculations as well as hydraulic grade analysis reports are provided within the Appendix of this report to demonstrate roadway, inlet, and pipe capacities of the proposed storm system.

The remainder of the filing consists of rural development with 2.5-acre single family residential estate lots and rural roadway sections with roadside swales. The storm infrastructure within these areas consist of public culvert pipes for roadway crossings and consideration for future public culvert pipes for future driveways for each lot. Culvert calculations and graphics are provided within the Appendix of this report to demonstrate culvert capacities and show any roadway/driveway overtopping as a result of peak flows. The culverts are designed to have full capacity of the minor (5-year) storm event and a maximum of 4" of roadway or driveway pooling during the major (100-year) storm event.

V. Environmental Evaluations

a. Significant Existing or Potential Wetland and Riparian Areas Impacts

As part of this work, the developer has engaged Bristlecone Ecology, LLC to perform environmental studies of the site that will be submitted with the planning documents. Major information in the report concerning wetlands concludes that there is a wetland associated with Black Squirrel Creek. Black Squirrel Creek is known to be a jurisdictional stream.

At this time, there are no improvements proposed for Black Squirrel Creek. The minimal impact to the stream will keep the natural habitat intact and the natural function of the Creek as it is to maintain the wetland habitat.

Stormwater Quality Considerations and Proposed Practices

As part of the development, full spectrum detention facilities will be installed to provide water quality for the development. The facilities are designed using El Paso County criteria and provide stormwater quality by slowing the release of stormwater captured by the ponds and allowing solids to settle out. Additionally, when possible, the existing natural drainage ways will be used to convey stormwater to more closely mimic the natural hydrologic and hydraulic cycle. Some of the drainage ways will be used to convey water to the ponds and others will receive water from the ponds and in both scenarios will provide additional water quality benefits.

Provide runoff reduction calculations, provide WQ exclusions that are applicable, or treat the WQCV. See previous comments



Flying Horse North Master Development Drainage Plan Project No.: 211030.01

On site practices for the estate homes includes direct discharge of roof and hardscape runoff to the surrounding landscaped areas. This would include discharge of the gutters onto landscape areas vs. directly connecting to storm sewer and as discussed above as well using natural ditches and swales where it is logical and makes sense to convey stormwater in lieu of storm sewer piping.

Areas in which stormwater runoff is directed offsite without detention being provided have grass buffers that provide 100 percent water quality runoff reduction due to the small percent imperviousness compared to their respective buffer areas that consist of pervious open landscaped areas.

d. Permitting Requirements

When work infringes upon the wetlands or floodplain a 404 Permit will be required. If the work within the waterways is minimal, it will likely be covered under a nationwide 404 permit; it is however possible that an individual permits will be required.

The Colorado Department of Public Health and Environment will require permits for any disturbance that exceed 1 acre of land. Should groundwater be encountered, a dewatering permit will also be required.

El Paso County will require an Erosion and Stormwater Quality Control Permit and any other construction permits required to complete the construction of the site.

Should development occur which effects the floodplain, FEMA will require a permit for work withing the floodplain prior to the commencement of any construction or development within any special flood hazard area (SFHA). If the infrastructure is to be installed within the channel the designer shall route the design through the proper FEMA channels whether that be with a no rise certification or via the CLOMR/LOMR process should a more major improvement within the floodplain be proposed. At this time the project does not propose any direct development within the floodplain however storm infrastructure will discharge into the existing FEMA channel.

e. 4-Step Process

In accordance with the Engineering Criteria Manual I.7.2.A and DCM V2, this site has implemented the four-step process to minimize adverse impacts of urbanization. The four-step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume, and considering the need for Industrial Commercial BMPs.

Step 1 – Reducing Runoff Volumes: The majority of the development of the project site includes the land use categories of 2.5-acre single-family residential and lawn (golf course area). Both land uses have relatively minor imperviousness and runoff coefficients. The developed areas for the homes as designated by pad areas on the plans are disbursed with open land areas of vegetation and trees between which provide runoff reduction into the pervious soil.

Step 2 – Stabilize Drainageways: The existing tertiary drainage ways are assessed for stormwater runoff capacity, velocity, and shear stress. Any altered drainage ways will be designed in a manner that provides water quality benefits through infiltration and the removal of pollutants via phytoremediation. Vegetation and/or matting will also be selected to stabilize the drainage ways by reducing the velocity of flows and decreasing any scour. These improvements help stabilize drainageways and minimize erosion and sediment runoff. Roadside ditches are stabilized swales by way of compaction per the roadway typical section and are also prescribed any required seeding, erosion control blanketing, and/or matting.



Discuss all proposed and existing ponds that provide the WQCV and clearly discuss what basins are treated and what areas are excluded and which exclusions apply. See comments on drainage map. Please provide a figure clearly showing all applicable exclusions and what ing Horse North areas are treated so it is clear how every basin is inclopment Drainage Plan compliance with County MS4 requirements.

Step 3 – Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV via detention ponds that are designed per current El Paso County DCM V2 and the MHFD.

Step 4 - Consider the need for Industrial and Commercial BMP's: A site specific storm water quality and erosion control plan and narrative will be prepared with subsequent land use approvals prepared in conjunction with the report prior to any construction. Site specific temporary source control BMPs as well as permanent BMPs are detailed in this plan and narrative. Guidelines detailed in the El Paso DCM V2 4.2 pertaining to the covering and storage handline and spill containment and control shall be followed as necessary. This filing does not contain any commercial of industrial land uses.

VI. Drawings

Please refer to the appendices for the Vicinity Map, FEMA Floodplain Map, NRCS Soils Map, hydrology and hydraulic calculations, and drainage basin maps. Reference materials from previously approved reports are included in the appendix including the 2018 Classic Consulting FDR/PDR calculations and drainage maps.

VII. Drainage and Bridge Fees

The East Cherry Creek Basin does not currently have a Drainage Basin Fee. However, the following fees for the filing no. 1 platted area within the black Squirrel Creek Basin are due prior to platting:

The fees are calculated using the following impervious acreage method approved by El Paso county. The acreage for Flying Horse Filing No. 3 within the Black Squirrel Creek Basin is 151.9 acres. This total area is entirely made up of 2.5 acre lots which have an imperviousness of 11%. The acreage of imperviousness is calculated below:

2.5 ac. Lots (incl. roads and tracts)

151.9 Ac. 11% = 16.71 Impervious Ac.

The following calculations are based on the 2023 drainage/bridge fees for the Black Squirrel Creek Drainage Basin:

Filing 3 Fee Totals (prior to reduction):

Bridge Fees

\$ 660.00 x 16.71 Ac. = \$ 11,028.60

Drainage Fees

\$ 10,478.00 x 16.71 Ac. = \$ 175,087.38

Fee calculations and appendices not reviewed in detail pending approval of deviations, and design clarifications.

Per the ECM 3.10.4a, this development requests a reduction of drainage fees based on the one on-site full spectrum detention/SWQ facilities proposed within the Black Squirrel Creek Drainage Basin to be construction with Filing 3 rather than utilizing a reduction for low density lots. The following facilities within the Black Squirrel Creek basin meet the required six criteria as follows:

1. No downstream regional facility in place yet.





- 2. all three proposed facilities are less than 15 ac-ft. in volume.
- 3. the proposed on-site facilities are not part of a regional plan.
- 4. The proposed outlets are designed to release to full-spectrum criteria.
- 5. Proposed facilities are per county criteria and will gain county approval.
- 6. All three proposed facilities will be private with ownership and maintenance by HOA.

Detention Pond B 4.75 ac-ft. full spectrum

 $$50,000 \times 50\% = $25,000$

Filing 1 Fee Totals:

Bridge Fees

 $$660.00 \times 16.71 \text{ Ac.} = $11,028.60$

Drainage Fees

 $10,478.00 \times 16.71 \text{ Ac.} = 175,087.38 - 25,000 = 150,087.38$

VIII. Summary

Flying Horse North Filing No. 3 is a 166.4 acre single-family residential estate lot development area that will contain paved roadways and roadside ditch sections. A portion of one of the road sections will serve a future development area intended for flats that are to be built in a later filing. The future development area has been accounted for with assumed land use and imperviousness. Full spectrum detention facilities are proposed to provide water quality and detention to release the stormwater at or below historical rates. Existing detention facilities within the Filing No. 1 area are utilized per the 2018 Classic Consulting PDR/FDR and require no retrofitting.

The Filing No. 3 final design is assessed for stormwater capacity of roadway sections, roadside swales and the existing tertiary drainage ways to ensure that development of the 2.5-acre single-family residential estate lots and the future flats areas will not be negatively impacted by drainage conditions, including existing and proposed altered areas for the roadway and lot construction phases.

All County and MHFD drainage design standards are met. It is anticipated that there will be no negative impacts to downstream and surrounding developments and facilities due to the development of Filing No. 3.



IX. References

El Paso County - Drainage Criteria Manual, 2014

City of Colorado Springs - Drainage Criteria Manual, May 2014

Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018

Mile High Flood District Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3; latest revisions

Mile High Flood District Software Resources and Tools (UD-Detention, UD-Inlet, UD-BMP)

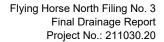
United States Department of Agriculture National Resources Conservation Service Rock Chute Design Data Spreadsheet

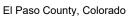
Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1, Classic Consulting Engineers and Surveyors, November 2017

Flying Horse North Master Development Drainage Plan, HR Green Development, LLC., September 2022

Flying Horse North Irrigation Reservoir Embankment Design Report, Classic Consulting Engineers and Surveyors, latest revision June 2018, County approved on September 25, 2018

Black Squirrel Drainage Basin Planning Study (DBPS), URS Consultants, January 1989







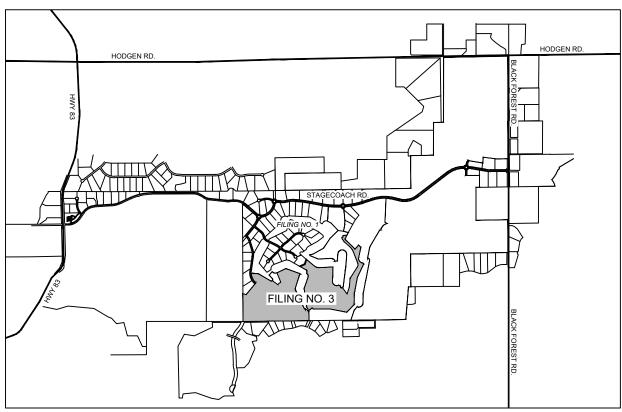
APPENDIX A

VICINITY MAP NRCS SOILS MAP FEMA FLOODPLAIN MAP EL PASO COUNTY MAJOR DRAINAGE BASINS MAP

VICINITY MAP

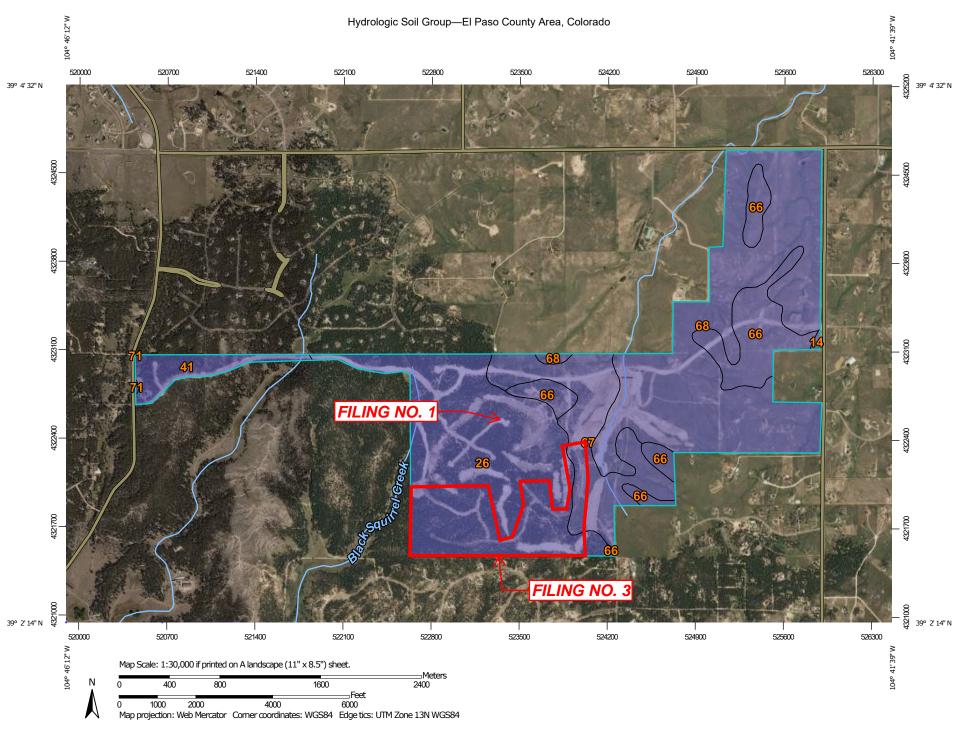
FLYING HORSE NORTH FILING NO. 3

A PORTION OF SECTION 36, TOWNSHIP 11 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO





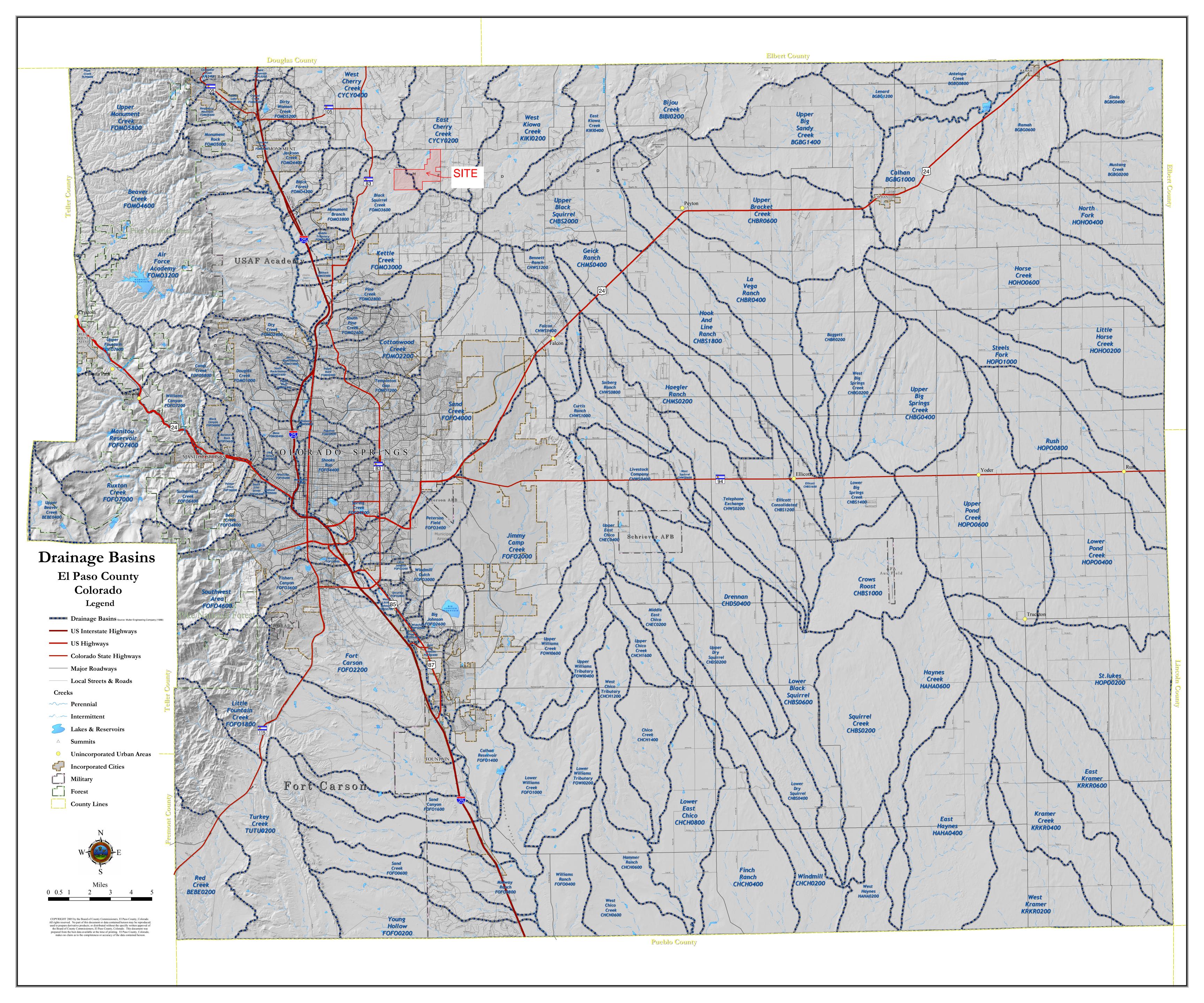
NOT TO SCALE



MAP LEGEND MAP INFORMATION The soil surveys that comprise your AOI were mapped at Area of Interest (AOI) С 1:24.000. Area of Interest (AOI) C/D Please rely on the bar scale on each map sheet for map Soils D measurements. Soil Rating Polygons Not rated or not available Α Source of Map: Natural Resources Conservation Service Web Soil Survey URL: **Water Features** A/D Coordinate System: Web Mercator (EPSG:3857) Streams and Canals В Maps from the Web Soil Survey are based on the Web Mercator Transportation projection, which preserves direction and shape but distorts B/D Rails distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more Interstate Highways accurate calculations of distance or area are required. C/D **US Routes** This product is generated from the USDA-NRCS certified data as D Major Roads of the version date(s) listed below. Not rated or not available -Local Roads Soil Survey Area: El Paso County Area, Colorado Soil Rating Lines Survey Area Data: Version 19, Aug 31, 2021 Background Aerial Photography Soil map units are labeled (as space allows) for map scales 1:50.000 or larger. Date(s) aerial images were photographed: Aug 19, 2018—May 26, 2019 B/D 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 C/D shifting of map unit boundaries may be evident. D Not rated or not available **Soil Rating Points** A/D B/D

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
14	Brussett loam, 1 to 3 percent slopes	В	1.9	0.1%
26	Elbeth sandy loam, 8 to 15 percent slopes	В	474.2	33.7%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	В	53.4	3.8%
66	Peyton sandy loam, 1 to 5 percent slopes	В	160.9	11.4%
67	Peyton sandy loam, 5 to 9 percent slopes	В	182.8	13.0%
68	Peyton-Pring complex, 3 to 8 percent slopes	В	533.4	37.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	В	0.6	0.0%
Totals for Area of Interest			1,407.3	100.0%



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, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

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/.

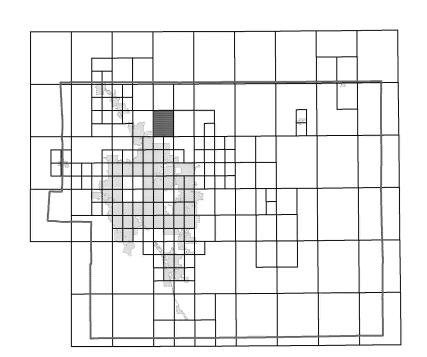
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

Flooding Source Vertic

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

El Paso County Vertical Datum Offset Table

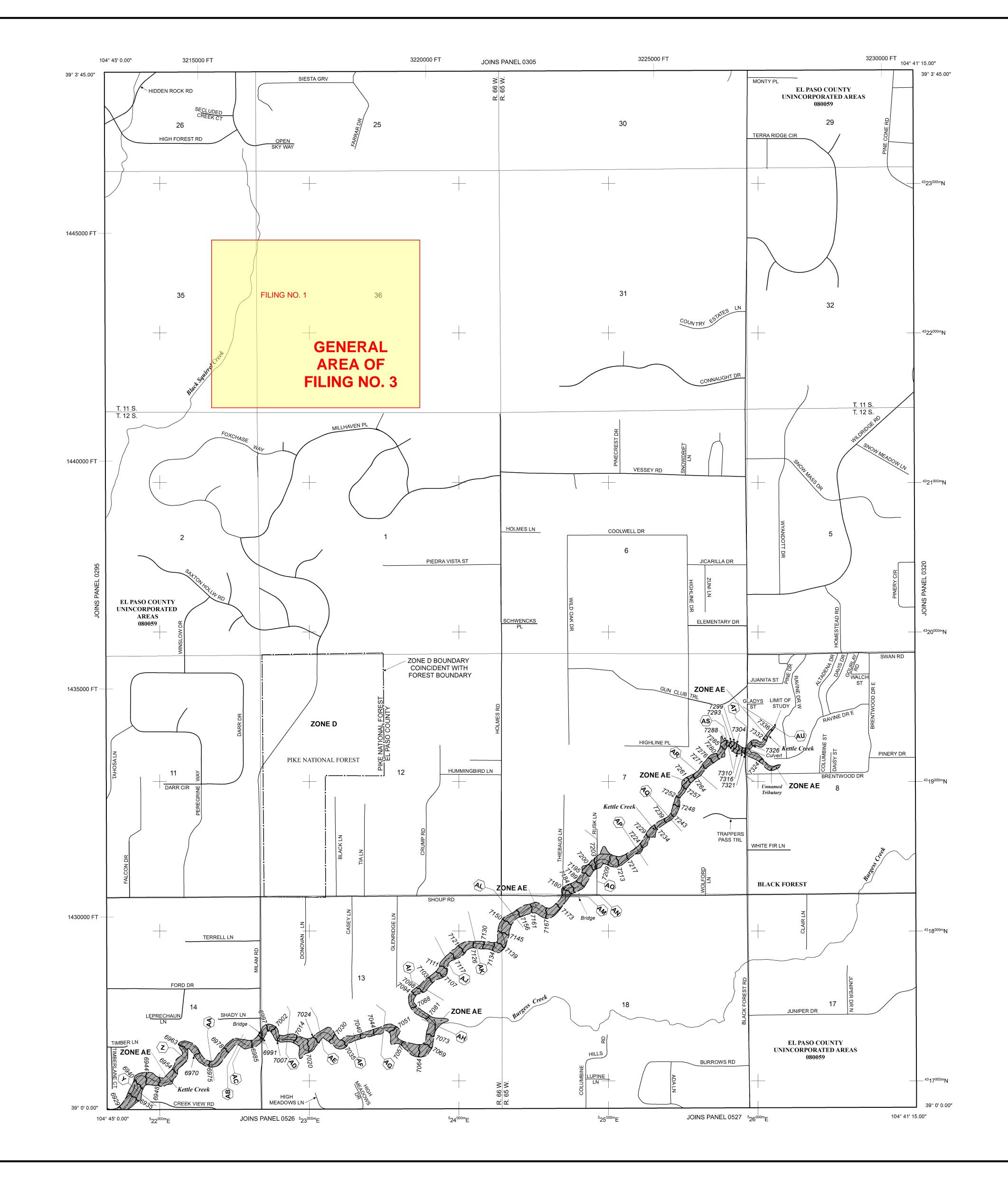
Panel Location Map



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

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

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

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

Areas in which flood hazards are undetermined, but possible.

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 Sase Flood Elevation line and value; elevation in feet*

(EL 987)

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 Cross section line

Transect line

97° 07' 30.00" Geographic coordinates referenced to the North American 32° 22' 30.00" Datum of 1983 (NAD 83)

4275^{000m}N 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

Bench mark (see explanation in Notes to Users section of this FIRM panel)

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

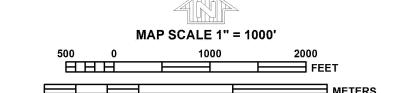
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to

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.



PANEL 0315G

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 315 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NUMBER PANEL SUFFIX

080059

COMMUNITY
EL PASO COUNTY

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 REVISED DECEMBER 7, 2018

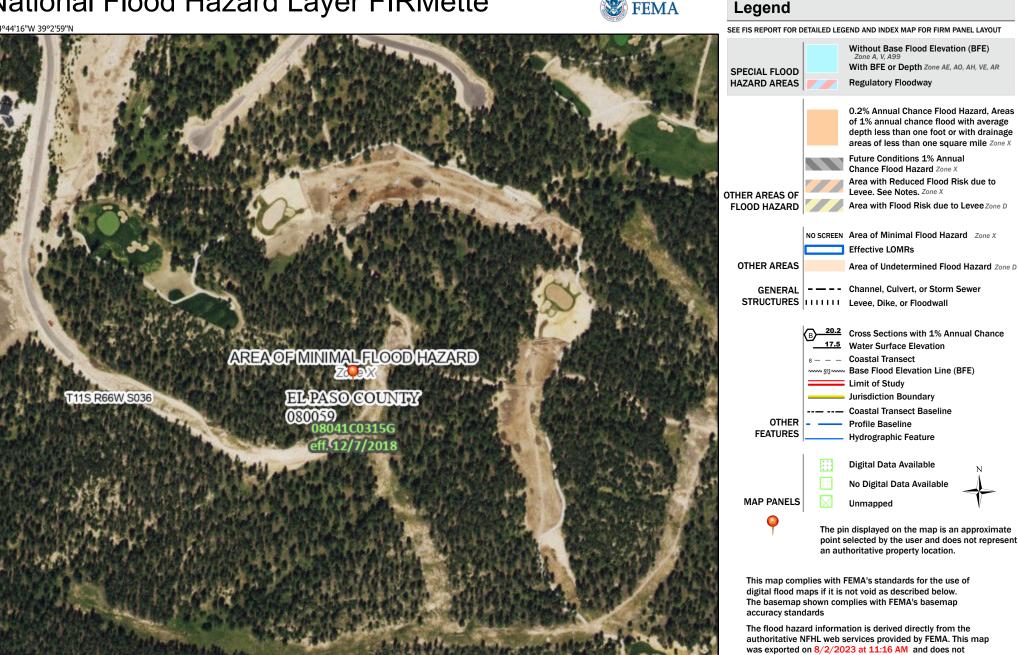
MAP NUMBER

08041C0315G

Federal Emergency Management Agency

National Flood Hazard Layer FIRMette





With BFE or Depth Zone AE, AO, AH, VE, AR 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X

Chance Flood Hazard Zone X

Area with Reduced Flood Risk due to

NO SCREEN Area of Minimal Flood Hazard Zone X

₩ 513 W Base Flood Elevation Line (BFE)

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap

authoritative NFHL web services provided by FEMA. This map was exported on 8/2/2023 at 11:16 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

250

500

1,000

1,500

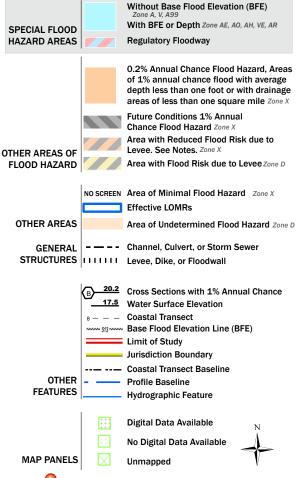




2,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap

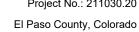
accuracy standards

The pin displayed on the map is an approximate point selected by the user and does not represent

an authoritative property location.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/2/2023 at 11:04 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.





APPENDIX B

HYDROLOGY CALCULATIONS



Calc'd by:	DLH
Checked by:	RDL
Date:	######

	SUMMARY RUNOFF TABLE														
BASIN	AREA (ac)	% IMP.	C ₅	C ₁₀₀	Q ₅ (cfs)	Q ₁₀₀ (cfs)									
BS-18	33.90	7.77	0.14	0.39	12.6	60.1									
BS-19	6.35	11.00	0.17	0.42	4.1	16.8									
BS-20	23.79	6.83	0.13	0.39	9.6	48.5									
BS-20.1	42.26	8.49	0.14	0.39	16.3	77.7									
BS-20.2	4.32	11.00	0.17	0.42	2.5	10.1									
BS-20.3	0.56	100.00	0.90	0.96	2.3	4.1									
BS-21	0.77	100.00	0.90	0.96	3.0	5.4									
BS-21.1	15.24	11.95	0.17	0.42	8.5	34.3									
BS-21.2	0.18	100.00	0.90	0.96	0.8	1.5									
BS-21.3	50.92	7.83	0.14	0.39	17.7	85.0									
BS-22	0.37	100.00	0.90	0.96	1.7	3.1									
BS-22.1	16.62	9.61	0.16	0.41	8.6	37.8									
BS-23A	9.57	8.51	0.15	0.40	4.3	19.6									
BS-23A.1	7.79	10.69	0.17	0.41	4.1	17.1									
BS-23	37.06	7.26	0.13	0.39	15.6	76.7									
BS-25	12.65	8.49	0.15	0.40	6.1	28.1									
BS-26	4.90	3.74	0.10	0.36	1.7	10.6									
BS-27	9.68	11.00	0.17	0.42	5.6	22.9									
BS-28	24.03	11.00	0.17	0.42	12.3	50.6									
BS-28.1	5.76	9.56	0.16	0.41	2.8	12.5									
BS-28.2	19.47	8.75	0.15	0.40	9.0	41.0									
BS-28.3	0.54	100.00	0.90	0.96	2.5	4.5									
BS-29	22.93	7.78	0.14	0.39	8.3	39.7									
BS-30	11.53	10.84	0.17	0.42	4.9	20.4									
BS-31	8.40	4.57	0.11	0.37	3.2	18.6									
BS-32	6.33	6.73	0.13	0.39	3.0	15.4									
BS-33	8.91	10.39	0.16	0.41	5.2	21.9									
BS-34	2.22	44.74	0.42	0.60	3.6	8.6									
BS-34.1	10.80	7.34	0.13	0.39	4.2	20.6									
BS-34.2	1.95	100.00	0.90	0.96	5.2	9.3									
BS-34.3	1.16	35.79	0.36	0.56	1.6	4.2									
BS-34.4	6.10	49.33	0.46	0.63	8.5	19.5									
OS-1	2.70	29.55	0.29	0.51	2.8	8.2									
OS-2	0.34	100.00	0.90	0.96	1.3	2.3									
OS-17	15.80	11.00	0.17	0.42	9.9	40.6									
OS-18	13.00	11.00	0.17	0.42	8.2	33.7									

	DESIGN POINT SUMMARY TABLE														
DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ ₁₀₀ (cfs)	Tributary Area (ac.)	Weighted % Impervious										
1	OS-1 & BS-34.3	4.5	12.4	3.9	31.43%										
1.1	BS-34, DP1, DP1.2	4.1	19.1	12.2	42.82%										
1.2	BS-34.4	8.5	19.5	6.1	49.33%										
1.3	BS-34.2, OS-2	6.5	11.6	2.3	100.00%										
2	BS-34-34.4, OS-1-2	27.2	72.6	25.3	32.84%										
4	BS-21.1	8.5	34.3	15.2	11.95%										
5	BS-20.2-20.3	4.7	14.2	4.9	21.21%										
6	BS-20-20.3, 21.1-21.3	57.7	261.3	137.3	8.92%										
7	BS-19, BS-22-22.1, DP6	72.2	318.9	160.6	9.28%										
8	BS-18, 23, DP7	100.3	455.8	231.6	8.74%										
9	BS-23A.1	4.1	17.1	7.8	7.79%										
10	BS-23A, DP8, DP9	108.7	492.5	248.9	8.79%										
11	BS-21	3.0	5.4	0.8	100.00%										
12	BS-28.1, DP11	5.9	17.9	6.5	20.23%										
13	BS-28.2	9.0	41.0	19.5	8.75%										
14	BS-28, BS-28.3, DP12, DP13	29.7	114.0	50.6	12.28%										
15	OS-18, BS-29-30	21.4	93.8	47.5	9.41%										
16	OS-17, BS-27, DP15	36.9	157.3	72.9	9.96%										
17	BS-26, DP14, DP16	68.2	281.8	128.4	10.04%										
18	BS-31	3.2	18.6	8.4	4.57%										
19	BS-32	3.0	15.4	6.3	6.73%										
20	BS-33	5.2	21.9	8.9	10.39%										
21	BS-25	6.1	28.1	12.7	8.49%										



Flying Horse North Filing No. 3

PROPOSED CONDITIONS

Calc'd by: DLH

Checked by: RDL

EL PASO COUNTY, COLORADO 8/14/2023

					COM	POSITE 'C	' F	AC	TO	RS												
BASIN	GOLF COURSE / UNDEVELOPED	ROADWAY	RESIDENTIAL (2.5AC LOT)	ROOFTOP	TOTAL	SOIL TYPE		GO OUI	RSE				NAY	(2	SIDEN	LOT)	ROOI	FTOP			OMPOSIT	SS & C
			ACRES				%I	C ₅	-		%I	C ₅	C ₁₀₀	%I	C ₅ *	C ₁₀₀ *	%I	C ₅	C ₁₀₀	%I	C ₅	C ₁₀₀
BS-18	12.2	0.0	21.8	0.0	33.9	В				0.35			0.96	11	0.17	0.42	90	0.73	0.81	7.8	0.14	0.39
BS-19	0.0	0.0	6.4	0.0	6.4	В	2	0.0	0 88	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	11.0	0.17	0.42
BS-20	11.0	0.0	12.8	0.0	23.8	В	2	0.0		0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	6.8	0.13	0.39
BS-20.1	23.4	0.2	17.6	1.1	42.3	В	2	0.0		0.35			0.96	11	0.17	0.42	90	0.73		8.5	0.14	0.39
BS-20.2	0.0	0.0	4.3	0.0	4.3	В	2	0.0		0.35			0.96	11	0.17	0.42	90	0.73		11.0	0.17	0.42
BS-20.3	0.0	0.6	0.0	0.0	0.6	В		0.0		0.35			0.96	11	0.17	0.42	90		0.81	100.0	0.90	0.96
BS-21	0.0	0.8	0.0	0.0	0.8	В	2	0.0		0.35			0.96	11	0.17	0.42	90		0.81	100.0	0.90	0.96
BS-21.1	1.6	0.1	13.3	0.3	15.2	В	2	0.0		0.35	100	0.90	0.96	11	0.17	0.42	90	0.73		11.9	0.17	0.42
BS-21.2	0.0	0.2	0.0	0.0	0.2	В	2	0.0		0.35	100		0.96	11	0.17	0.42	90		0.81	100.0	0.90	0.96
BS-21.3	21.9	0.4	28.7	0.0	50.9	В	2	0.0	0 88	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	7.8	0.14	0.39
BS-22	0.0	0.4	0.0	0.0	0.4	В	2	0.0	-	0.35			0.96	11	0.17	0.42	90		0.81	100.0	0.90	0.96
BS-22.1	2.6	0.0	14.1	0.0	16.6	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	9.6	0.16	0.41
BS-23A	2.7	0.0	6.9	0.0	9.6	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	8.5	0.15	0.40
BS-23A.1	0.3	0.0	7.5	0.0	7.8	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	10.7	0.17	0.41
BS-23	15.4	0.0	21.7	0.0	37.1	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	7.3	0.13	0.39
BS-25	3.5	0.0	9.1	0.0	12.7	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	8.5	0.15	0.40
BS-26	4.0	0.0	1.0	0.0	4.9	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	3.7	0.10	0.36
BS-27	0.0	0.0	9.7	0.0	9.7	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	11.0	0.17	0.42
BS-28	0.0	0.0	24.0	0.0	24.0	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	11.0	0.17	0.42
BS-28.1	0.9	0.0	4.8	0.0	5.8	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	9.6	0.16	0.41
BS-28.2	4.9	0.0	14.6	0.0	19.5	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	8.7	0.15	0.40
BS-28.3	0.0	0.5	0.0	0.0	0.5	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	100.0	0.90	0.96
BS-29	8.2	0.0	14.7	0.0	22.9	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	7.8	0.14	0.39
BS-30	0.2	0.0	11.3	0.0	11.5	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	10.8	0.17	0.42
BS-31	6.0	0.0	2.4	0.0	8.4	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	4.6	0.11	0.37
BS-32	3.0	0.0	3.3	0.0	6.3	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	6.7	0.13	0.39
BS-33	0.6	0.0	8.3	0.0	8.9	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	10.4	0.16	0.41
BS-34	1.2	0.6	0.0	0.4	2.2	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	44.7	0.42	0.60
BS-34.1	4.4	0.0	6.4	0.0	10.8	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	7.3	0.13	0.39
BS-34.2	0.0	2.0	0.0	0.0	2.0	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	100.0	0.90	0.96
BS-34.3	0.8	0.4	0.0	0.0	1.2	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	35.8	0.36	0.56
BS-34.4	3.0	2.0	0.0	1.1	6.1	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	49.3	0.46	0.63
OS-1	1.9	0.3	0.0	0.5	2.7	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	29.6	0.29	0.51
OS-2	0.0	0.3	0.0	0.0	0.3	В	2	0.0	0 8	0.35	100	0.90	0.96	11	0.17	0.42	90	0.73	0.81	100.0	0.90	0.96
OS-17	0.0	0.0	15.8	0.0	15.8	В		0.0		0.35			0.96	11	0.17	0.42	90		0.81	11.0	0.17	0.42
OS-18	0.0	0.0	13.0	0.0	13.0	В	2	0.0	0 8	0.35			0.96	11	0.17	0.42	90		0.81	11.0	0.17	0.42
TOTAL ONSITE	131.49	8.01	264.69	2.87	407.06															10.40%	0.16	0.41
TOTAL OFFSITE	1.89	0.66	28.80	0.49	31.84															13.52%	0.19	0.43
GRAND TOTAL	133.38	8.67	293,49	3.36	438.90															10.63%	0.16	0.41



Flying Horse North Filing No. 3 PROPOSED CONDITIONS

HRGreen EL PASO COUNTY, COLORADO

Calc'd by:	DLH
Checked by:	RDL
Date:	8/14/2023

, ,														
BAS	IN DATA		OVER	LAND TIMI	E (T _i)		TRAV	EL TIME (T _t)		TOTAL	tc=(L/180)+10	Design to	
DESIGNATION	C ₅	AREA (ac)	LENGTH (ft)	SLOPE %	t _i (min)	C _V	LENGTH (ft)	SLOPE %	V (ft/s)	t _t (min)	t _c (min)	tc max	tc design (min)	
BS-18	0.14	33.90	300	3.0	21.2	10	2600	3.00	1.7	25.0	46.2	26.1	26.1	
BS-19	0.17	6.35	300	3.0	20.5	10	180	6.00	2.4	1.2	21.7	12.7	12.7	
BS-20	0.13	23.79	260	7.0	15.0	10	1400	8.00	2.8	8.2	23.3	19.2	19.2	
BS-20.1	0.14	42.26	300	7.0	16.0	10	2300	10.00	3.2	12.1	28.1	24.4	24.4	
BS-20.2	0.17	4.32	300	5.4	16.8	10	950	5.00	2.2	7.1	23.9	16.9	16.9	
BS-20.3	0.90	0.56	16	2.0	1.2	10	860	5.00	2.2	6.4	7.6	14.9	7.6	
BS-21	0.90	0.77	16	2.0	1.2	10	1000	5.00	2.2	7.5	8.6	15.6	8.6	
BS-21.1	0.17	15.24	300	7.0	15.4	10	1250	8.00	2.8	7.4	22.7	18.6	18.6	
BS-21.2	0.90	0.18	16	2.0	1.2	10	260	5.00	2.2	1.9	5.0	11.5	5.0	
BS-21.3	0.14	50.92	300	7.0	16.0	10	3110	7.00	2.6	19.6	35.6	28.9	28.9	
BS-22	0.90	0.37	16	2.0	1.2	10	250	2.20	1.5	2.8	5.0	11.5	5.0	
BS-22.1	0.16	16.62	300	4.5	18.2	10	970	6.00	2.4	6.6	24.8	17.1	17.1	
BS-23A	0.15	9.57	250	10.0	12.8	10	1600	6.00	2.4	10.9	23.7	20.3	20.3	
BS-23A.1	0.17	7.79	180	10.0	10.7	10	1483	6.00	2.4	10.1	20.7	19.2	19.2	
BS-23	0.13	37.06	300	7.0	16.1	10	1320	6.00	2.4	9.0	25.0	19.0	19.0	
BS-25	0.15	12.65	280	11.0	13.2	10	1000	10.00	3.2	5.3	18.4	17.1	17.1	
BS-26	0.10	4.90	150	20.0	8.3	10	700	2.00	1.4	8.2	16.5	14.7	14.7	
BS-27	0.17	9.68	170	10.0	10.3	10	1000	5.00	2.2	7.5	17.8	16.5	16.5	
BS-28	0.17	24.03	200	8.0	12.1	10	1800	6.00	2.4	12.2	24.3	21.1	21.1	
BS-28.1	0.16	5.76	200	7.0	12.8	10	1400	6.00	2.4	9.5	22.3	18.9	18.9	
BS-28.2	0.15	19.47	300	6.0	16.6	10	1400	6.00	2.4	9.5	26.2	19.4	19.4	
BS-28.3	0.90	0.54	16	2.0	1.2	10	370	4.00	2.0	3.1	5.0	12.1	5.0	
BS-29	0.14	22.93	300	10.0	14.2	10	2800	5.00	2.2	20.9	35.1	27.2	27.2	
BS-30	0.17	11.53	300	8.0	14.8	10	3100	5.00	2.2	23.1	37.9	28.9	28.9	
BS-31	0.11	8.40	180	10.0	11.4	10	640	8.00	2.8	3.8	15.1	14.6	14.6	
BS-32	0.13	6.33	180	11.0	10.8	10	320	6.00	2.4	2.2	12.9	12.8	12.8	
BS-33	0.16	8.91	300	10.0	13.8	10	550	6.00	2.4	3.7	17.5	14.7	14.7	
BS-34	0.42	2.22	100	2.0	9.9	10	300	1.00	1.0	5.0	14.9	12.2	12.2	
BS-34.1	0.13	10.80	100	2.0	14.1	10	2150	1.00	1.0	35.8	49.9	22.5	22.5	
BS-34.2	0.90	1.95	16	2.0	1.2	10	2150	1.00	1.0	35.8	37.0	22.0	22.0	
BS-34.3	0.36	1.16	16	2.0	4.3	10	480	1.00	1.0	8.0	12.3	12.8	12.3	
BS-34.4	0.46	6.10	100	2.0	9.3	10	1839	1.00	1.0	30.7	40.0	20.8	20.8	
OS-1	0.29	2.70	300	3.0	17.7	10	500	1.00	1.0	8.3	26.1	14.4	14.4	
OS-2	0.90	0.34	16	2.0	1.2	10	500	1.00	1.0	8.3	9.5	12.9	9.5	
OS-17	0.17	15.80	300	6.7	15.7	10	350	6.00	2.4	2.4	18.0	13.6	13.6	
OS-18	0.17	13.00	300	6.0	16.2	10	300	6.00	2.4	2.0	18.3	13.3	13.3	



Flying Horse North Filing No. 3	Calc'd by:	DLH
PROPOSED CONDITIONS	Checked by:	RDL
DESIGN STORM: 5-YEAR	Date:	8/14/2023

1 11 (OI C																	2	2.6894	58595	5		
					DIRECT	RUNG	OFF		то	TAL R	UNOI	FF	ov	ERLAN	ID.		PII	PE		TI	RAVEL		REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	Ç	t _c (min)	C ₅ *A (ac)	/ (in./ hr.)	Q (cfs)	t _c (min)	C ₅ *A (ac)	/ (in./ hr.)	Q (cfs)	Q _{street} (cfs)	C ₅ *A (ac)	% 3COPE %	Q _{PIPE} (cfs)	C ₅ *A (ac)	SLOPE %	PIPE SIZE (FT)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min	
		BS-18	33.90	0.14	26.1	4.67	2.69	12.6															BS-18 FLOW TO DP8 VIA PROP. PERMANENT TRM CHANNEL IN FILING 1
		BS-19	6.35	0.17	12.7	1.08	3.77	4.1					9.6	3.06	6.0					900	4.9	3.06	BS-19 FLOW TO DP7 VIA PROP. PERMANENT TRM CHANNEL IN FILING 1
		BS-20	23.79	0.13	19.2	3.06	3.15	9.6		3.06		9.6											BS-20 TO COLLECTION INTO DET. POND AT DP3
		BS-20.1	42.26	0.14	24.4	5.84	2.79	16.3															BS-20.1 TO COLLECT AT DP6 W/ BS-20.2, BS-20.3
		BS-20.2	4.32	0.17	16.9	0.74	3.34	2.5		0.74		2.5											FLOW TO DP5
		BS-20.3	0.56	0.90	7.6	0.50	4.55	2.3															FLOW TO DP5
		DO-20.0	0.50	0.30	7.0	0.50	4.55	2.0					4.7	1.24	8.0					330	5.7	0.97	
	5									1.24		4.7	30.7	10.14	6.0					520	4.9	1.77	DP5 TO OVERLAND FLOW TO DP6
	С									10.14		30.7	3.0	0.60	6.0					1400	4.9	4.76	SECTION C TO INCLUDE FLOW FROM DP5 & BS-20-20.1
	11	BS-21	0.77	0.90	8.6	0.69	4.35	3.0		0.69		3.0											BS-21 TO COLLECT AT CULVERT AT DP11
	4	BS-21.1	15.24	0.17	18.6	2.66	3.20	8.5		2.66		8.5	8.5	2.66	5.6					1450	4.7	5.11	BS-21.1 TO COLLECT AT CULVERT AT DP4, FLOW TO DP6 POND
		BS-21.2	0.18	0.90	5.0	0.16	5.17	0.8					0.8	0.16	5.6					1450	4.7	5.11	BS-21.2 COMBINES W/ BS-21.1, FLOW TO DP6 POND
		BS-21.3	50.92	0.14	28.9	6.99	2.53	17.7					57.7	19.95	28.0				1	60	10.6	0.09	BS-21.3 COLLECTS AT DP6 POND DP6 TO COLLECT SECTION C & BS-21.1-21.3, POND SIZED BY CLASSIC TO CAPTURE 215 CFS
	6									19.95		57.7	1.7		6.0					662	4.9	2.25	
		BS-22	0.37	0.90	5.0	0.33	5.17	1.7					1.7	0.50	0.0					002	4.5	2.23	BS-22 TO FLOW TO DP7
		BS-22.1	16.62	0.16	17.1	2.60	3.33	8.6															BS-22.1 FLOW TO DP7
	7									23.96		72.2	72.2	23.96	3.5					1030	3.7	4.59	DP7 COLLECTS BS-22-22.1, & DP6, FLOW TO DP8 VIA PERM. TRM CHANNEL W/ ROCK CHECK DAMS
										23.90		12.2											
		BS-23A	9.57	0.15	20.3	1.39	3.07	4.3															BS-23A TO FLOW TO DP10 POND VIA ROADSIDE DITCH
	9	BS-23A.1	7.79	0.17	19.2	1.30	3.15	4.1		1.30		4.1				4.1	1.30	2.0	2.0	160	#DIV/0!	#DIV/0!	BS-23A.1 FLOW TO CULVERT AT DP9
		BS-23	37.06	0.13	19.0	4.92	3.17	15.6															BS-23 FLOW TO CULVERT AT DP8
	8									28.88		100.3				100.3	28.88	2.0	5.0	270	#DIV/0!	#DIV/0!	DP8 COLLECTS BS-18 & BS-23 & DP7, FLOWS TO CULVERT OUTLET AT DP10 DET POND
	10									31.57		108.7											DP10 COLLECTS BS-23A, DP8 & DP9 AT POND SIZED BY CLASSIC HOMES
	21	BS-25	12.65	0.15	17.1	1.83	3.32	6.1		1.83		6.1											BS-25 TO FLOW OFFSITE
	-	BS-26	4.90				3.55			1.00		0.1											BS-26 CONTAINS POND AT DP17, TO COLLECT DP14 & DP16
		BS-27	9.68				3.38			4.34		15.4	15.4	4.34	20.0					130	8.9	0.24	BS-27 INCLUDES OS-17 AND COLLECTS AT DP16
		BS-28	24.03			4.09	3.01						0.0	0.00	20.0					150	8.9	0.28	BS-28 FLOWS INTO ROADSIDE DITCH AT DP14
	12						3.18			1.59		5.9	5.9	1.59	5.6					1640	4.7	5.78	BS-28.1 COMBINES W/ DP11 FLOWS TO CULVERT AT DP12
	12	BS-28.1	5.76	0.16	18.9	0.90	3.18	2.8		1.59	ı!	5.9			1	1			1	1	<u> </u>	1	D3-20.1 COMIDINES W/ DF11 FLOWS TO CULVERT AT DF12

- HR(3. Gre	en
	POINT	•

Flying Horse North Filing No. 3	Calc'd by:	DLH
PROPOSED CONDITIONS	Checked by:	RDL
DESIGN STORM: 5-YEAR	Date:	8/14/2023

2.689458595

			2.6 DIRECT RUNOFF TOTAL RUNOFF OVERLAND PIPE															.6894	58595				
				D	IRECT	RUNC	DFF		FF	ov	ERLAN	ID		PII	PE		TF	RAVEL		REMARKS			
STREET	DESIGN POINT	BASIN ID	AREA (ac)	Cs	t _c (min)	C _s *A (ac)	/ (in./ hr.)	Q (cfs)	t _c (min)	C ₅ *A (ac)	/ (in./ hr.)	Q (cfs)	Q _{street} (cfs)	C ₅ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₅ *A (ac)	SLOPE %	PIPE SIZE (FT)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min	
	10	BC 00.0	10.47	0.45	10.4	2.07	2.40			2.07	\		9.0	2.87	4.5			_	_	1700	4.2	6.68	DO 30 SELOWO TO CHENCET AT DOGS
\vdash	13	BS-28.2	19.47	0.15	19.4	2.87	3.13	9.0		2.87	\vdash	9.0	2.5	0.49	4.5	\vdash			 	1620	4.2	6.36	BS-28.2 FLOWS TO CULVERT AT DP13
		BS-28.3	0.54	0.90	5.0	0.49	5.17	2.5			نــــا												BS-28.3 W/ DP13 AT NATURAL DRAINAGE WAY TO DP14
] }	\longrightarrow	BS-29	22.93	0.14	27.2	3.16	2.63	8.3		5.38	ļ Ī	16.5	16.5	5.38	4.0	[آ ا		900	4.0	3.75	BS-29 INCLUDE OS-18 AND COLLECTS AT DP15
	\dashv	DO-29	22.93	0.14	21.2	3.10	2.03	0.3		5.38	\vdash	10.5	4.9	1.94	6.4	\vdash		 	\vdash	150	5.1	0.49	20-25 INCEODE OSTIO AND COLLECTO AT DP13
		BS-30	11.53	0.17	28.9	1.94	2.54	4.9			لسا	igsquare						<u> </u>	\vdash				BS-30 COLLECTS IN ROADSIDE DITCH, FLOWS TO DP15
·	15	$\vdash \vdash \vdash$!	<u>'</u>			<u> </u>	1 .		7.32	l i	21.4	21.4	7.32	4.0			۱ ۱		900	4.0	3.75	DP15 COLLECTS BS-29, BS-30, OS-18
	13		$\vdash \vdash \vdash$	<u> </u>			<u> </u>	 		1.32	\vdash	Z1.4	36.9	11.66	30.0	\vdash		 	\vdash	100	11.0	0.15	
	16		<u> </u>					 		11.66	Ш	36.9						Щ.	<u> </u>				DP16 COLLECTS BS-27, OS-17, DP15
	14	$\vdash \vdash \vdash$	\	<u>'</u>			<u> </u>	-		9.04		29.7	29.7	9.04	30.0			۱ ۱		150	11.0	0.23	DP14 COLLECTS BS-28, 28.1, 28.2, 28.3, BS-21
			\vdash				<u> </u>	\vdash					+			\vdash		<u> </u>	t			\vdash	
	17	lacksquare	<u> </u>					 		21.18	igwdap	68.2	1		—	<u> </u>		Щ.	 	$\vdash \vdash$	<u> </u>		DP17 CONTAINS BS-21, 28, 28.1, 28.2, 28.3, 30, 29, 27 & OS-17-18 IN DET. POND
	18	BS-31	8.40	0.11	14.6	0.89	3.57	3.2		0.89		3.2			$ldsymbol{ldsymbol{ldsymbol{eta}}}$			L		Ш	<u> </u>		BS-31 TO FLOW OFFSITE SOUTH
	19	BS-32	6.33	0.13	12.8	0.81	3.76	3.0		0.81		3.0									<u> </u>		BS-32 TO FLOW OFFSITE SOUT
	20	BS-33	8.91	0.16	14.7	1.46	3.55	5.2		1.46		5.2	'_			L			L		<u> </u>	L	BS-33 TO FLOW OFFSITE SOUTH
													1					<u> </u>			1		
\vdash	1.1	BS-34	2.22	0.42	12.2	0.94	3.83	3.6		1.09	₩	4.1	!		 	16.6	4.96	2.0	2.0	30	10.2	0.05	BS-34 & OVERFLOW FROM DP'S 1 & 1.2 CAPTURED AT 15' SUMP INLET
		BS-34.1	10.80	0.13	22.5	1.44	2.91	4.2			Ш	igsquare	·		<u> </u>	ļ		<u> </u>	<u> </u>	Ш	<u> </u>		BASIN FLOW CAPTURED IN ROADSIDE DITCH, COLLECTED AT DP2 POND
	1.3	BS-34.2	1.95	0.90	22.0	1.76	2.94	5.2		2.06		6.5			Ш	23.0	7.03	5.5	3.0	95	22.1	0.07	BS-34.2 & OS-2 CAPTURED W/ 10' TYPE R SUMP INLET, PIPE FLOW FROM DP1.1 & DP1.3 CONVERGE
<u> </u>	<u></u>	BS-34.3	1.16	0.36	12.3	0.42	3.82	2 1.6					!		L			L_		<u> </u>	<u> </u>		BS-34.3 TO FLOW DOWNSTREAM INTO ON-GRADE INLET AT DP1
	1.2	BS-34.4	6.10	0.46	20.8	2.81	3.03	8.5		2.81		8.5	0.3	0.11	1.0		2.70	1.1	2.0	185	7.6	0.41	BS-34.4 CAPTURED ON GRADE BY 15' CDOT TYPE R INLET
-	2		,					-		8.47		27.2											FULL SPECTRUM DETENTION POND A TO BE DESIGNED AT DP2
								1													 		
\vdash	\longrightarrow	OS-1	2.70	0.29	14.4	0.80	3.58	2.8		0.80	\vdash	2.8	0.1	0.04	4.0	 		 	₩	$\vdash \vdash$	<u> </u>	 	OS-1 TO FLOW DOWNSTREAM INTO ON-GRADE INLET AT DP1
	1		!					1		1.22	Ш	4.5	J. 1	5.04	<u> </u>	4.3	1.18	2.0	1.5	305	8.4	0.60	BS-34.3 & OS-2 CAPTURED ON GRADE BY 10' CDOT TYPE R INLET
		OS-2	0.34	0.90	9.5	0.31	4.21	1.3			Ш		<u> </u>		lacksquare			<u> </u>		Ш	<u> </u>		OS-2 FLOWS TO DP1.3
		OS-17	15.80	0.17	13.6	2.69	3.67	9.9		2.69	Ш	9.9			$ldsymbol{ldsymbol{ldsymbol{eta}}}$					Ш	<u> </u>		OS-17 FLOWS INTO BS-27
<u> </u>	_	OS-18	13.00	0.17	13.3	2.21	3.70	8.2		2.21		8.2	l]		L	L		_	<u>_</u>		<u> </u>		OS-18 FLOWS INTO BS-29
	\Box		1	1									1					ļ			I		
			ш				<u> </u>									ь		Щ_	Ь		<u> </u>	1	<u> </u>



Flying Horse North Filing No. 3

PROPOSED CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by:

Checked by:

Date:

8/14/2023

				D	IRECT	RUNG)FF			TOTAL R	UNOFF	•	0\	/ERLAN	ND_		PI	PE		TR	AVEL	TIME	REMARKS
STREET	DESIGN PONT	BASIN ID	AREA (ac)	C ₁₀₀	t _c (min)	C ₁₀₀ *A (ac)	/ (in./ hr.)	Q (cfs)	t _e (min)	C ₁₀₀ *A (ac)	/ (in./ hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	% HODE %	Q _{PIPE} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
		BS-18	33.90	0.39	26.1	13.32	4.51	60.1															BS-18 FLOW TO DP8 VIA PROP. PERMANENT TRM CHANNEL IN FILING 1
		BS-19	6.35	0.42	12.7	2.65	6.34	16.8															BS-19 FLOW TO DP7 VIA PROP. PERMANENT TRM CHANNEL IN FILING 1
		BS-20	23.79				5.29			9.18		48.5	48.5	9.18	6.0					900	4.9	3.06	BS-20 TO COLLECTION INTO DET. POND AT DP3
										9.10		40.5											
		BS-20.1	42.26				4.68																BS-20.1 TO COLLECT AT DP6 W/ BS-20.2, BS-20.3
		BS-20.2	4.32	0.42	16.9	1.80	5.60	10.1		1.80		10.1											FLOW TO DP5
		BS-20.3	0.56	0.96	7.6	0.54	7.63	4.1					14.2	2.34	8.0					330	5.7	0.97	FLOW TO DP5
	5									2.34		14.2	140.4		6.0							1.77	DP5 TO OVERLAND FLOW TO DP6
	С									28.12		140.4	5.4		6.0					1400		4.76	SECTION C TO INCLUDE FLOW FROM DP5 & BS-20-20.1
	11	BS-21	0.77	0.96	8.6	0.74	7.31	5.4		0.74		5.4											BS-21 TO COLLECT AT CULVERT AT DP11
	4	BS-21.1	15.24	0.42	18.6	6.40	5.37	34.3		6.40		34.3	34.3	6.40	5.6					1450	4.7	5.11	BS-21.1 TO COLLECT AT CULVERT AT DP4, FLOW TO DP6 POND
		BS-21.2	0.18	0.96	5.0	0.17	8.68	1.5					1.5	0.17	5.6					1450	4.7	5.11	BS-21.2 COMBINES W/ BS-21.1, FLOW TO DP6 POND
		BS-21.3	50.92	0.39	28.9	19.99	4.25	85.0															BS-21.3 COLLECTS AT DP6 POND
	_			0.00						54.00		004.0	261.3	54.68	28.0					60	10.6	0.09	DP6 TO COLLECT SECTION C & BS-21.1-21.3, POND SIZED BY CLASSIC TO CAPTURE 215 CFS
	6									54.68		261.3	3.1	0.36	6.0					662	4.9	2.25	
		BS-22	0.37	0.96	5.0	0.36	8.68	3.1															BS-22 TO FLOW TO DP7
		BS-22.1	16.62	0.41	17.1	6.76	5.59	37.8					318.9	64.45	3.5					1030	3.7	4.59	BS-22.1 FLOW TO DP7
	7									64.45		318.9											DP7 COLLECTS BS-22-22.1, & DP6, FLOW TO DP8 VIA PERM. TRM CHANNEL W/ ROCK CHECK DAMS
		BS-23A	9.57	0.40	20.3	3.81	5.15	19.6															BS-23A TO FLOW TO DP10 POND VIA ROADSIDE DITCH
	9	BS-23A.1	7.79	0.41	19.2	3.23	5.28	17.1		3.23		17.1				17.1	3.23	2.0	2.0	160	10.2	0.26	BS-23A.1 FLOW TO CULVERT AT DP9
		BS-23	37.06	0.39	19.0	14.43	5.32	76.7															BS-23 FLOW TO CULVERT AT DP8
	8									92.20		455.8				455.8	92.20	2.0	5.0	270	18.8	0.24	DP8 COLLECTS BS-18 & BS-23 & DP7, FLOWS TO CULVERT OUTLET AT DP10 DET POND
	10									99.24		492.5											DP10 COLLECTS BS-23A, DP8 & DP9 AT POND SIZED BY CLASSIC HOMES
	21	BS-25	12.65	0.40	17.1	5.04	5.58	28.1		5.04		28.1											BS-25 TO FLOW OFFSITE
		BS-26	4.90				5.96			2.01													BS-26 CONTAINS POND AT DP17, TO COLLECT DP14 & DP16
		BS-27					5.67			10.63		63.5	63.5	10.63	20.0					130	8.9	0.24	BS-27 INCLUDES OS-17 AND COLLECTS AT DP16
			9.68							10.03		03.5	0.0	0.00	20.0					150	8.9	0.28	
		BS-28	24.03				5.05						17.9	3.08	5.6					1640	4.7	5.78	BS-28 FLOWS INTO ROADSIDE DITCH AT DP14
	12	BS-28.1	5.76	0.41	18.9	2.34	5.33	12.5		3.08		17.9	41.0	7.79	4.5					1700	4.2	6.68	BS-28.1 COMBINES W/ DP11 FLOWS TO CULVERT AT DP12
	13	BS-28.2	19.47	0.40	19.4	7.79	5.26	41.0		7.79		41.0											BS-28.2 FLOWS TO CULVERT AT DP13



Flying Horse North Filing No. 3

PROPOSED CONDITIONS
Checked by:
DESIGN STORM: 100-YEAR

Calc'd by:
Checked by:
RDL

8/14/2023

1 11 13				D	IRECT	RUNG	OFF			TOTAL R	UNOFF		0\	/ERLAI	ND		PI	PE		TR	AVEL	TIME	REMARKS
STREET	DESIGN PONT	BASIN ID	AREA (ac)	C ₁₀₀	t _c (min)	C ₁₀₀ *A (ac)	/ (in./ hr.)	Q (cfs)	t _c (min)	C ₁₀₀ *A (ac)	/ (in./ hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	% HODE %	Q _{PIPE} (cfs)	C ₁₀₀ *A (ac)	% 3401S	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
		BS-28.3	0.54	0.96	5.0	0.52	8.68	4.5					4.5	0.52	4.5					1620	4.2	6.36	BS-28.3 W/ DP13 AT NATURAL DRAINAGE WAY TO DP14
		DO-20.3	0.54	0.90	3.0	0.52	0.00	4.0	'				73.4	14.44	4.0					900	4.0	3.75	BO-20.3 WI DE IS AT INCIDING BINAINAGE WAT TO DE 14
		BS-29	22.93	0.39	27.2	9.01	4.41	39.7	,	14.44		73.4	00.4	4.00	0.4					450	F.4	0.40	BS-29 INCLUDE OS-18 AND COLLECTS AT DP15
		BS-30	11.53	0.42	28.9	4.80	4.26	20.4					20.4	4.80	6.4					150	5.1	0.49	BS-30 COLLECTS IN ROADSIDE DITCH, FLOWS TO DP15
	45									40.00		00.0	93.8	19.23	4.0					900	4.0	3.75	PRIS 001 F070 P0 00 00 00 10
	15									19.23		93.8	157.3	29.86	30.0					100	11.0	0.15	DP15 COLLECTS BS-29, BS-30, OS-18
	16									29.86		157.3											DP16 COLLECTS BS-27, OS-17, DP15
	14									21.42		114.0	114.0	21.42	30.0					150	11.0	0.23	DP14 COLLECTS BS-28, 28.1, 28.2, 28.3, BS-21
	17									53.05		281.8											DP17 CONTAINS BS-21, 28, 28.1, 28.2, 28.3, 30, 29, 27 & OS-17-18 IN DET. POND
	18	BS-31	8.40	0.37	14.6	3.10	5.99	18.6	5	3.10		18.6											BS-31 TO FLOW OFFSITE SOUTH
	19	BS-32	6.33	0.39	12.8	2.44	6.31	15.4		2.44		15.4											BS-32 TO FLOW OFFSITE SOUT
		B0.00																					
	20	BS-33	8.91	0.41	14.7	3.68	5.96	21.9	1	3.68		21.9										-	BS-33 TO FLOW OFFSITE SOUTH
	1.1	BS-34	2.22	0.60	12.2	1.33	6.43	8.6	5	3.25		19.1				40.5	7.18	2.0	2.0	30	10.2	0.05	BS-34 & OVERFLOW FROM DP'S 1 & 1.2 CAPTURED AT 15' SUMP INLET
		BS-34.1	10.80	0.39	22.5	4.21	4.89	20.6															BASIN FLOW CAPTURED IN ROADSIDE DITCH, COLLECTED AT DP2 POND
	4.0	50.04.0								0.00		44.0				50.0	0.00			0.5	00.4		
	1.3	BS-34.2	1.95	0.96	22.0	1.87	4.94	9.3	5	2.20		11.6				52.0	9.38	5.5	3.0	95	22.1	0.07	BS-34.2 & OS-2 CAPTURED W/ 10' TYPE R SUMP INLET, PIPE FLOW FROM DP1.1 & DP1.3 CONVERGE
		BS-34.3	1.16	0.56	12.3	0.65	6.41	4.2	2				0.4	4.40									BS-34.3 TO FLOW DOWNSTREAM INTO ON-GRADE INLET AT DP1
	1.2	BS-34.4	6.10	0.63	20.8	3.84	5.09	19.5		3.84		19.5	6.1	1.19	1.0		2.65	1.1	2.0	185	7.6	0.41	BS-34.4 CAPTURED ON GRADE BY 15' CDOT TYPE R INLET
	2																						FULL ODEOTO IM DETENTION DONO A TO DE DEGIONED AT DO
								-		13.59		72.6											FULL SPECTRUM DETENTION POND A TO BE DESIGNED AT DP2
		OS-1	2.70	0.51	14.4	1.37	6.01	8.2		1.37		8.2	4.5	0.70	4.0							1	OS-1 TO FLOW DOWNSTREAM INTO ON-GRADE INLET AT DP1
	1									2.02		12.4	4.5	0.73	4.0	7.9	1.29	2.0	1.5	305	8.4	0.60	BS-34.3 & OS-2 CAPTURED ON GRADE BY 10' CDOT TYPE R INLET
		OS-2	0.34	0.96	9.5	0.33	7.06	2.3															OS-2 FLOWS TO DP1.3
		OS-17	15.80	0.42	13.6	6.59	6.16	40.6		6.59		40.6											OS-17 FLOWS INTO BS-27
		OS-18	13.00				6.21			5.42		33.7											OS-18 FLOWS INTO BS-29
		03-18	13.00	0.42	13.3	3.42	0.21	33.7		5.42		33.1											OS-101 LOWG HATO BS-28

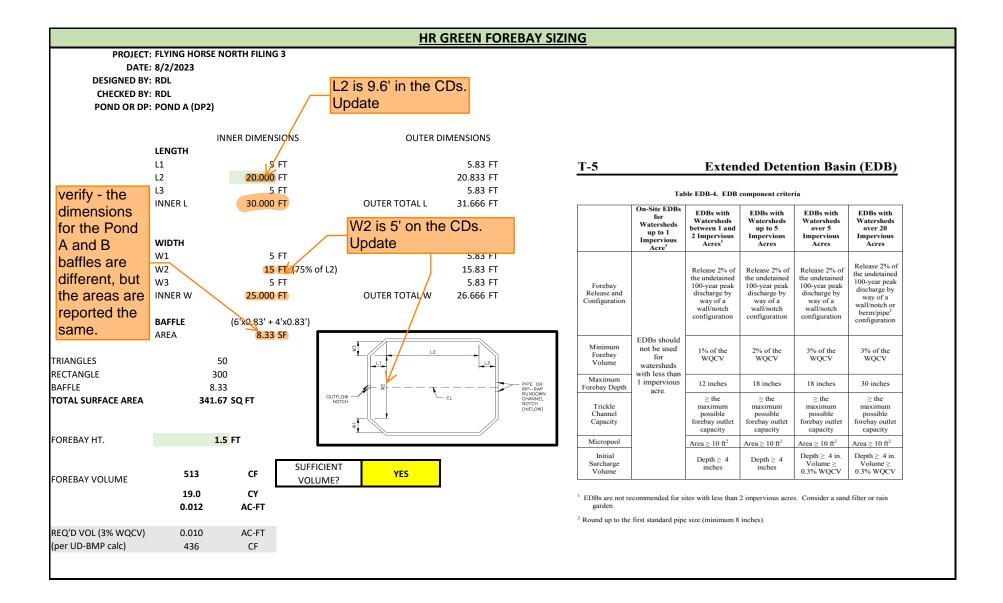
Design Procedure Form: Runoff Reduction															
	UD-BMP (Version 3.07, March 2018) Sheet 1 of 1														
Designer:															
Company:	HR GREEN												_		
Date: August 1, 2023								_							
Project:	FLYING HOR	SE NORTH FIL	ING NU	MBER :	3								_		
Location:	Location:														
SITE INFORMATION (Us	Please provide other calculations if runoff reduction is proposed that show that WQCV reduction is 100%														
(**		ainfall Depth	0.60	0 ii	nches is	prop	ose	d that	show	that W	QCV re	eduction	n is 100	%	
Depth of Average Ru	noff Producing	g Storm, d ₆ =	0.43	3 iı	nches (for	Watershe	ds Outsid	de of the D	enver Regio	n, Figure 3-1	IN USDCM V	ol. 3)			
															_
Area Type			_												4
Area ID Downstream Design Point ID	BS-25 DP21		┨ .	THIS	SHEE	T IS UI	NABLE	TO CO	NDUCT	SWMM (CALCULA	TIONS OI	F MORE T	'HAN	4
Downstream BMP Type	None		ع 🗕	30,00	0 SF ~	1.8 AC	RES.	BECAL	SE OF T	HIS, THE	MOST C	ONSERV	ATIVE MO	DDEL	┨
DCIA (ft²)			┨	APPLICABLE HAS BEEN SHOWN TO REPRESENT ALL BASINS THAT FLOW DIRECTLY OFF-SITE. THIS IS MEANT TO PROVE THAT NO WATER QUALITY AND											
UIA (ft²)	12,000														
RPA (ft²)	68,000		DETENTION IS REQUIRED FOR THESE BASINS DUE TO SUFFICIENT GRASS												
SPA (ft²)										FERS.				1]
HSG A (%)	0%		_]							-				[]
HSG B (%)	100%		4					AS	SUMPT	IONS MA	DE:			[1
HSG C/D (%)	0%		4.	ENT	TRETY	OF AF	REA AN					5 ACRE L	OTS AT 0	.11%	4
Average Slope of RPA (ft/ft)	0.330		- ENTIRETY OF AREA ANALYZED IS REPRESENTING 2.5 ACRE LOTS AT 0.11% IMPERVIOUS (12,000 SF UIA)												
UIA:RPA Interface Width (It)	UIA:RPA Interface Width (ft) 75.00 - AVERAGE SLOPE IS AT MAX ALLOWABLE GRADING SLOPE (33%)						J								
	- UIA-RPA INTERFACE WIDTH (75FT)														
CALCULATED RUNOFF	RESULTS										(-	,			
Area ID															
UIA:RPA Area (ft²)	80,000		- THE 12,000 SF OF UIA ROUGHLY TRANSLATES TO 15% IMPERVIOUS WHEN												
L / W Ratio	14.22		LOOKING AT A MAX AREA OF 80,000 SF.												
UIA / Area	0.1500		_	- AVERAGE SLOPE THROUGHOUT THE BASINS WILL NOT BE 33%											
Runoff (in)	0.00														
Runoff (ft ³) Runoff Reduction (ft ³)	Runoff (ft ³) 0 THE WQCV REDUCTION IS 100%. THIS MODEL APPLIES TO BASINS BS-25, BS-31,														
Runon Reduction (It*)	500		┨							, BS-33.				´ }	٦
CALCULATED WQCV RI	ESULTS									•					
Area ID															٦
WQCV (ft ³)	500														1
WQCV Reduction (ft ³)	500]
WQCV Reduction (%)	100%														4
Untreated WQCV (ft ³)	0														⅃
CALCULATED DESIGN I	OINT DESU	TS (sums ===	ulte f-	om all	columns	with the	ame Dev	wnetroom	Design Poli	at ID)					
Downstream Design Point ID	DP21	Lio (sullis re	ouns if	om all	Columns	with the s	same DOV	wiisu eaM	Design Foll	(טו זי					٦
DCIA (ft²)	0			-+		+						1			1
UIA (ft²)	12,000			$-\dagger$		1						1			1
RPA (ft²)	68,000														1
SPA (ft²)	0]
Total Area (ft²)	80,000			\Box		1									1
Total Impervious Area (ft²)	- ,														4
WQCV (ft ³)	500			\dashv		+				-		1			4
WQCV Reduction (ft ³) WQCV Reduction (%)	500 100%			-+											4
Untreated WQCV (ft ³)	0			-+		+						+			4
J 53.00 17 (11)		ı İ				1				1	1	1		1	_
CALCULATED SITE RES	SULTS (sums	results from	all colu	ımns in	workshe	et)									
Total Area (ft²)	80,000					-									
Total Impervious Area (ft²)	12,000														
WQCV (ft ³)	500														
WQCV Reduction (ft ³)	500														
WQCV Reduction (%)	100%														
Untreated WQCV (ft ³)	0	J													



El Paso County, Colorado

APPENDIX C

HYDRAULIC CALCULATIONS



HR GREEN FOREBAY SIZING

PROJECT: FLYING HORSE NORTH FILING 3

DATE: 8/2/2023 DESIGNED BY: RDL CHECKED BY: RDL

POND OR DP: POND B (DP17)

	INNER DIMENSIONS	OUTER DIMENSIONS
LENGTH		

L1	5 FT		5.83 FT
L2	28.500 FT		29.333 FT
L3	5 FT		5.83 FT
INNER L	38.500 FT	OUTER TOTAL L	40.166 FT

WIDTH

W1	5 FT		5.83 FT
W2	21.375 FT (75% of L2)		22.21 FT
W3	5 FT		5.83 FT
INNER W	31.375 FT	OUTER TOTAL W	33.041 FT

SUFFICIENT

VOLUME?

BAFFLE (6'x0.83' + 4'x0.83')

AREA 8.33 SF

 TRIANGLES
 50

 RECTANGLE
 609.1875

 BAFFLE
 8.33

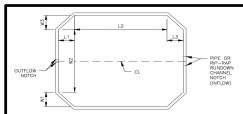
 TOTAL SURFACE AREA
 650.8575 SQ FT

FOREBAY HT. 1.5 FT

FOREBAY VOLUME 976.28625 CF

36.15875 CY 0.022412448 AC-FT

REQ'D VOL (3% WQCV) 0.022 AC-FT (per UD-BMP calc) 958.32 CF



YES

T-5

Extended Detention Basin (EDB)

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre ¹	EDBs with Watersheds between 1 and 2 Impervious Acres ¹	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration		Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe ² configuration
Minimum Forebay Volume	EDBs should not be used for watersheds	1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth	with less than 1 impervious acre.	12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity	ucit.	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity
Micropool		Area ≥ 10 ft ²			
Initial Surcharge Volume		Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

¹ EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

² Round up to the first standard pipe size (minimum 8 inches).

Rock Chute.xls Page 1 of 3

Rock Chute Design Data

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

County: El Paso County Project: Flying Horse North Fil. 3 Designer: HR Green (RDL) Checked by: RDL Date: 11/16/23

Date: November 16, 2023

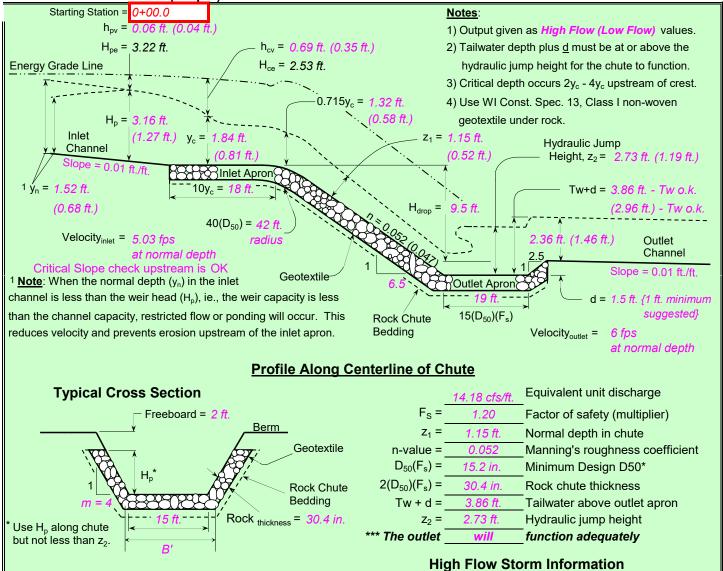
Input Geometry:

Upstream Channel Chute Downstream Channel Bw = 30.0 ft. Bw = 15.0 ft. Bw = 15.0 ft. Side slopes = 4.0 (m:1) Factor of safety = 1.20 (F_s) Side slopes = 4.0 (m:1) Side slopes = 4.0 (m:1) \rightarrow 2.0:1 max. Velocity n-value = 0.035 Velocity n-value = 0.035Bed slope = 0.0100 ft./ft. Bed slope (6.5:1) = 0.153 ft./ft \rightarrow 3.0:1 max. Bed slope = 0.0100 ft./ft. Note: n value = a) velocity n from waterway program Freeboard = 2.0 ft. or b) computed mannings n for channel Outlet apron depth, d = 1.5 ft. Base flow = 70.0 cfs

Design Storm Data (Table 2, FOTG, WI-NRCS Grade Stabilization Structure No. 410):

Note: The total required capacity is routed Apron elev. --- Inlet =7377.0 ft. ---- Outle ₹366.0 ft. --- (H_{drop} = through the chute (principal spillway) or Q_{high} = Runoff from design storm capacity from Table 2, FOTG Standard 410 in combination with an auxiliary spillway. Q_5 = Runofff from a 5-year, 24-hour storm. Input tailwater (Tw): $Q_{high} = 275.0$ cfs High flow storm through chute ➤ Tw (ft.) = Program $Q_5 = 70.0$ Low flow storm through chute ➤ Tw (ft.) = Program

Profile and Cross Section (Output):



Rock Chute Design - Plan Sheet

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

-	t: Flying Horse I r: HR Green (RI			County: El Paso County Checked by:	
	e: 11/16/2023	JL)		Date:	
<u>Minimum</u>	<u>Enter</u>				
Design Values	Plan Values	Rock Gradation	on Envelope	Quantitie	
15.2 _{in.} D ₅₀ dia. =	in.	<u>% Passing</u> <u>Diame</u>	ter, in. (weight, lbs.)	Rock = 0	yd ³
30.4 in. Rock _{chute} thicknes	s= in.	D ₁₀₀	0 - 0 (0 - 0)	Geotextile (WCS-13) $^b = 350$	0 yd ²
18 ft. Inlet apron length		D ₈₅	0 - 0 (0 - 0)	Bedding 6 in. = 62	yd ³
19 ft. Outlet apron lengt		D ₅₀	0 - 0 (0 - 0)	Excavation = 18	<mark>52</mark> yd ³
42 ft. Radius =	0 ft.	D ₁₀	0 - 0 (0 - 0)	Earthfill = 8	yd ³
Will bedding be use	d? Yes	Depth (in.) = 6.0		Seeding = 0.3	acres
from	the x-section belo	otextile quantities are de w (neglect radius). -woven) shall be overla		Degree of angularity =	1
		in. along sides and 24-i		1 50% angular, 50%	rounded
Upstream Channel	tation	Inlet apron	elev. = 7377 ft.	2 100 % rounded	
Slope = 0.02	1 ft./ft.	Inlet apron 4 Roo	k _{thickness} = 0 in.		
Rock Chu	te Radius =		Outlet a		
Stakeout Notes	Radius –	UIL.	/ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	7366.02 ft)	Downstream
Sta. Elev. (Pnt)		otextile —		7	Channel
0+00.0 7377 ft. (1)				Slo	ppe = 0.01 ft./ft.
0+00.0 7377 ft. (2) 0+00.0 7377 ft. (3)			72 ft. 6.54	Outlet apron d = 1.5	5 ff
0+00.0 7377 ft. (4)		-		2.5 d = 7.5	, n.
0+71.8 7366.02 ft. (5	5)	Profile Along Center	line of Rock Chute	** <u>Note</u> : The outlet wil	
0+71.8 7366.02 ft. (6	•			function adeq	uately
0+75.5 7367.52 ft. (7	·)				
Class I non-woven		Freeboard =	**************************************	*y = 3.16 ft. Ro	Geotextile
DOT Light riprap Gradatio	n		4 1,10	Bei	dding
Rock Chute Cost I	Estimate		4,-	7 Rock thickness	,= <i>in.</i>
Unit	Unit Cost	Cost	←	<u> </u>	throughout chute
Rock	\$10.00 /yd ³	\$0.00		but not le	ess than z ₂ .
Geotextile Bedding	\$12.00/yd ² \$12.00 /yd ³	\$4,200.00 \$744.00	Rock Ch	nute Cross Section	
Excavation		\$22,224.00	Profile, Cro	oss Sections, and Qua	entities
Earthfill	\$1.00 /yd ³	\$8.30			
Seeding	\$2.00 /ac.	\$0.50			
	Total	\$27,176.80			
	•			Date	File Name
	Flyi	ng Horse North Fil. 3		Designed HR Green (RDL) Drawn	Drawing Mama
Natural Resources Conservation Ser		El Paso County County	I		Drawing Name
United States Department of Agricult	ure		<u> </u>	Approved	Sheet of (

County: El Paso County

Rock Chute Design - Cut/Paste Plan

(Version WI-July-2010, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Flying Horse North Fil. 3

Designer: HR Green (R	DL)	Checked by:
Date: 11/16/2023	_	Date:
Design Values	Rock Gradation Envelope	Quantities ^a
D ₅₀ dia. = 0.0 in.	% Passing Diameter, in. (weight, lbs.)	$Rock = 0 yd^3$
Rock _{chute} thickness = 0.0 in.	D ₁₀₀ 0 - 0 (0 - 0)	Geotextile (WCS-13) ^b = 350 yd^2
Inlet apron length = 0 ft.	D ₈₅ 0 - 0 (0 - 0)	Bedding 6 in. = 62 yd ³
Outlet apron length = 0 ft.	D ₅₀ 0 - 0 (0 - 0)	Excavation = 1852 yd ³
Radius = 0 ft.	D ₁₀ 0 - 0 (0 - 0)	Earthfill = 8 yd³
Will bedding be used? Yes	Coefficient of Uniformity, $(D_{60})/(D_{10}) < 1.7$	Seeding = 0.3 acres
^b Geotextile and 24-in.	ding, and geotextile quantities are determined fit Class I (Non-woven) shall be overlapped and a minimum on the ends) quantity not included	nnchored (18-in. minimum along sides <u>d</u> .
Upstream ၌ Channel g	Inlet apron elev. = 7377 ft.	Point No. Description
Slope = 0.01 ft./ft.	Inlet apron Rock thickness = 0 in.	2 Point of curvature (PC)3 Point of intersection (PI)
	- 0 ft	4 Point of fine section (FT)
Sta. Elev. (Pnt) 0+00.0 7377 ft. (1) Radius = 0+00.0 7377 ft. (2) Ge 0+00.0 7377 ft. (3) Ge 0+00.0 7377 ft. (4) Ge 0+71.8 7366.02 ft. (5) Ge 0+75.5 7367.52 ft. (7)	/ / . 4) / k	Downstream Channel Slope = 0.01 ft./ft. Outlet apron Office
Notes: Rock gradation envelope can be met wi DOT Light riprap Gradation	Freeboard = 2 ft.	*y = 3.16 ft. *Berm Geotextile Rock Chute Bedding Rock thickness = in. *Use H _p throughout chute but not less than z ₂ .
	Profile, Cr	oss Sections, and Quantities
IN NRCS FIV	┃ ing Horse North Fil. 3	Designed HR Green (RDL)
Natural Resources Conservation Service		Drawing Name
United States Department of Agriculture	El Paso County County	Checked Sheet of
		Approved

Inlets Chapter 8

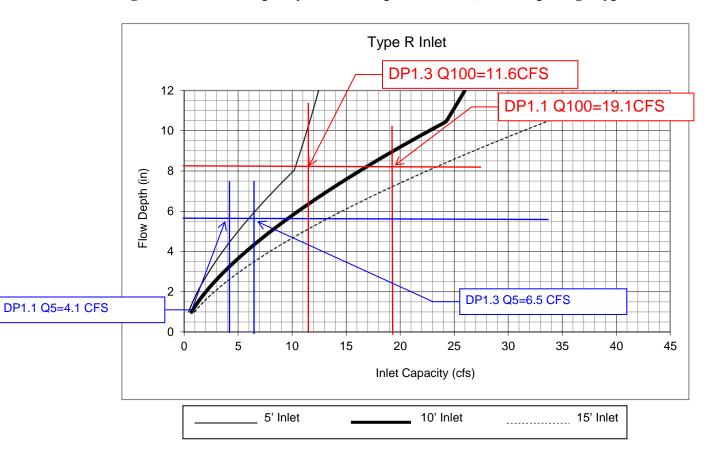


Figure 8-11. Inlet Capacity Chart Sump Conditions, Curb Opening (Type R) Inlet

DP1.1: Q5 = 4.1 CFS Q100 = 19.1 CFS INLET SIZE: 15' TYPE R SUMP INLET

DP1.3: Q5 = 6.5 CFS Q100 = 11.6 CFS INLET SIZE: 10' TYPE R SUMP INLET

Notes:

1. The standard inlet parameters must apply to use this chart.

MHFD-Inlet, Version 5.02 (August 2022) **INLET MANAGEMENT**

Worksheet Protected

Minor Total Design Peak Flow, Q (cfs)

Major Total Design Peak Flow, Q (cfs)

Minor Flow Bypassed Downstream, Q_b (cfs) Major Flow Bypassed Downstream, Q_b (cfs)

URBAN STREET On Grade Type R Curb Opening 4.5 12.4 t be organized from upstrea //pass Flow Received 0.0 0.0	URBAN STREET On Grade CDOT Type R Curb Opening 4.1 19.1 am (left) to downstream (right) in order f No Bypass Flow Received 0.0 0.0	URBAN STREET On Grade CDOT Type R Curb Opening 8.5 19.5 or bypass flows to be linked. No Bypass Flow Received 0.0 0.0
On Grade Type R Curb Opening 4.5 12.4 t be organized from upstrea //pass Flow Received 0.0	On Grade CDOT Type R Curb Opening 4.1 19.1 am (left) to downstream (right) in order f No Bypass Flow Received 0.0	On Grade CDOT Type R Curb Opening 8.5 19.5 or bypass flows to be linked. No Bypass Flow Received 0.0
4.5 12.4 st be organized from upstrea //pass Flow Received 0.0	4.1 19.1 am (left) to downstream (right) in order f No Bypass Flow Received 0.0	8.5 19.5 or bypass flows to be linked. No Bypass Flow Received 0.0
4.5 12.4 st be organized from upstrea /pass Flow Received 0.0	4.1 19.1 am (left) to downstream (right) in order f No Bypass Flow Received 0.0	8.5 19.5 for bypass flows to be linked. No Bypass Flow Received 0.0
t be organized from upstrea pass Flow Received 0.0	19.1 am (left) to downstream (right) in order f No Bypass Flow Received 0.0	19.5 or bypass flows to be linked. No Bypass Flow Received 0.0
t be organized from upstrea pass Flow Received 0.0	19.1 am (left) to downstream (right) in order f No Bypass Flow Received 0.0	19.5 or bypass flows to be linked. No Bypass Flow Received 0.0
t be organized from upstrea pass Flow Received 0.0	19.1 am (left) to downstream (right) in order f No Bypass Flow Received 0.0	19.5 or bypass flows to be linked. No Bypass Flow Received 0.0
ot be organized from upstrea pass Flow Received 0.0	am (left) to downstream (right) in order f No Bypass Flow Received 0.0	or bypass flows to be linked. No Bypass Flow Received 0.0
pass Flow Received 0.0	No Bypass Flow Received 0.0	No Bypass Flow Received 0.0
0.0	0.0	0.0
0.0	0.0	0.0
0.0	0.0	0.0

4.1

19.1

1.5

14.2

4.5

12.4

0.1

4.4

8.5

19.5

0.4

6.0

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	<u>DP1.3</u>
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	On Grade
Inlet Type	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows	
Minor Q _{Known} (cfs)	6.5
Major Q _{Known} (cfs)	11.6

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received
Minor Bypass Flow Received, Q _b (cfs)	0.0
Major Bypass Flow Received, Q _b (cfs)	0.0

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

Minor Storm Rainfall Input

Design Storm Return Period	d, T _r (years)	
One-Hour Precipitation, P ₁	(inches)	

Major Storm Rainfall Input

Design Storm Return Period, T _r (years)	
One-Hour Precipitation, P ₁ (inches)	

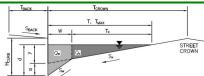
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	6.5	
Major Total Design Peak Flow, Q (cfs)	11.6	
Minor Flow Bypassed Downstream, Q _b (cfs)	1.0	
Major Flow Bypassed Downstream, Q _b (cfs)	4.1	

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

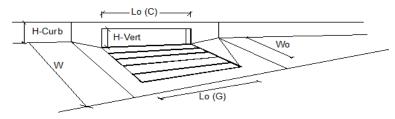
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Inlet ID: DP1



Gutter Geometry: Maximum Allowable Width for Spread Behind Curb T_{BACK} : 9.0 Side Slope Behind Curb (leave blank for no conveyance credit behind curb) 0.020 ft/ft S_{BACK} Manning's Roughness Behind Curb (typically between 0.012 and 0.020) 0.020 Height of Curb at Gutter Flow Line $\mathsf{H}_{\mathsf{CURB}}$ 6.00 nches Distance from Curb Face to Street Crown T_{CROWN} : 17.0 Gutter Width 2.50 Street Transverse Slope S_X = 0.020 ft/ft Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) S_{W} ft/ft 0.083 Street Longitudinal Slope - Enter 0 for sump condition S_0 0.010 ft/ft Manning's Roughness for Street Section (typically between 0.012 and 0.020) n_{STREET} Minor Storm Major Storm Max. Allowable Spread for Minor & Major Storm 17.0 17.0 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm 5.6 8.2 Allow Flow Depth at Street Crown (check box for yes, leave blank for no) MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion Minor Storm Major St

INLET ON A CONTINUOUS GRADE MHFD-Inlet, Version 5.02 (August 2022)



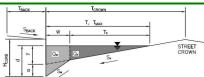
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R	Curb Opening	
Local Depression (additional to continuous gutter depression 'a')	a _{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L _o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o =$	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_f(G) =$	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_f(C) =$	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'	_	MINOR	MAJOR	_
Total Inlet Interception Capacity	Q =	4.4	8.0	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b =$	0.1	4.4	cfs
Capture Percentage = Q _a /Q _o	C% =	97	64	%

1

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Inlet ID: DP1.1

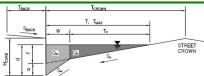


Gutter Geometry: Maximum Allowable Width for Spread Behind Curb T_{BACK} : 9.0 Side Slope Behind Curb (leave blank for no conveyance credit behind curb) 0.020 ft/ft S_{BACK} Manning's Roughness Behind Curb (typically between 0.012 and 0.020) 0.020 Height of Curb at Gutter Flow Line $\mathsf{H}_{\mathsf{CURB}}$ 6.00 nches Distance from Curb Face to Street Crown T_{CROWN} : 17.0 Gutter Width 2.00 Street Transverse Slope S_X = 0.020 ft/ft Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) S_{W} ft/ft 0.083 Street Longitudinal Slope - Enter 0 for sump condition S_0 0.010 ft/ft Manning's Roughness for Street Section (typically between 0.012 and 0.020) n_{STREET} Minor Storm Major Storm Max. Allowable Spread for Minor & Major Storm 17.0 17.0 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm 5.6 8.2 Allow Flow Depth at Street Crown (check box for yes, leave blank for no) MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.10 cfs on sheet 'Inlet Management' Major storm max. allowable capacity GOOD - greater than the design peak flow of 19.10 cfs on sheet 'Inlet Management'

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

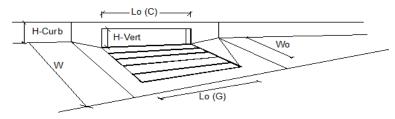
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Inlet ID: DP1.2



Gutter Geometry: Maximum Allowable Width for Spread Behind Curb T_{BACK} : 9.0 Side Slope Behind Curb (leave blank for no conveyance credit behind curb) 0.020 ft/ft S_{BACK} Manning's Roughness Behind Curb (typically between 0.012 and 0.020) 0.020 Height of Curb at Gutter Flow Line $\mathsf{H}_{\mathsf{CURB}}$ 6.00 nches Distance from Curb Face to Street Crown T_{CROWN} : 17.0 Gutter Width 2.00 Street Transverse Slope S_X = 0.020 ft/ft Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) S_{W} ft/ft 0.083 Street Longitudinal Slope - Enter 0 for sump condition S_0 0.010 ft/ft Manning's Roughness for Street Section (typically between 0.012 and 0.020) n_{STREET} Minor Storm Major Storm Max. Allowable Spread for Minor & Major Storm 17.0 17.0 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm 5.6 8.2 Allow Flow Depth at Street Crown (check box for yes, leave blank for no) MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion Minor storm max. allowable capacity GOOD - greater than the design peak flow of 8.50 cfs on sheet 'Inlet Management' Major storm max. allowable capacity GOOD - greater than the design peak flow of 19.50 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE MHFD-Inlet, Version 5.02 (August 2022)



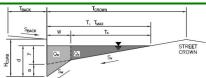
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R	Curb Opening	
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} =$	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L _o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o =$	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_f(G) =$	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_f(C) =$	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	_
Total Inlet Interception Capacity	Q =	8.1	13.5	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = $	0.4	6.0	cfs
Capture Percentage = Q _a /Q _o	C% =	96	69	%

1

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

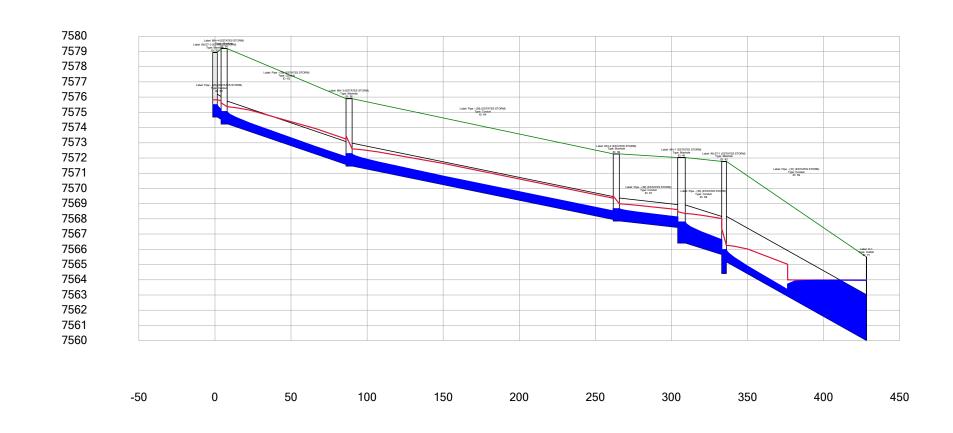
Project: Inlet ID: DP1.3



Gutter Geometry: Maximum Allowable Width for Spread Behind Curb T_{BACK} : 9.0 Side Slope Behind Curb (leave blank for no conveyance credit behind curb) 0.020 ft/ft S_{BACK} Manning's Roughness Behind Curb (typically between 0.012 and 0.020) 0.020 Height of Curb at Gutter Flow Line $\mathsf{H}_{\mathsf{CURB}}$ 6.00 nches Distance from Curb Face to Street Crown T_{CROWN} : 17.0 Gutter Width 2.00 Street Transverse Slope S_X = 0.020 ft/ft Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) S_{W} ft/ft 0.083 Street Longitudinal Slope - Enter 0 for sump condition S_0 0.010 ft/ft Manning's Roughness for Street Section (typically between 0.012 and 0.020) n_{STREET} Minor Storm Major Storm Max. Allowable Spread for Minor & Major Storm 17.0 17.0 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm 5.6 8.2 Allow Flow Depth at Street Crown (check box for yes, leave blank for no) MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion Major Storm Mallowable Capacity is based on Depth Criterion Minor storm max. allowable capacity GOOD - greater than the design peak flow of 6.50 cfs on sheet 'Inlet Management' Major storm max. allowable capacity GOOD - greater than the design peak flow of 11.60 cfs on sheet 'Inlet Management'

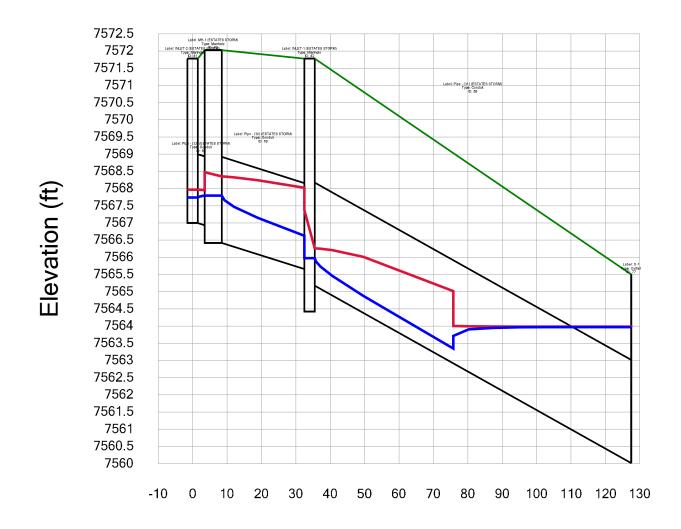
	5-YEAR SCENARIO										
		Length			Slope	Invert	Invert	Hydraulic Grade	Hydraulic Grade	Elevation	Elevation
		(Unified)	Flow	Velocity	(Calculated)	(Start)	(Stop)	Line (In)	Line (Out)	Ground (Start)	Ground (Stop)
Label	Notes	(ft)	(cfs)	(ft/s)	(ft/ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
INLET-3	10' TYPE-R INLET							7575.5	7575.5		
Pipe - (25)	18" RCP	6	4.4	7.94	0.025	7574.7	7574.55	7575.5	7575.19	7578.94	7579.19
MH-4	SDMH							7575.05	7575.05		
Pipe - (26)	18" RCP	82.1	4.4	8.73	0.032	7574.2	7571.58	7575.05	7572.07	7579.19	7575.9
MH-3	SDMH							7572.28	7572.28		
Pipe - (28)	18" RCP	175.7	4.4	7.32	0.02	7571.5	7567.96	7572.28	7568.52	7575.9	7572.27
MH-2	SDMH							7568.67	7568.67		
Pipe - (29)	18" RCP	42.8	4.4	5.68	0.01	7567.9	7567.44	7568.67	7568.12	7572.27	7572.03
INLET-4	15' TYPE-R INLET							7569.9	7569.9		
Pipe - (33)	24" RCP	6	8.1	8.49	0.02	7568.9	7568.77	7569.9	7569.61	7573.66	7573.91
MH-5	SDMH							7569.48	7569.48		
Pipe - (34)	24" RCP	153.1	8.1	6.6	0.01	7568.5	7566.94	7569.48	7567.76	7573.91	7572.03
INLET-2	15' TYPE-R INLET							7567.74	7567.74		
MH-1	SDMH							7567.8	7567.8		
Pipe - (30)	30" RCP	28	16.6	11.39	0.027	7566.4	7565.66	7567.8	7566.63	7572.03	7571.78
Pipe - (32)	24" RCP	6	4.1	5.47	-0.01	7566.9	7567	7567.74	7567.8	7572.03	7571.78
INLET-1	10' TYPE-R INLET							7565.98	7565.98		
Pipe - (31)	36" RCP	85.0	6.5	10.93	0.055	7565.2	7560.02	7565.98	7563.97	7571.78	7565.5
0-1	Null Structure										

Profile - 1 - Estates Storm-5YR

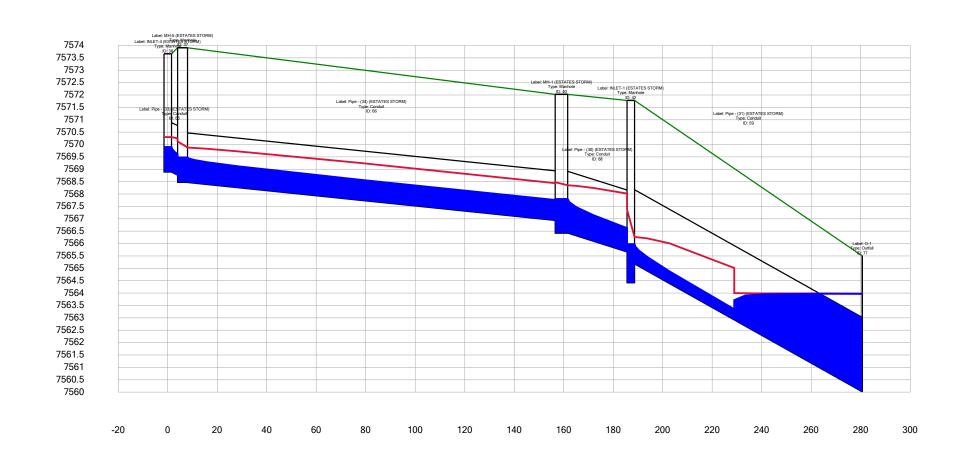


Profile Report
Profile: Profile - 2

Profile - 2 - Estates Storm-5YR

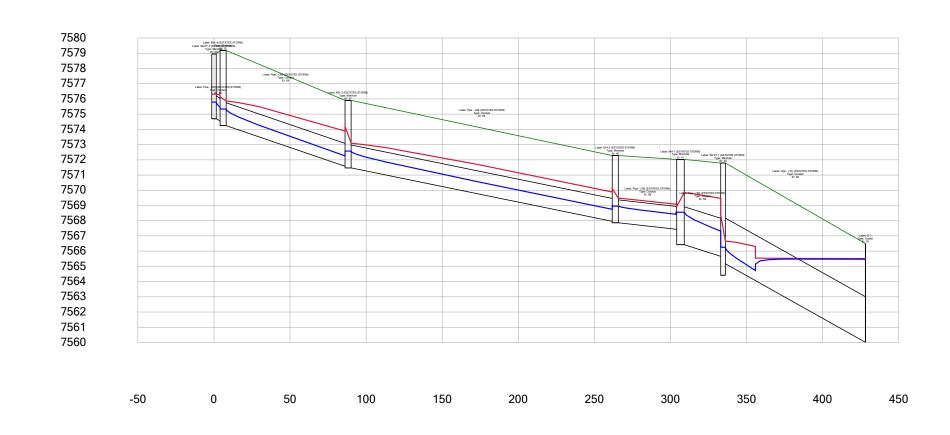


Profile - 3 - Estates Storm-5YR

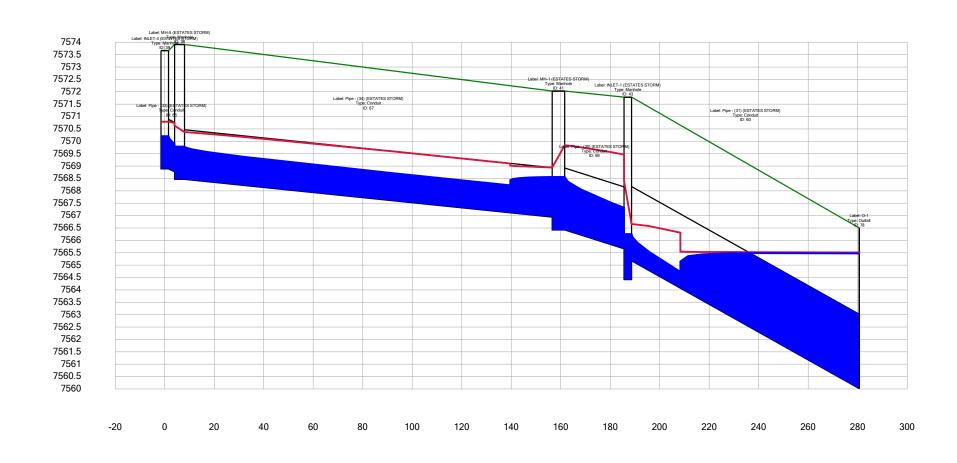


	100-YEAR SCENARIO										
		Length			Slope	Invert	Invert	Hydraulic Grade	Hydraulic Grade	Elevation	Elevation
		(Unified)	Flow	Velocity	(Calculated)	(Start)	(Stop)	Line (In)	Line (Out)	Ground (Start)	Ground (Stop)
Label	Notes	(ft)	(cfs)	(ft/s)	(ft/ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
INLET-4	15' TYPE-R INLET							7570.21	7570.21		
Pipe - (33)	24" RCP	6	13.5	9.75	0.02	7568.9	7568.8	7570.21	7569.89	7573.66	7573.91
MH-5	SDMH							7569.79	7569.79		
Pipe - (34)	24" RCP	153.1	13.5	7.52	0.01	7568.5	7566.9	7569.79	7568.56	7573.91	7572.03
INLET-3	10' TYPE-R INLET							7575.79	7575.79		
Pipe - (25)	18" RCP	6	8	9.31	0.025	7574.7	7574.6	7575.79	7575.45	7578.94	7579.19
MH-4	SDMH							7575.34	7575.34		
Pipe - (26)	18" RCP	82.1	8	10.26	0.032	7574.2	7571.6	7575.34	7572.26	7579.19	7575.9
MH-3	SDMH							7572.57	7572.57		
Pipe - (28)	18" RCP	175.7	8	8.56	0.02	7571.5	7568	7572.57	7568.75	7575.9	7572.27
MH-2	SDMH							7568.96	7568.96		
Pipe - (29)	18" RCP	42.8	8	6.54	0.01	7567.9	7567.4	7568.96	7568.56	7572.27	7572.03
INLET-2	15' TYPE-R INLET							7568.57	7568.57		
MH-1	SDMH							7568.56	7568.56		
Pipe - (30)	30" RCP	28	40.6	14.39	0.027	7566.4	7565.7	7568.56	7567.32	7572.03	7571.78
Pipe - (32)	24" RCP	6	19.1	8.07	-0.01	7566.9	7567	7568.57	7568.56	7572.03	7571.78
INLET-1	10' TYPE-R INLET							7566.26	7566.26		
Pipe - (31)	36" RCP	85.0	11.6	12.98	0.055	7565.2	7560	7566.26	7565.47	7571.78	7566.5
0-1	Null Structure										

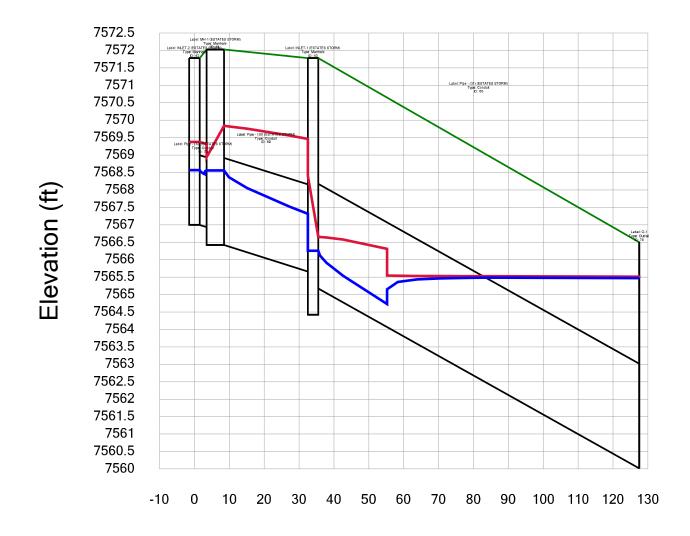
Profile - 1 - Estates Storm 100-YR



Profile - 2 - Estates Storm 100-YR



Profile Report
Profile: Profile - 3
Profile - 3 - Estates Storm 100-YR



Riprap Sizing - DP4 OUTLET							
q (cfs/ft)	S (ft/ft)	C_f	n	D ₅₀ min. (in)			
2.86	0.15	2	0	7.26			

Type L Riprap ($D_{50} = 9$ ") will be utilized for the outlet protection.

Riprap Sizing - DP12 OUTLET							
q (cfs/ft) S (ft/ft) C_f n D_{50} min. (in)							
3.58	0.07	2	0	5.94			

Type VL Riprap ($D_{50} = 6$ ") will be utilized for the outlet protection.

Riprap Sizing - DP11 OUTLET								
q (cfs/ft)	S (ft/ft)	C_f	n	D ₅₀ min. (in)				
1.08	0.15	2	0	4.21				

Type VL Riprap (D_{50} = 6") will be utilized for the outlet protection.

Riprap Sizing - DP13 OUTLET					
q (cfs/ft)	S (ft/ft)	C_f	n	D ₅₀ min. (in)	
4.10	0.15	2	0	8.89	

Type L Riprap (D_{50} = 9") will be utilized for the outlet protection.

 $D_{50} = 5.23 \ S^{0.43} \ (1.35 \, C_f \, q)^{0.56}$

median rock size (in)longitudinal slope (ft/ft) D_{50}

S= concentration factor (1.0 to 3.0)

= unit discharge (cfs/ft)

When:

 η (porosity) = 0.0 (i.e., for buried soil riprap)

Equation 13-9

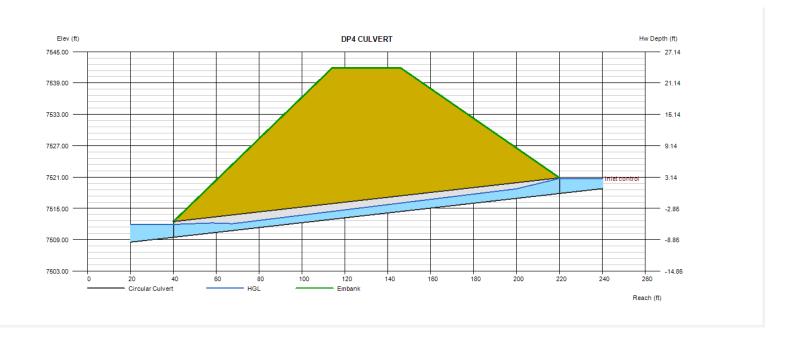
Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Jul 24 2023

DP4 CULVERT

Invert Elev Dn (ft)	= 7509.48	Calculations	
Pipe Length (ft)	= 180.00	Qmin (cfs)	= 8.50
Slope (%)	= 4.66	Qmax (cfs)	= 34.30
Invert Elev Up (ft)	= 7517.86	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 36.0		
Shape	= Circular	Highlighted	
Span (in)	= 36.0	Qtotal (cfs)	= 34.30
No. Barrels	= 1	Qpipe (cfs)	= 34.30
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	Circular Concrete	Veloc Dn (ft/s)	= 5.55
Culvert Entrance	Square edge w/headwall (C)	Veloc Up (ft/s)	= 7.26
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7511.93
		HGL Up (ft)	= 7519.76
Embankment		Hw Elev (ft)	= 7520.74
Top Elevation (ft)	= 7541.88	Hw/D (ft)	= 0.96
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 100.00		



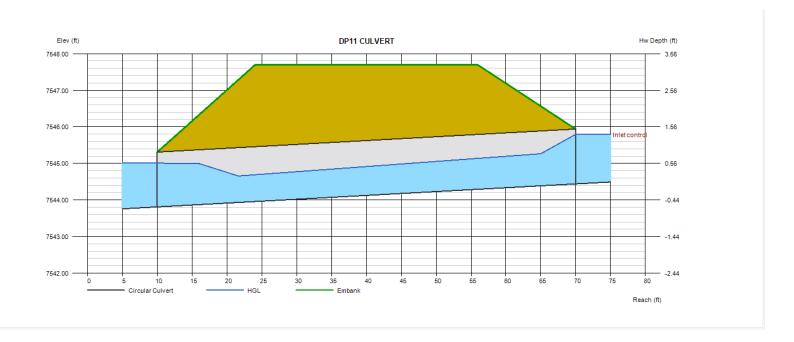
Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Jul 27 2023

DP11 CULVERT

Invert Elev Dn (ft)	= 7543.81	Calculations	
Pipe Length (ft)	= 60.00	Qmin (cfs)	= 3.00
Slope (%)	= 1.05	Qmax (cfs)	= 5.40
Invert Elev Up (ft)	= 7544.44	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 18.0		
Shape	= Circular	Highlighted	
Span (in)	= 18.0	Qtotal (cfs)	= 5.40
No. Barrels	= 1	Qpipe (cfs)	= 5.40
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	Circular Concrete	Veloc Dn (ft/s)	= 3.57
Culvert Entrance	Square edge w/headwall (C)	Veloc Up (ft/s)	= 4.91
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7545.01
		HGL Up (ft)	= 7545.33
Embankment		Hw Elev (ft)	= 7545.79
Top Elevation (ft)	= 7547.69	Hw/D (ft)	= 0.90
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 100.00		



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

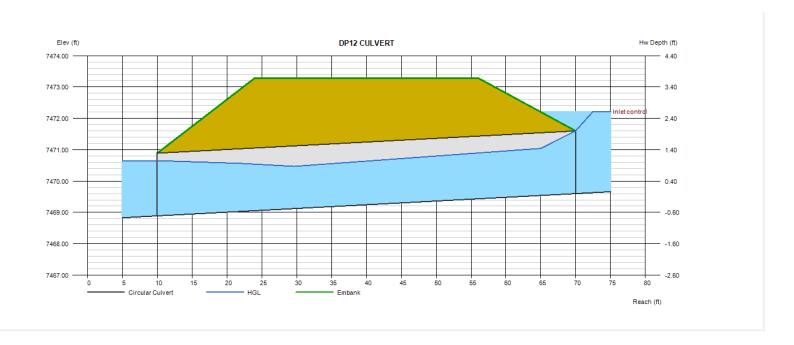
= 100.00

Thursday, Jul 27 2023

DP12 CULVERT

Crest Width (ft)

Invert Elev Dn (ft) Pipe Length (ft) Slope (%) Invert Elev Up (ft) Rise (in)	= 7468.89 = 60.00 = 1.18 = 7469.60 = 24.0	Calculations Qmin (cfs) Qmax (cfs) Tailwater Elev (ft)	= 5.90 = 17.90 = (dc+D)/2
Shape [′]	= Circular	Highlighted	
Span (in)	= 24.0	Qtotal (cfs)	= 17.90
No. Barrels	= 1	Qpipe (cfs)	= 17.90
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	Circular Concrete	Veloc Dn (ft/s)	= 6.11
Culvert Entrance	Square edge w/headwall (C)	Veloc Up (ft/s)	= 6.97
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7470.65
		HGL Up (ft)	= 7471.12
Embankment		Hw Elev (ft)	= 7472.22
Top Elevation (ft)	= 7473.29	Hw/D (ft)	= 1.31
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
· · · · · · · · · · · · · · · ·		-	

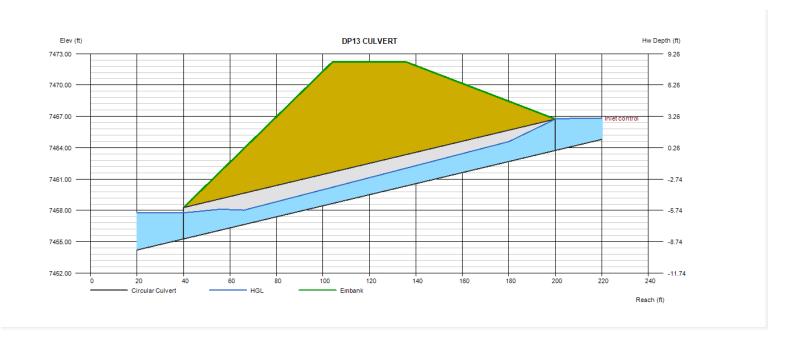


Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Jul 24 2023

DP13 CULVERT

Invert Elev Dn (ft) Pipe Length (ft) Slope (%) Invert Elev Up (ft)	= 7455.27 = 160.00 = 5.29 = 7463.74	Calculations Qmin (cfs) Qmax (cfs) Tailwater Elev (ft)	= 9.00 = 41.00 = (dc+D)/2
Rise (in) Shape Shape (in)	= 36.0 = Circular = 36.0	Highlighted	- 27.00
Span (in) No. Barrels n-Value	= 36.0 = 1 = 0.012	Qtotal (cfs) Qpipe (cfs)	= 37.80 = 37.80
Culvert Type Culvert Entrance	= 0.012= Circular Concrete= Square edge w/headwall (C)	Qovertop (cfs) Veloc Dn (ft/s) Veloc Up (ft/s)	= 0.00 = 6.01 = 7.56
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft) HGL Up (ft)	= 7.50 = 7457.77 = 7465.74
Embankment		Hw Elev (ft)	= 7466.83
Top Elevation (ft) Top Width (ft) Crest Width (ft)	= 7472.19 = 32.00 = 100.00	Hw/D (ft) / Flow Regime	= 1.03 = Inlet Control



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

= 32.00

= 50.00

Wednesday, Aug 2 2023

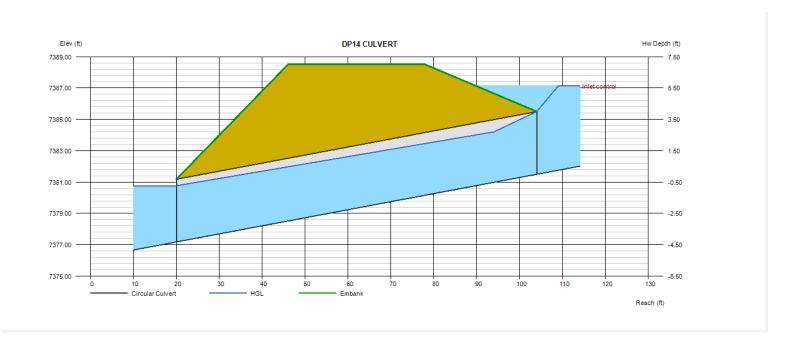
= Inlet Control

DP14 CULVERT

Top Width (ft)

Crest Width (ft)

Invert Elev Dn (ft) Pipe Length (ft) Slope (%) Invert Elev Up (ft) Rise (in)	= 7377.18 = 84.00 = 5.14 = 7381.50 = 48.0	Calculations Qmin (cfs) Qmax (cfs) Tailwater Elev (ft)	= 20.00 = 114.00 = (dc+D)/2
Shape	= Circular	Highlighted	
Span (in)	= 48.0	Qtotal (cfs)	= 110.00
No. Barrels	= 1	Qpipe (cfs)	= 110.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 9.26
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 10.31
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7380.76
		HGL Up (ft)	= 7384.67
Embankment		Hw Elev (ft)	= 7387.13
Top Elevation (ft)	= 7388.50	Hw/D (ft)	= 1.41



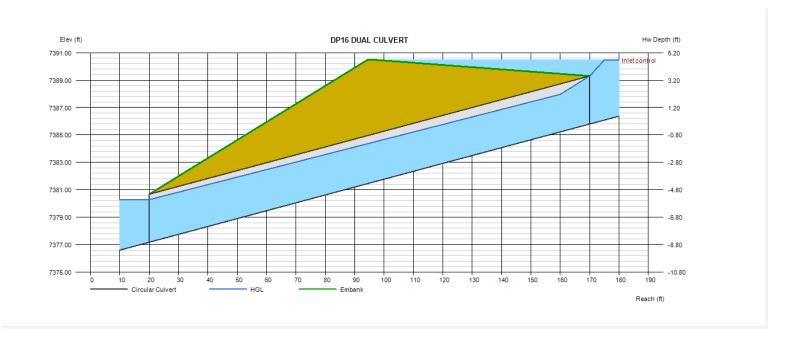
Flow Regime

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Aug 2 2023

DP16 DUAL CULVERT

Invert Elev Dn (ft)	= 7377.18	Calculations	
Pipe Length (ft)	= 150.00	Qmin (cfs)	= 20.00
Slope (%)	= 5.75	Qmax (cfs)	= 159.00
Invert Èlev Up (ft)	= 7385.80	Tailwater Élev (ft)	= (dc+D)/2
Rise (in)	= 42.0	()	,
Shape	= Circular	Highlighted	
Span (in)	= 42.0	Qtotal (cfs)	= 150.00
No. Barrels	= 2	Qpipe (cfs)	= 150.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	Circular Concrete	Veloc Dn (ft/s)	= 8.31
Culvert Entrance	Square edge w/headwall (C)	Veloc Up (ft/s)	= 9.39
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7380.29
		HGL Up (ft)	= 7388.51
Embankment		Hw Elev (ft)	= 7390.46
Top Elevation (ft)	= 7390.50	Hw/D (ft)	= 1.33
Top Width (ft)	= 1.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 50.00		



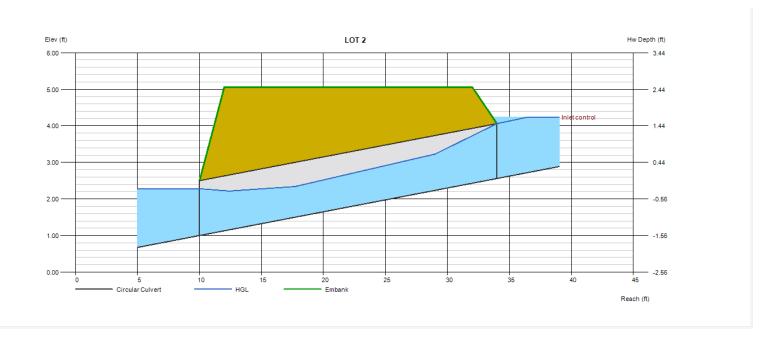
DRIVEWAY CULVERT SIZING CALCULATIONS				
LOT	100-YR FLOW	CULVERT SIZE	ANTICIPATED DRIVEWAY LOCATION	NOTES
NUMBER	CFS	INCH	(24' MAX WIDTH)	(SEE APPENDIX FOR NON-STD. DRIVEWAY CULVERT CALCS)
2	15	Dual 18	EAST OF LOT	See appendix for calculations
3	12	18	NORTH EAST OF LOT	
4	3.1	18	EAST SIDE OF LOT	
5	3.1	18	NORTH PART OF KNUCKLE	
6	3.1	18	EAST SIDE OF KNUCKLE	
7	3.1	18	SOUTH EAST SIDE OF KNUCKLE	
8	6	18	NORTH SIDE OF LOT	
9	10	18	SOUTH SIDE OF LOT	
10	8	18	WEST STREET NORTH SIDE OF LOT	
11	20.4	Dual 18	CENTER OF LOT	See appendix for calculations
12	20.4	Dual 18	EAST SIDE OF LOT	See appendix for calculations
13	20.4		WEST SIDE OF LOT	See appendix for calculations
14	20.4		EAST SIDE OF LOT	See appendix for calculations
15	93.8		CENTER/WEST OF LOT	See appendix for calculations
16	110		CENTER OF LOT	See appendix for calculations
17	130		CENTER/EAST OF LOT	See appendix for calculations
18	157.3		SOUTH EAST PART OF C.D.S. BULB	See appendix for calculations
19	10		WEST END OF C.D.S. BULB	Cumulative flows to DP14 will be diverted before lot
20	10		NORTH SIDE OF C.D.S. BULB	Cumulative flows to DP14 will be diverted before lot
21	114		EAST SIDE OF LOT	See appendix for calculations
22	90		EAST SIDE OF LOT	See appendix for calculations
23	32.9		EAST SIDE OF LOT	See appendix for calculations
23	32.9		SOUTHERN STREET WEST SIDE	See appendix for calculations
			NORTH SIDE OF LOT	see appendix for calculations
25	4.5			
26 27	3.1		WEST SIDE OF LOT CENTER OF LOT	
	8 10		CENTER OF LOT	
28				
29	15		CENTER OF LOT	
30	19.6		CENTER/EAST SIDE OF LOT	
31	10		EAST SIDE HIGH POINT	
32	7		SOUTHERN STREET WEST SIDE	
33	1.5		CENTER SOUTH OF LOT	
34	4.1		CENTER OF LOT	
35	14.2		END OF C.D.S. BULB	
36	10.1		EAST SIDE OF C.D.S. BULB	
37	8		SOUTH SIDE OF LOT	
38	6		CENTER OF LOT	
39	6		NORTH SIDE OF LOT	
40	5.4		WEST STREET SOUTH SIDE	
41	5.4		CENTER/WEST OF LOT	
42	5.4		CENTER OF LOT	
43	16		CENTER OF LOT	
44	14		CENTER/EAST OF LOT	
45	10	18	CENTER OF LOT	
46	8	18	CENTER/EAST OF LOT	
47	5	18	CENTER OF LOT	
48	N/A		CENTER OF LOT	
	N/A		CENTER OF LOT	
50	N/A		CENTER OF LOT	

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Jul 24 2023

LOT 2

Invert Elev Dn (ft)	= 1.00	Calculations	
Pipe Length (ft)	= 24.00	Qmin (cfs)	= 1.00
Slope (%)	= 6.50	Qmax (cfs)	= 15.00
Invert Elev Up (ft)	= 2.56	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 18.0		
Shape	= Circular	Highlighted	
Span (in)	= 18.0	Qtotal (cfs)	= 15.00
No. Barrels	= 2	Qpipe (cfs)	= 15.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	Circular Concrete	Veloc Dn (ft/s)	= 4.67
Culvert Entrance	Square edge w/headwall (C)	Veloc Up (ft/s)	= 5.62
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 2.28
		HGL Up (ft)	= 3.62
Embankment		Hw Elev (ft)	= 4.24
Top Elevation (ft)	= 5.06	Hw/D (ft)	= 1.12
Top Width (ft)	= 20.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		

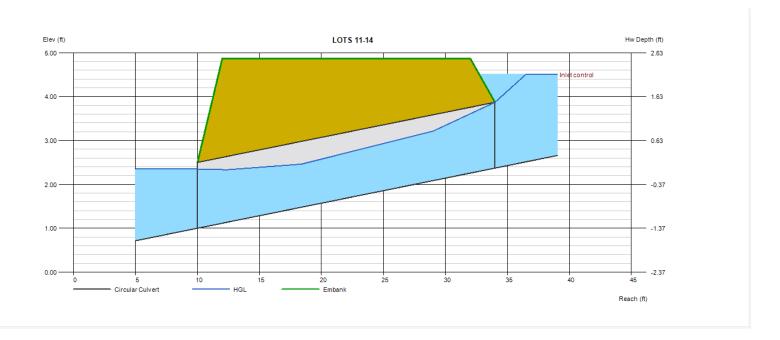


Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Jul 24 2023

LOTS 11-14

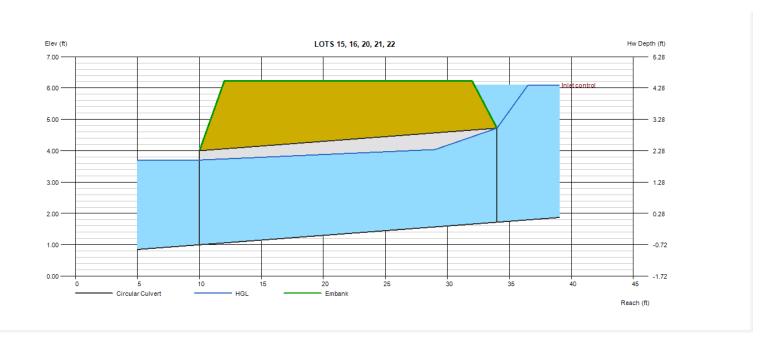
Invert Elev Dn (ft)	= 1.00	Calculations	
Pipe Length (ft)	= 24.00	Qmin (cfs)	= 1.00
Slope (%)	= 5.71	Qmax (cfs)	= 20.40
Invert Elev Up (ft)	= 2.37	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 18.0		
Shape	= Circular	Highlighted	
Span (in)	= 18.0	Qtotal (cfs)	= 19.20
No. Barrels	= 2	Qpipe (cfs)	= 19.20
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	Circular Concrete	Veloc Dn (ft/s)	= 5.74
Culvert Entrance	Square edge w/headwall (C)	Veloc Up (ft/s)	= 6.36
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 2.35
		HGL Up (ft)	= 3.57
Embankment		Hw Elev (ft)	= 4.51
Top Elevation (ft)	= 4.87	Hw/D (ft)	= 1.42
Top Width (ft)	= 20.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		



Monday, Jul 24 2023

LOTS 15, 16, 20, 21, 22

Invert Elev Dn (ft)	= 1.00	Calculations	
Pipe Length (ft)	= 24.00	Qmin (cfs)	= 20.00
Slope (%)	= 3.00	Qmax (cfs)	= 114.00
Invert Elev Up (ft)	= 1.72	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 36.0	, ,	, ,
Shape	= Circular	Highlighted	
Span (in)	= 36.0	Qtotal (cfs)	= 110.00
No. Barrels	= 2	Qpipe (cfs)	= 110.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 8.20
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 9.05
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 3.70
		HGL Up (ft)	= 4.12
Embankment		Hw Elev (ft)	= 6.09
Top Elevation (ft)	= 6.22	Hw/D (ft)	= 1.46
Top Width (ft)	= 20.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00	-	

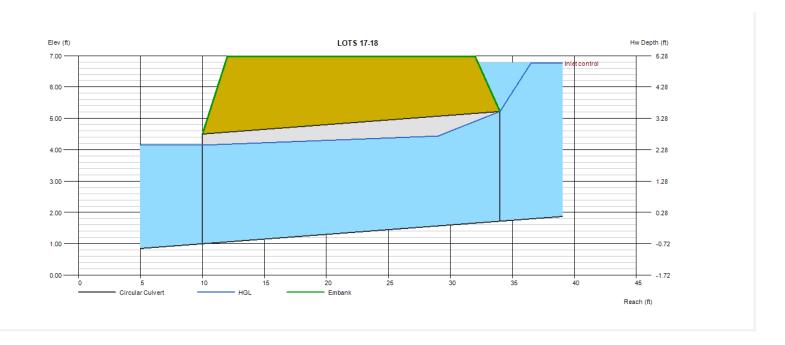


Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Jul 24 2023

LOTS 17-18

Invert Elev Dn (ft)	= 1.00	Calculations	
Pipe Length (ft)	= 24.00	Qmin (cfs)	= 20.00
Slope (%)	= 3.00	Qmax (cfs)	= 160.00
Invert Elev Up (ft)	= 1.72	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 42.0		
Shape	= Circular	Highlighted	
Span (in)	= 42.0	Qtotal (cfs)	= 160.00
No. Barrels	= 2	Qpipe (cfs)	= 160.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 8.78
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 9.72
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 4.15
		HGL Up (ft)	= 4.51
Embankment		Hw Elev (ft)	= 6.76
Top Elevation (ft)	= 6.97	Hw/D (ft)	= 1.44
Top Width (ft)	= 20.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		

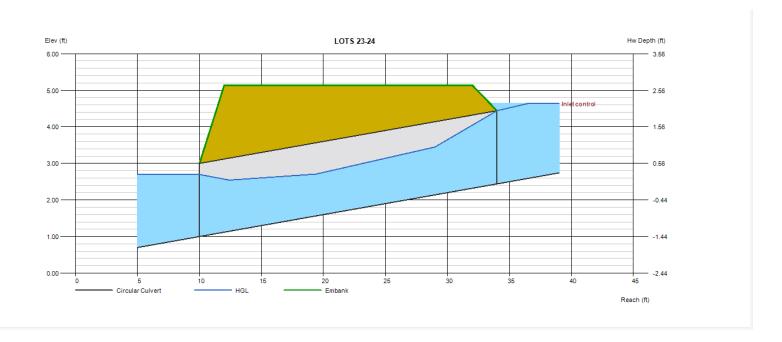


Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Jul 24 2023

LOTS 23-24

Invert Elev Dn (ft)	= 1.00	Calculations	
Pipe Length (ft)	= 24.00	Qmin (cfs)	= 5.00
Slope (%)	= 6.00	Qmax (cfs)	= 32.90
Invert Elev Up (ft)	= 2.44	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 24.0		
Shape	= Circular	Highlighted	
Span (in)	= 24.0	Qtotal (cfs)	= 30.00
No. Barrels	= 2	Qpipe (cfs)	= 30.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 5.28
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 6.41
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 2.70
		HGL Up (ft)	= 3.83
Embankment		Hw Elev (ft)	= 4.64
Top Elevation (ft)	= 5.14	Hw/D (ft)	= 1.10
Top Width (ft)	= 20.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		



FROUD	E NUMBER CA	LCULATIONS	CALCULATED BY:	DLH	DATE:	8/1/2023
PROJECT: 211030 F	ILING NO. 3		CHECKED BY:	RL		
Froude Number Calculations: 100-YR						
Section	Velocity	Gravitational Constant	Hydraulic depth	Xsectional Area	top Width	Froude #
-	ft/s	ft/s^2	ft	ft^2	ft	N/A
A-A	4.87	32.17	0.39	2.08	5.39	1.38
B-B	3.87	32.17	0.28	1.06	3.85	1.30
C-C	7.21	32.17	0.74	19.45	26.46	1.48
D-D	6.47	32.17	0.51	5.3	10.3	1.59
E-E	3.29	32.17	0.21	12.47	59.75	1.27
F-F	6.32	32.17	0.52	6.49	12.48	1.55
G-G	8.45	32.17	0.55	4.84	8.8	2.01
H-H	6.03	32.17	0.45	2.83	6.3	1.59
I-I	6.2	32.17	0.48	3.16	6.65	1.59
J-J	5.54	32.17	0.45	20.58	45.76	1.46
K-K	10.1	32.17	0.63	11.29	17.78	2.23
L-L	6.81	32.17	0.91	16.73	18.3	1.26
M-M	7.37	32.17	1.04	21.35	20.62	1.28
N-N	6.09	32.17	0.42	12.06	29.05	1.67
0-0	6.41	32.17	0.55	11.44	20.76	1.52
P-P	6.05	32.17	0.52	6.61	12.6	1.47
Q-Q	8.51	32.17	0.77	13.4	17.32	1.71
R-R	6.03	32.17	0.46	5.46	11.85	1.57
S-S	5.26	32.17	0.41	3.87	9.5	1.45
T-T	5.73	32.17	0.47	12.81	27.26	1.47

SHEAR STRESS & CHANNEL LININGS	CALCULATED BY:	DLH	DATE:	8/1/2023
PROJECT: 211030 FILING NO. 3	CHECKED BY:	RL		

	Shear Stress Calculations: 100-YR				
Section	unit weight of water	Depth of flow	Slope	Shear Stress	
-	lb/ft^3	ft	ft/ft	lb/ft^2	
A-A	62.43	0.77	0.05	2.48	
B-B	62.43	0.55	0.05	1.77	
C-C	62.43	1.47	0.04	4.04	
D-D	62.43	1.03	0.06	3.73	
E-E	62.43	0.25	0.05	0.78	
F-F	62.43	1.04	0.05	3.51	
G-G	62.43	1.10	0.09	6.46	
H-H	62.43	0.90	0.04	2.37	
I-I	62.43	0.95	0.04	2.50	
J-J	62.43	0.48	0.05	1.50	
K-K	62.43	1.27	0.11	8.48	
L-L	62.43	1.12	0.03	2.10	
M-M	62.43	1.27	0.03	2.38	
N-N	62.43	0.83	0.07	3.47	
0-0	62.43	0.64	0.05	2.12	
P-P	62.43	1.05	0.05	3.34	
Q-Q	62.43	0.92	0.04	2.30	
R-R	62.43	0.55	0.06	2.06	
S-S	62.43	0.50	0.06	1.72	
T-T	62.43	0.94	0.05	3.05	

Channel Lining Determination						
Calculated Values			P300 Max Values			
Section	Shear Stress	Velocity	Shear Stress	Velocity	Lining Required	
A-A	2.48	4.87	3	9	P300	
B-B	1.77	3.87	3	9	P300	
C-C	4.04	7.21	3	9	TMAX	
D-D	3.73	6.47	3	9	TMAX	
E-E	0.78	3.29	3	9	P300	
F-F	3.51	6.32	3	9	TMAX	
G-G	6.46	8.45	3	9	TMAX	
H-H	2.37	6.03	3	9	P300	
I-I	2.50	6.20	3	9	P300	
J-J	1.50	5.54	3	9	P300	
K-K	8.48	10.10	3	9	TMAX	
L-L	2.10	6.81	3	9	P300	
M-M	2.38	7.37	3	9	P300	
N-N	3.47	6.09	3	9	P300	
0-0	2.12	6.41	3	9	P300	
P-P	3.34	6.05	3	9	TMAX	
Q-Q	2.30	8.51	3	9	P300	
R-R	2.06	6.03	3	9	P300	
S-S	1.72	5.26	3	9	P300	
T-T	3.05	5.73	3	9	P300	

DRAINAGE CHANNEL SECTION CALCULATIONS

MINOR (5-YEAR) STORM ANALYSIS

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Jul 31 2023

TYP. CONSERVATIVE WEIR

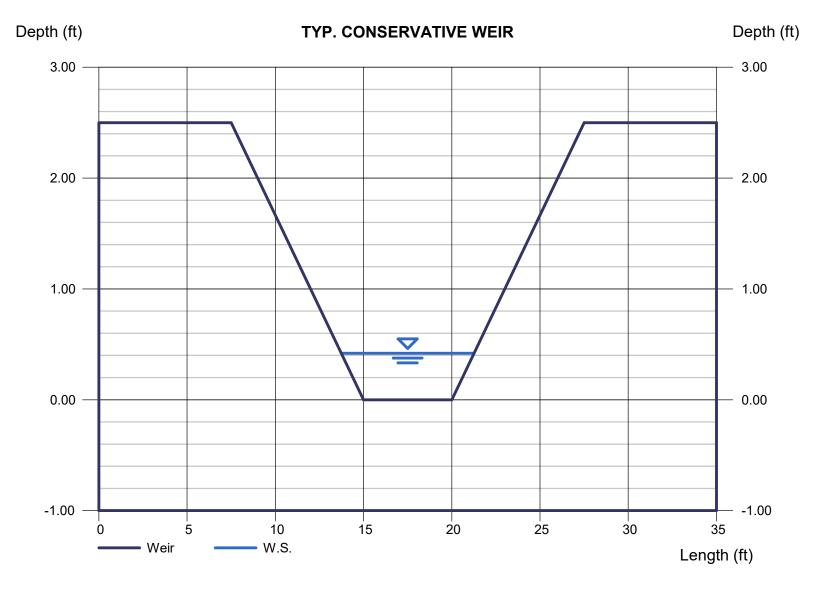
Trapezoidal Weir	
Crest	= Sharp
Bottom Length (ft)	= 5.00
Total Depth (ft)	= 2.50
Side Slope (z:1)	= 3.00

Calculations

Weir Coeff. Cw = 3.10 Compute by: Known Q Known Q (cfs) = 5.00 Highlighted

Depth (ft) = 0.42 Q (cfs) = 5.000 Area (sqft) = 2.63 Velocity (ft/s) = 1.90 Top Width (ft) = 7.52

THIS CALCULATION IS PROVIDED FOR AREAS IN WHICH DITCHES REACH LOW POINTS AND OUTFALL TO CULVERTS. WEIRS ARE TO BE CUT INTO DITCH BERMS TO OUTFALL.



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION A-A ROADSIDE SWALE

Triangula	1
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Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 2.50

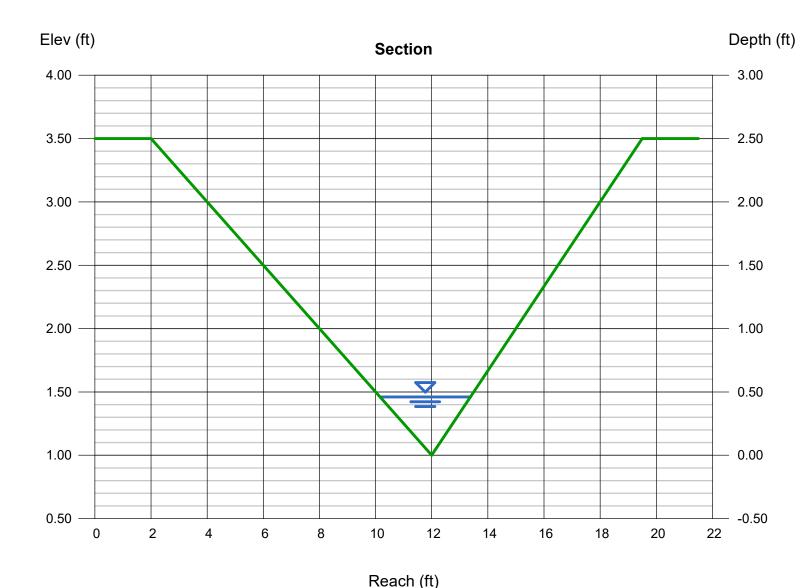
Invert Elev (ft) = 1.00 Slope (%) = 5.15 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 2.50

Highlighted

Depth (ft) = 0.46Q (cfs) = 2.500Area (sqft) = 0.74Velocity (ft/s) = 3.38Wetted Perim (ft) = 3.35Crit Depth, Yc (ft) = 0.51Top Width (ft) = 3.22EGL (ft) = 0.64



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION B-B ROADSIDE SWALE

Triangular

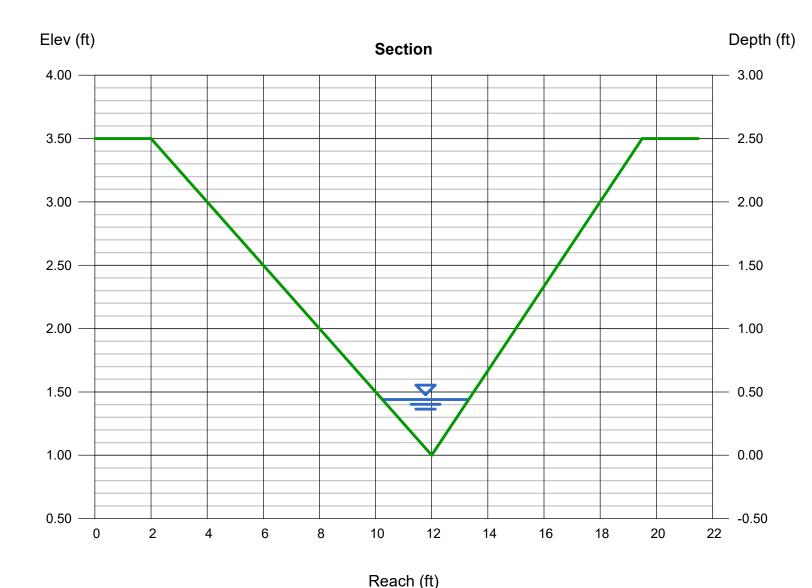
Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 2.50

Invert Elev (ft) = 1.00 Slope (%) = 5.15 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 2.30 Highlighted

= 0.44Depth (ft) Q (cfs) = 2.300Area (sqft) = 0.68Velocity (ft/s) = 3.39Wetted Perim (ft) = 3.21Crit Depth, Yc (ft) = 0.49Top Width (ft) = 3.08EGL (ft) = 0.62



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION VIEW C-C NATURAL TERTIARY SWALE

Triangular

Side Slopes (z:1) = 9.00, 9.00Total Depth (ft) = 20.00

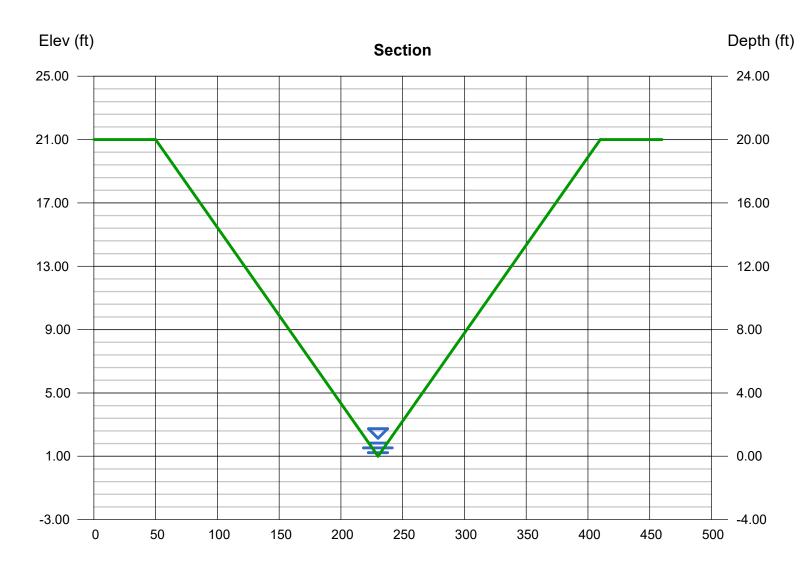
Invert Elev (ft) = 1.00 Slope (%) = 4.40 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 30.50

Highlighted

Depth (ft) = 0.83Q (cfs) = 30.50Area (sqft) = 6.20Velocity (ft/s) = 4.92Wetted Perim (ft) = 15.03 Crit Depth, Yc (ft) = 0.94Top Width (ft) = 14.94EGL (ft) = 1.21



Reach (ft)

Known Q (cfs)

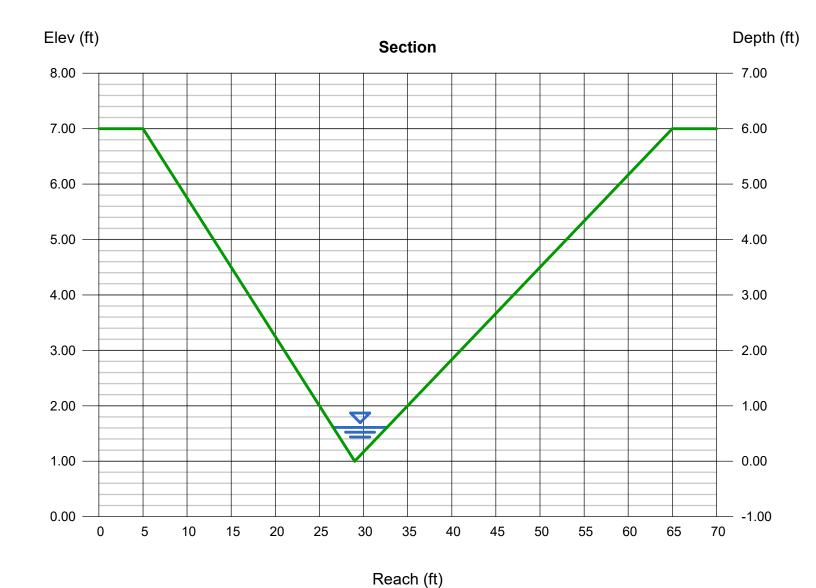
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION D-D LEFT SIDE NATURAL TERTIARY SWALE

= 8.50

Triangular		Highlighted	
Side Slopes (z:1)	= 4.00, 6.00	Depth (ft)	= 0.61
Total Depth (ft)	= 6.00	Q (cfs)	= 8.500
		Area (sqft)	= 1.86
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.57
Slope (%)	= 5.80	Wetted Perim (ft)	= 6.23
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.71
		Top Width (ft)	= 6.10
Calculations		EGL (ft)	= 0.93
Compute by:	Known Q		



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION E-E NATURAL TERTIARY SWALE

Trapezoidal

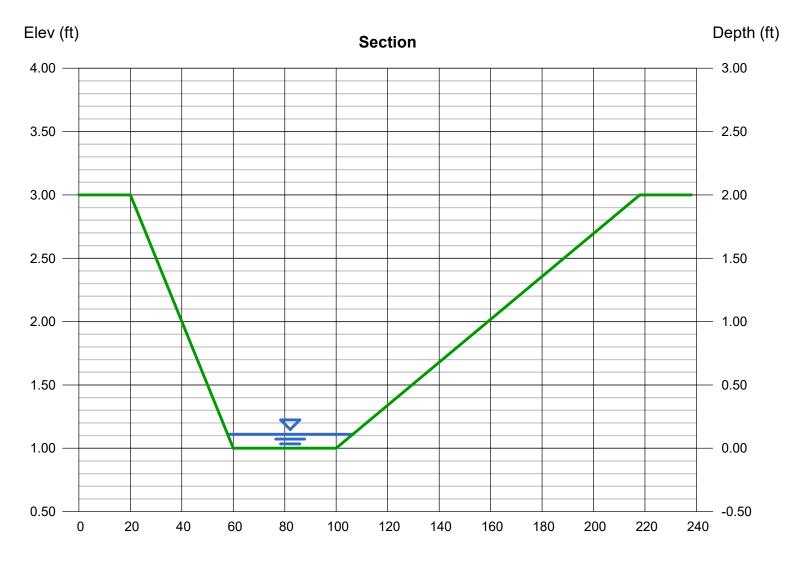
Bottom Width (ft) = 40.00 Side Slopes (z:1) = 20.00, 59.00

Total Depth (ft) = 2.00 Invert Elev (ft) = 1.00 Slope (%) = 5.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 9.00 Highlighted

Depth (ft) = 0.11Q (cfs) = 9.000Area (sqft) = 4.88Velocity (ft/s) = 1.85 Wetted Perim (ft) = 48.69Crit Depth, Yc (ft) = 0.12Top Width (ft) = 48.69EGL (ft) = 0.16



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION F-F NATURAL TERTIARY SWALE

Side Slopes (z:1) = 6.00, 6.00Total Depth (ft) = 10.57

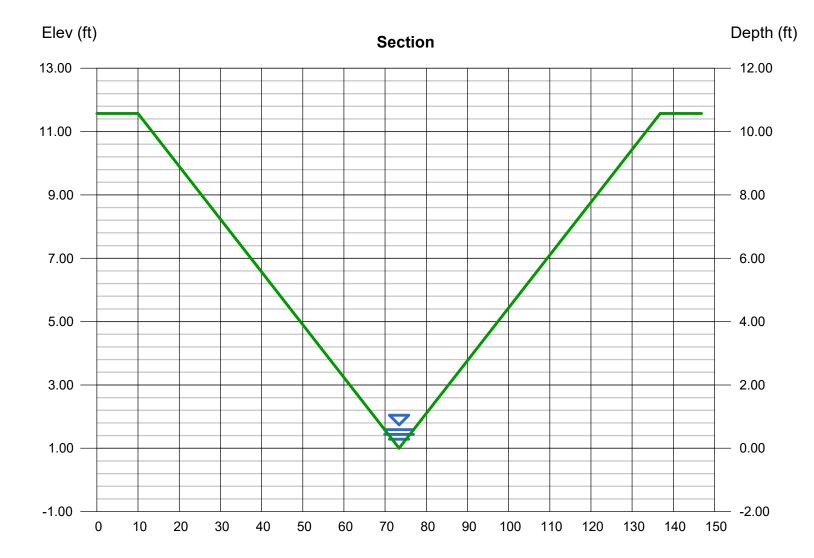
Invert Elev (ft) = 1.00 Slope (%) = 5.40 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 9.00

Highlighted

Depth (ft) = 0.59Q (cfs) = 9.000Area (sqft) = 2.09Velocity (ft/s) = 4.31 Wetted Perim (ft) = 7.18Crit Depth, Yc (ft) = 0.68Top Width (ft) = 7.08EGL (ft) = 0.88



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION G-G NATURAL TERTIARY SWALE

Triangula

Side Slopes (z:1) = 4.00, 4.00Total Depth (ft) = 8.00

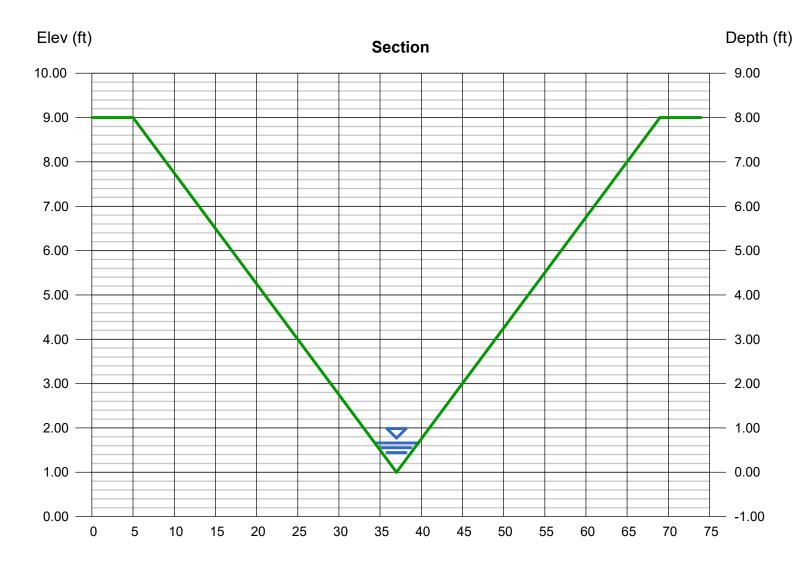
Invert Elev (ft) = 1.00 Slope (%) = 9.40 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 10.30

Highlighted

Depth (ft) = 0.66Q (cfs) = 10.30Area (sqft) = 1.74Velocity (ft/s) = 5.91 Wetted Perim (ft) = 5.44Crit Depth, Yc (ft) = 0.84Top Width (ft) = 5.28EGL (ft) = 1.20



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Jul 21 2023

SECTION H-H ROADSIDE SWALE

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 2.50

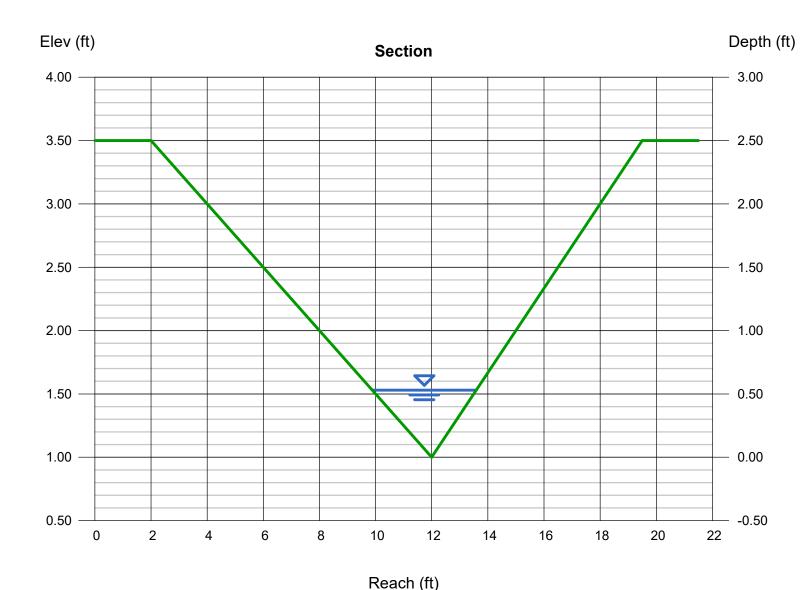
Invert Elev (ft) = 1.00 Slope (%) = 6.30 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 4.10

Highlighted

Depth (ft) = 0.53Q (cfs) = 4.100Area (sqft) = 0.98Velocity (ft/s) = 4.17 Wetted Perim (ft) = 3.86Crit Depth, Yc (ft) = 0.62Top Width (ft) = 3.71EGL (ft) = 0.80



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Jul 21 2023

SECTION I-I ROADSIDE SWALE

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 2.50

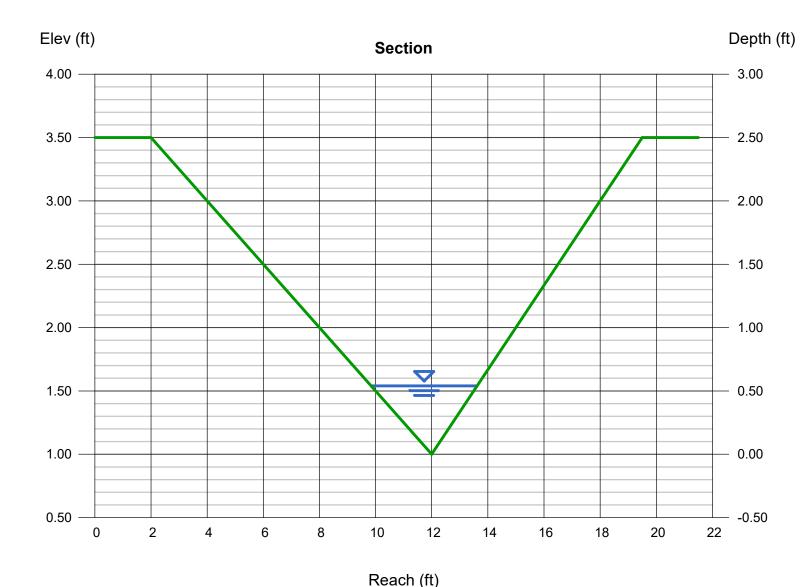
Invert Elev (ft) = 1.00 Slope (%) = 6.30 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 4.30

Highlighted

Depth (ft) = 0.54Q (cfs) = 4.300Area (sqft) = 1.02Velocity (ft/s) = 4.21 Wetted Perim (ft) = 3.93Crit Depth, Yc (ft) = 0.63Top Width (ft) = 3.78EGL (ft) = 0.82



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION J-J NATURAL TERTIARY SWALE

Trapezoida

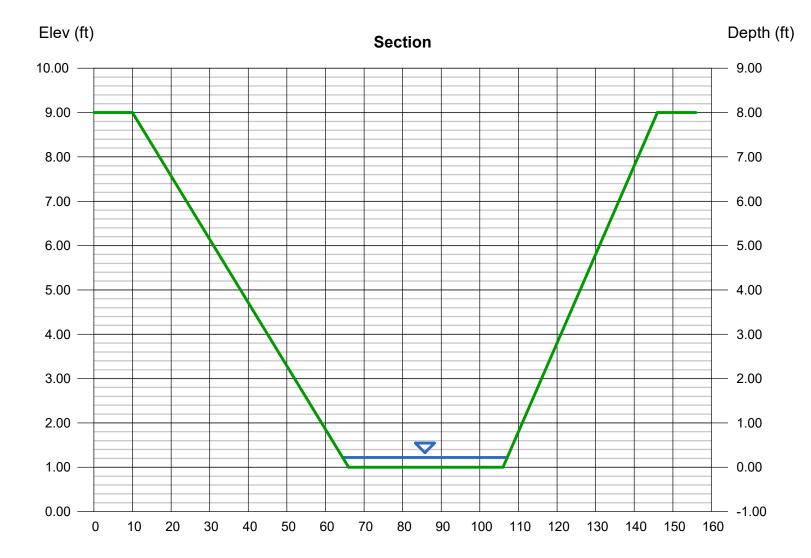
Bottom Width (ft) = 40.00 Side Slopes (z:1) = 7.00, 5.00 Total Depth (ft) = 8.00 Invert Elev (ft) = 1.00 Slope (%) = 5.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 29.70

Highlighted

Depth (ft) = 0.22Q (cfs) = 29.70Area (sqft) = 9.09Velocity (ft/s) = 3.27Wetted Perim (ft) = 42.68Crit Depth, Yc (ft) = 0.26Top Width (ft) = 42.64EGL (ft) = 0.39



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

= 1.57

NATURAL TERTIARY SWALE **SECTION K-K RIGHT**

Triangular	
Side Slopes (z:1)	= 6.00, 8.00
Total Depth (ft)	= 6.00

Invert Elev (ft) = 1.00 Slope (%) = 10.70N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 29.70

= 0.77Depth (ft) Q (cfs) = 29.70Area (sqft)

Highlighted

EGL (ft)

= 4.15Velocity (ft/s) = 7.16 Wetted Perim (ft) = 10.89Crit Depth, Yc (ft) = 1.03Top Width (ft) = 10.78

Elev (ft) Depth (ft) Section 8.00 -7.00 7.00 -- 6.00 6.00 -5.00 5.00 -4.00 4.00 -3.00 3.00 -2.00 2.00 -- 1.00 1.00 --0.000.00 - -1.00 0 10 20 30 40 50 60 70 80 90 100 110

Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Jul 27 2023

SECTION L-L ROADSIDE SWALE

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	\sim	oiaa:

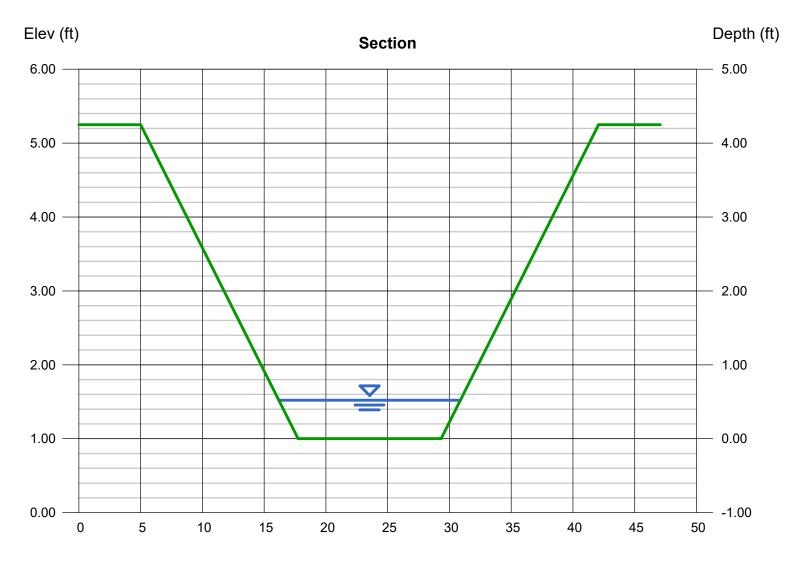
Bottom Width (ft) = 11.58 Side Slopes (z:1) = 3.00, 3.00 Total Depth (ft) = 4.25 Invert Elev (ft) = 1.00 Slope (%) = 3.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 29.70

Highlighted

Depth (ft) = 0.52Q (cfs) = 29.70Area (sqft) = 6.83Velocity (ft/s) = 4.35Wetted Perim (ft) = 14.87Crit Depth, Yc (ft) = 0.57Top Width (ft) = 14.70EGL (ft) = 0.81



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Jul 27 2023

SECTION M-M ROADSIDE SWALE

	ez		

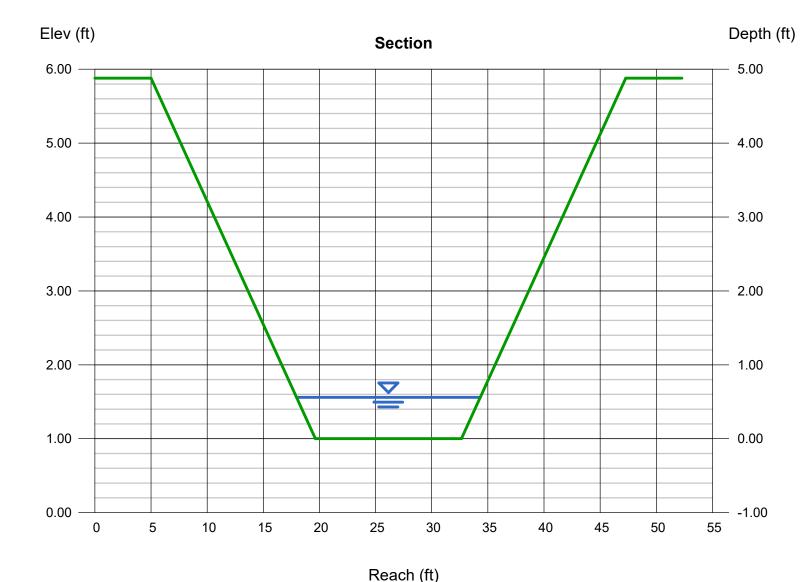
Bottom Width (ft) = 13.00 Side Slopes (z:1) = 3.00, 3.00 Total Depth (ft) = 4.88 Invert Elev (ft) = 1.00 Slope (%) = 3.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 36.90

Highlighted

Depth (ft) = 0.56Q (cfs) = 36.90Area (sqft) = 8.22Velocity (ft/s) = 4.49Wetted Perim (ft) = 16.54Crit Depth, Yc (ft) = 0.61Top Width (ft) = 16.36EGL (ft) = 0.87



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Nov 13 2023

SECTION N-N NATURAL TERTIARY SWALE

Triangular

Side Slopes (z:1) = 11.00, 24.00

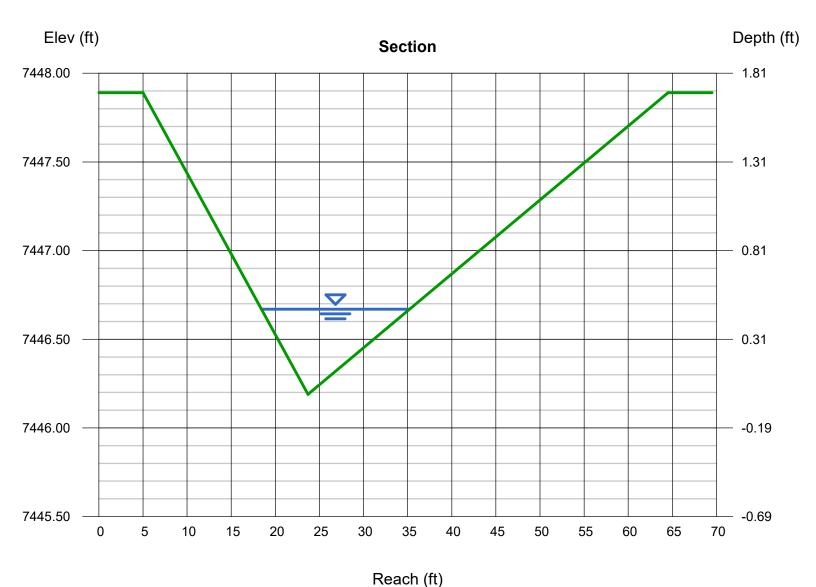
Total Depth (ft) = 1.70

Invert Elev (ft) = 7446.19 Slope (%) = 6.70 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 16.50 Highlighted

Depth (ft) = 0.48Q (cfs) = 16.50 Area (sqft) = 4.03Velocity (ft/s) = 4.09Wetted Perim (ft) = 16.83 Crit Depth, Yc (ft) = 0.57Top Width (ft) = 16.80EGL (ft) = 0.74



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION O-O NATURAL TERTIARY SWALE

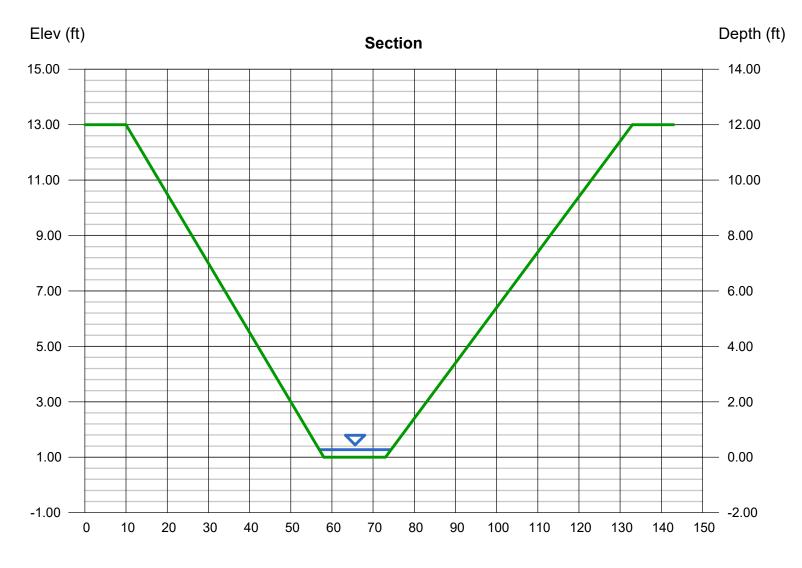
Trapezoidal

Bottom Width (ft) = 15.00 Side Slopes (z:1) = 4.00, 5.00 Total Depth (ft) = 12.00 Invert Elev (ft) = 1.00 Slope (%) = 5.30 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 16.50 Highlighted

Depth (ft) = 0.27Q (cfs) = 16.50 Area (sqft) = 4.38Velocity (ft/s) = 3.77Wetted Perim (ft) = 17.49Crit Depth, Yc (ft) = 0.33Top Width (ft) = 17.43EGL (ft) = 0.49



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION P-P NATURAL TERTIARY SWALE

Triangular	
Side Slopes (z:1)	= 5.00, 7.00
Total Depth (ft)	= 15.00

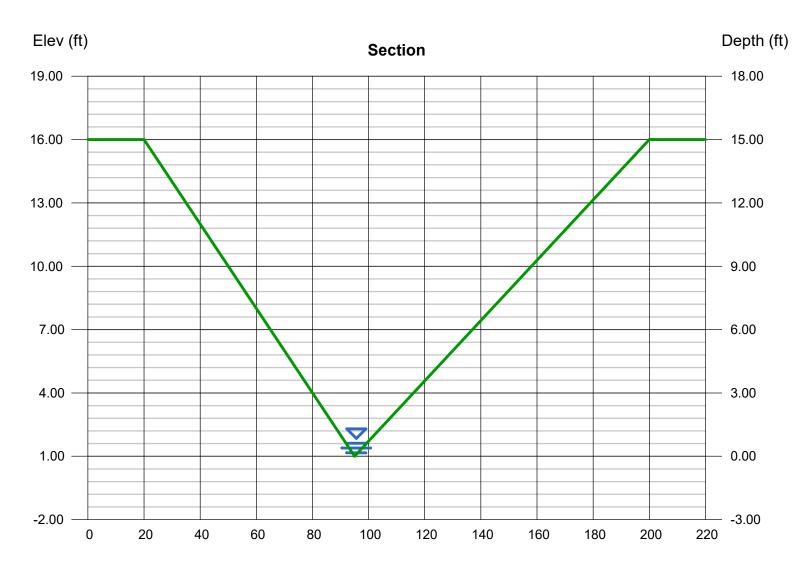
Invert Elev (ft) = 1.00 Slope (%) = 5.10 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 10.00

Highlighted

Depth (ft) = 0.62Q (cfs) = 10.00Area (sqft) = 2.31Velocity (ft/s) = 4.34Wetted Perim (ft) = 7.55Crit Depth, Yc (ft) = 0.71Top Width (ft) = 7.44EGL (ft) = 0.91



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Jul 27 2023

SECTION Q-Q ROADSIDE SWALE

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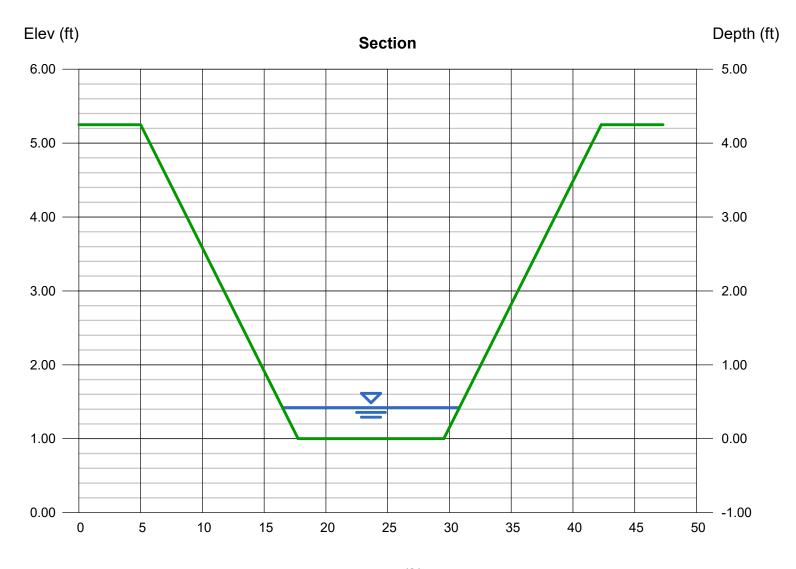
Bottom Width (ft) = 11.80 Side Slopes (z:1) = 3.00, 3.00 Total Depth (ft) = 4.25 Invert Elev (ft) = 1.00 Slope (%) = 6.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 29.70

Highlighted

= 0.42Depth (ft) Q (cfs) = 29.70Area (sqft) = 5.49Velocity (ft/s) = 5.41 Wetted Perim (ft) = 14.46Crit Depth, Yc (ft) = 0.56Top Width (ft) = 14.32EGL (ft) = 0.88



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Jul 27 2023

SECTION R-R ROADSIDE SWALE

Trapezoi	dal
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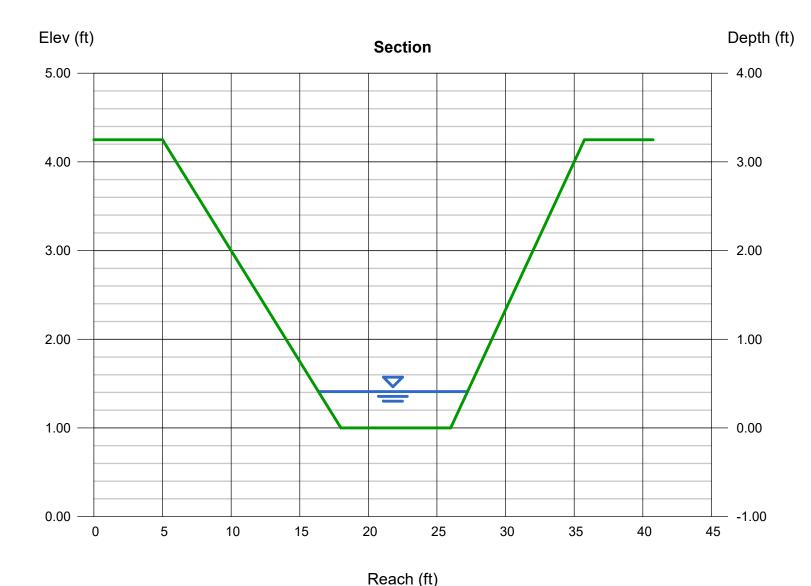
Bottom Width (ft) = 8.00 Side Slopes (z:1) = 4.00, 3.00 Total Depth (ft) = 3.25 Invert Elev (ft) = 1.00 Slope (%) = 6.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 20.00

Highlighted

= 0.41Depth (ft) Q (cfs) = 20.00Area (sqft) = 3.87Velocity (ft/s) = 5.17 Wetted Perim (ft) = 10.99Crit Depth, Yc (ft) = 0.54Top Width (ft) = 10.87EGL (ft) = 0.83



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Jul 27 2023

SECTION S-S ROADSIDE SWALE

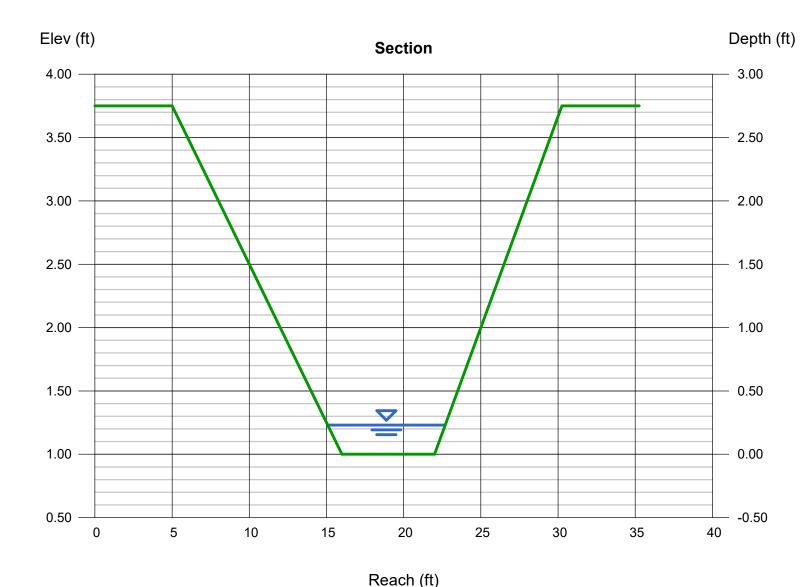
Trapezoidal

Bottom Width (ft) = 6.00 Side Slopes (z:1) = 4.00, 3.00 Total Depth (ft) = 2.75 Invert Elev (ft) = 1.00 Slope (%) = 5.50 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 5.00 Highlighted

Depth (ft) = 0.23Q (cfs) = 5.000Area (sqft) = 1.57Velocity (ft/s) = 3.19Wetted Perim (ft) = 7.68Crit Depth, Yc (ft) = 0.27Top Width (ft) = 7.61EGL (ft) = 0.39



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Nov 13 2023

SECTION T-T NATURAL TERTIARY SWALE

Triangular

Side Slopes (z:1) = 11.00, 18.00

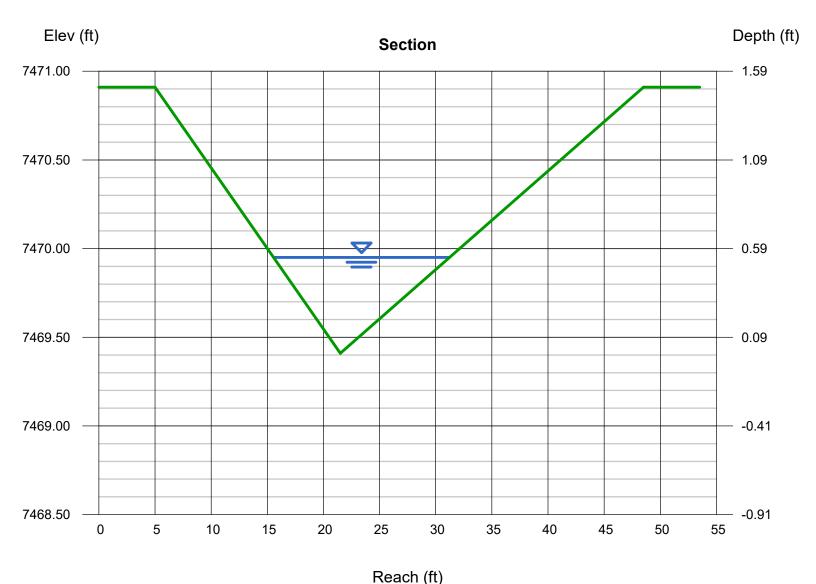
Total Depth (ft) = 1.50

Invert Elev (ft) = 7469.41 Slope (%) = 5.20 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 16.50 Highlighted

Depth (ft) = 0.54Q (cfs) = 16.50Area (sqft) = 4.23Velocity (ft/s) = 3.90Wetted Perim (ft) = 15.70Crit Depth, Yc (ft) = 0.61Top Width (ft) = 15.66 EGL (ft) = 0.78



DRAINAGE CHANNEL SECTION CALCULATIONS

MAJOR (100-YEAR) STORM ANALYSIS

Known Q (cfs)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

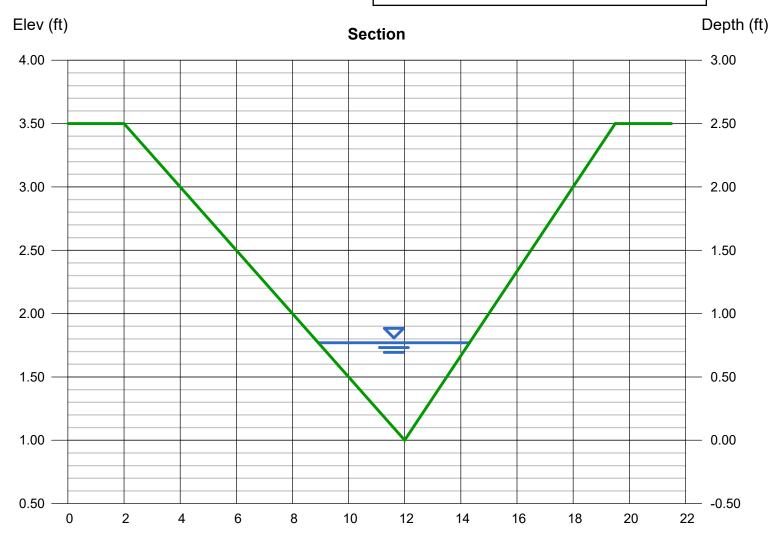
= 10.10

Tuesday, Jul 18 2023

SECTION A-A ROADSIDE SWALE

Triangular		Highlighted	
Side Slopes (z:1)	= 4.00, 3.00	Depth (ft)	= 0.77
Total Depth (ft)	= 2.50	Q (cfs)	= 10.10
		Area (sqft)	= 2.08
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.87
Slope (%)	= 5.15	Wetted Perim (ft)	= 5.61
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.88
		Top Width (ft)	= 5.39
Calculations		EGL (ft)	= 1.14
Compute by:	Known Q	Froude No.	= 1.38

Recommended BMP:
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 (or equiv.)
Permissible Velocity (ft/s) = 9.0
Permissible Shear Stress (lb/ft^2) = 3.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION B-B ROADSIDE SWALE

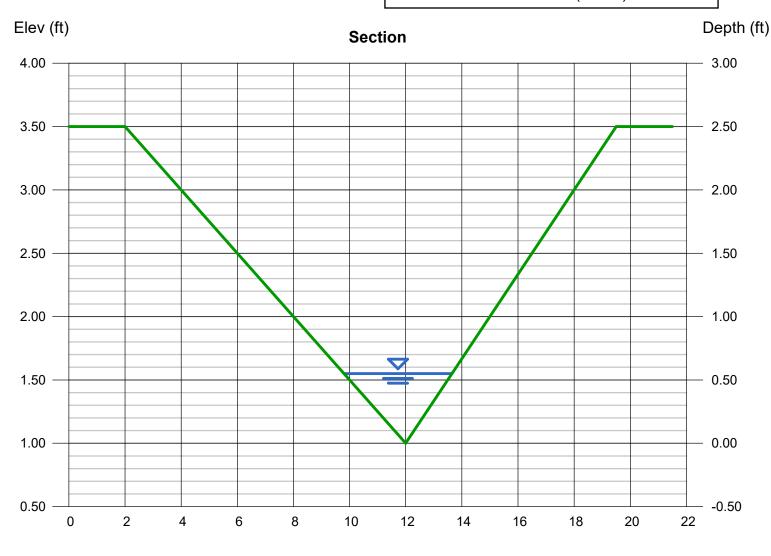
Triangular Side Slopes (z:1) Total Depth (ft)	= 4.00, 3.00 = 2.50	
Invert Elev (ft) Slope (%) N-Value	= 1.00 = 5.15 = 0.035	

Calculations

Compute by: Known Q Known Q (cfs) = 4.10

Highlighted	
Depth (ft)	= 0.55
Q (cfs)	= 4.100
Area (sqft)	= 1.06
Velocity (ft/s)	= 3.87
Wetted Perim (ft)	= 4.01
Crit Depth, Yc (ft)	= 0.62
Top Width (ft)	= 3.85
EGL (ft)	= 0.78
Froude No.	= 1.30

Recommended BMP:
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 (or equiv.)
Permissible Velocity (ft/s) = 9.0
Permissible Shear Stress (lb/ft^2) = 3.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION VIEW C-C NATURAL TERTIARY SWALE

Triangular		Highlighted	
Side Slopes (z:1)	= 9.00, 9.00	Depth (ft)	= 1.47
Total Depth (ft)	= 20.00	Q (cfs)	= 140.20
, ,		Area (sqft)	= 19.45
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 7.21
Slope (%)	= 4.40	Wetted Perim (ft)	= 26.62
N-Value	= 0.035	Crit Depth, Yc (ft)	= 1.73
		Top Width (ft)	= 26.46
Calculations		EGL (ft)	= 2.28
Compute by:	Known Q	Froude No.	= 1.48
Known Q (cfs)	= 140.20	Pacammandad RMP:	

Recommended BMP:

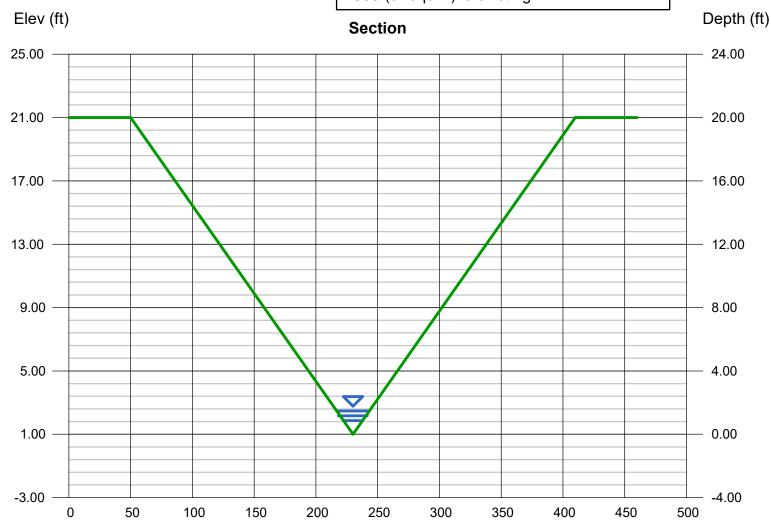
Rollmax Permanent Turf Reinforcement Mat TMAX (or equiv.)

Permissible Velocity (ft/s) = 25.0

Permissible Shear Stress (lb/ft^2) = 15.0

*Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.) is existing



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION D-D LEFT SIDE NATURAL TERTIARY SWALE

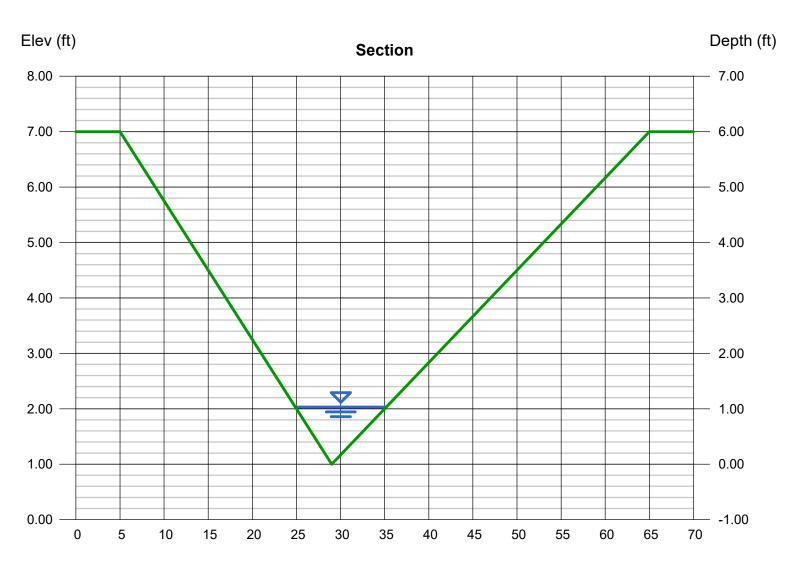
Triangular		Highlighted	
Side Slopes (z:1)	= 4.00, 6.00	Depth (ft)	= 1.03
Total Depth (ft)	= 6.00	Q (cfs)	= 34.30
		Area (sqft)	= 5.30
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 6.47
Slope (%)	= 5.80	Wetted Perim (ft)	= 10.51
N-Value	= 0.035	Crit Depth, Yc (ft)	= 1.24
		Top Width (ft)	= 10.30
Calculations		EGL (ft)	= 1.68
Compute by:	Known Q	Froude No.	= 1.59
Known Q (cfs)	= 34.30	Pacammandad RMP:	

Recommended BMP:

Rollmax Permanent Turf Reinforcement Mat

TMAX (or equiv.)

Permissible Velocity (ft/s) = 25.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION E-E NATURAL TERTIARY SWALE

Trapezoidal	
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Bottom Width (ft) = 40.00 Side Slopes (z:1) = 20.00, 59.00

Total Depth (ft) = 2.00 Invert Elev (ft) = 1.00 Slope (%) = 5.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 41.00

Highlighted

Depth (ft) = 0.25Q (cfs) = 41.00Area (sqft) = 12.47Velocity (ft/s) = 3.29Wetted Perim (ft) = 59.76Crit Depth, Yc (ft) = 0.29Top Width (ft) = 59.75 EGL (ft) = 0.42Froude No. = 1.27

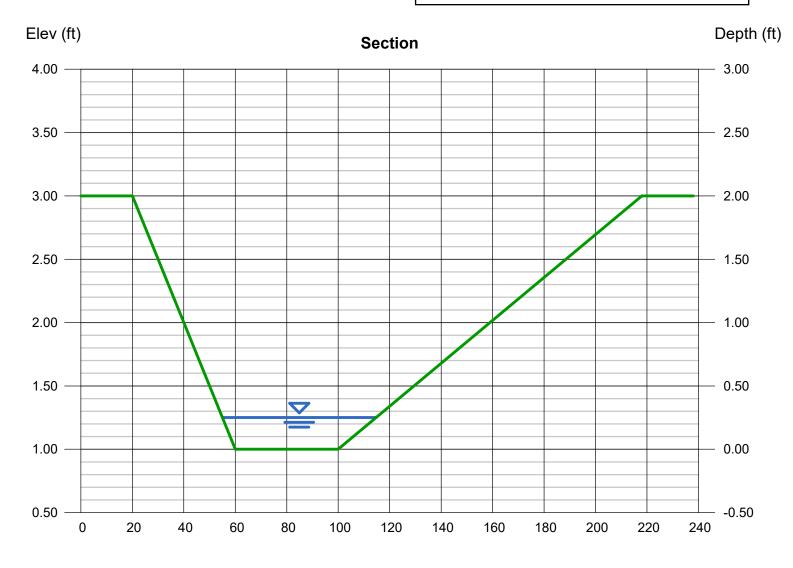
Recommended BMP:

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION F-F NATURAL TERTIARY SWALE

Side Slopes (z:1)	= 6.00, 6.00
Total Depth (ft)	= 10.57

Invert Elev (ft) = 1.00 Slope (%) = 5.40 N-Value = 0.035

Calculations

Triangular

Compute by: Known Q Known Q (cfs) = 41.00

Highlighted

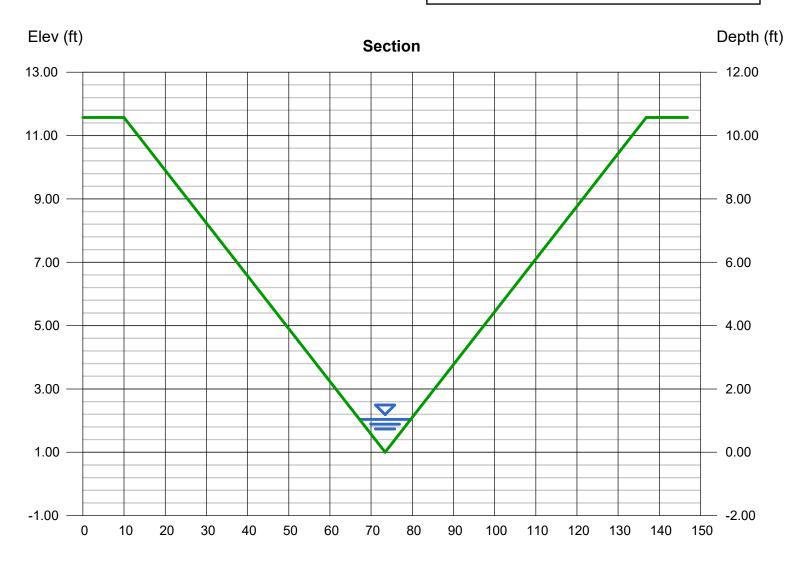
Depth (ft) = 1.04Q (cfs) = 41.00 Area (sqft) = 6.49Velocity (ft/s) = 6.32Wetted Perim (ft) = 12.65Crit Depth, Yc (ft) = 1.24Top Width (ft) = 12.48EGL (ft) = 1.66Froude No. = 1.55

Recommended BMP:

Rollmax Permanent Turf Reinforcement Mat

TMAX (or equiv.)

Permissible Velocity (ft/s) = 25.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION G-G NATURAL TERTIARY SWALE

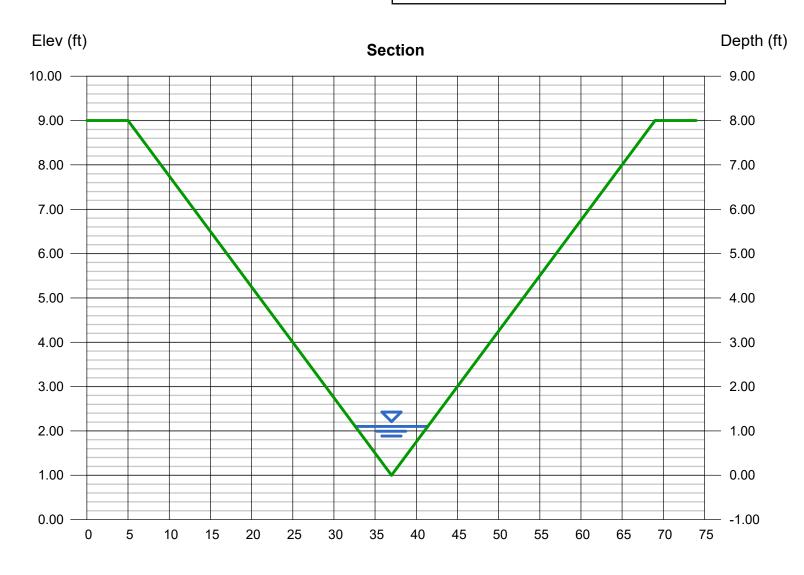
Side Slopes (z:1) = $4.00, 4.00$ Depth (ft) =	1.10
5:45 5:5p55 (2:1) 1:55, 1:55	40.00
Total Depth (ft) = 8.00 Q (cfs) = 4	40.90
Area (sqft) = 4	4.84
Invert Elev (ft) = 1.00 Velocity (ft/s) = 8	8.45
Slope (%) = 9.40 Wetted Perim (ft) = 9.40	9.07
N-Value = 0.035 Crit Depth, Yc (ft) = $\frac{1}{2}$	1.46
Top Width (ft) $= 8$	8.80
Calculations $EGL(ft) = 2$	2.21
Compute by: Known Q Froude No. = :	2.01
Known Q (cfs) = 40.90	

Recommended BMP:

Rollmax Permanent Turf Reinforcement Mat

TMAX (or equiv.)

Permissible Velocity (ft/s) = 25.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Jul 21 2023

SECTION H-H ROADSIDE SWALE

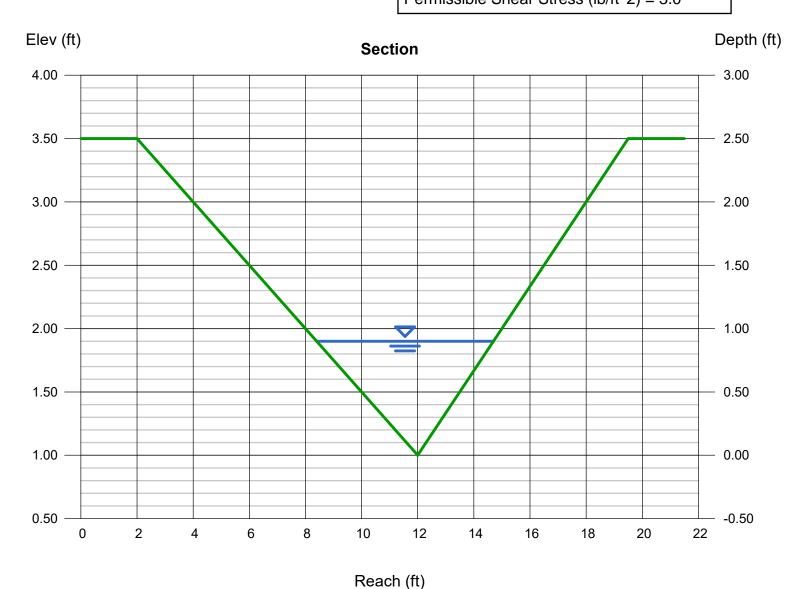
Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 6.30
N-Value	= 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 17.10

Highlighted		
Depth (ft)	=	0.90
Q (cfs)	=	17.10
Area (sqft)	=	2.83
Velocity (ft/s)	=	6.03
Wetted Perim (ft)	=	6.56
Crit Depth, Yc (ft)	=	1.09
Top Width (ft)	=	6.30
EGL (ft)	=	1.47
Froude No.	=	1.59

Recommended BMP:
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 (or equiv.)
Permissible Velocity (ft/s) = 9.0
Permissible Shear Stress (lb/ft^2) = 3.0



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Jul 21 2023

= 1.59

SECTION I-I ROADSIDE SWALE

Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 6.30
N-Value	= 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 19.60

Highlighted		
Depth (ft)	=	0.95
Q (cfs)	=	19.60
Area (sqft)	=	3.16
Velocity (ft/s)	=	6.20
Wetted Perim (ft)	=	6.92
Crit Depth, Yc (ft)	=	1.15
Top Width (ft)	=	6.65
EGL (ft)	=	1.55

Recommended BMP:

Froude No.

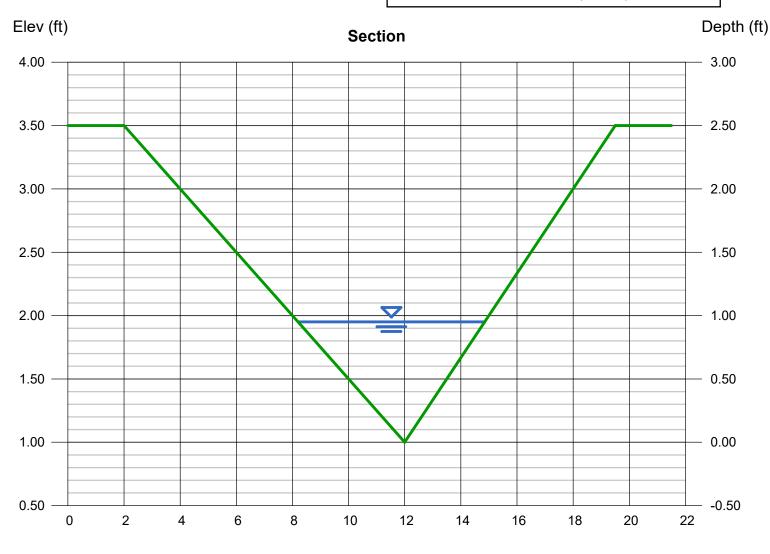
North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0

Permissible Shear Stress (lb/ft^2) = 3.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION J-J NATURAL TERTIARY SWALE

Trapezoidal	
Bottom Width (ft)	= 40.00
Side Slopes (z:1)	= 7.00, 5.00
Total Depth (ft)	= 8.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.00
N-Value	= 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 114.00

Depth (ft)	= 0.48
Q (cfs)	= 114.00
Area (sqft)	= 20.58
Velocity (ft/s)	= 5.54
Wetted Perim (ft)	= 45.84

Crit Depth, Yc (ft) = 0.62 Top Width (ft) = 45.76 EGL (ft) = 0.96 Froude No. = 1.46

Recommended BMP:

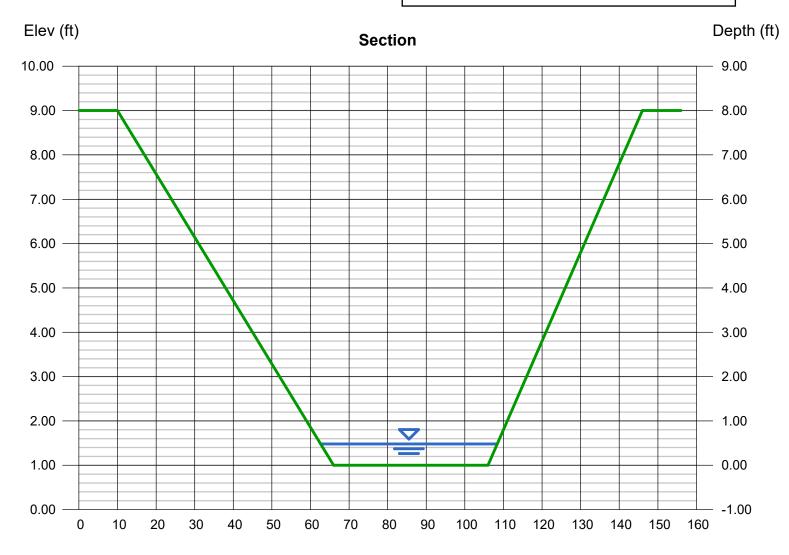
Highlighted

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Known Q (cfs)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION K-K RIGHT NATURAL TERTIARY SWALE

= 114.00

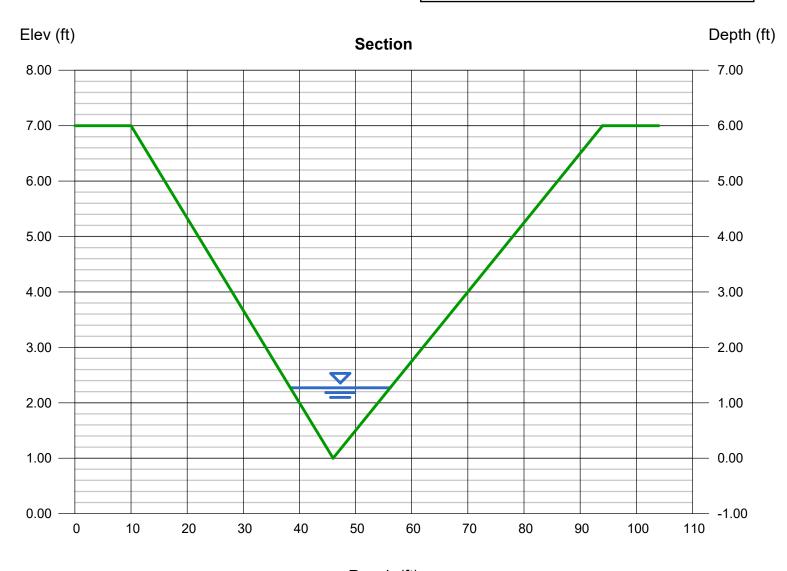
Triangular		Highlighted	
Side Slopes (z:1)	= 6.00, 8.00	Depth (ft)	= 1.27
Total Depth (ft)	= 6.00	Q (cfs)	= 114.00
		Area (sqft)	= 11.29
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 10.10
Slope (%)	= 10.70	Wetted Perim (ft)	= 17.96
N-Value	= 0.035	Crit Depth, Yc (ft)	= 1.76
		Top Width (ft)	= 17.78
Calculations		EGL (ft)	= 2.86
Compute by:	Known Q	Froude No.	= 2.23

Recommended BMP:

Rollmax Permanent Turf Reinforcement Mat

TMAX (or equiv.)

Permissible Velocity (ft/s) = 25.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Jul 27 2023

SECTION L-L ROADSIDE SWALE

Trapezoid	al
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Bottom Width (ft) = 11.58 Side Slopes (z:1) = 3.00, 3.00 Total Depth (ft) = 4.25 Invert Elev (ft) = 1.00 Slope (%) = 3.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 114.00

Highlighted

Depth (ft) = 1.12Q (cfs) = 114.00Area (sqft) = 16.73Velocity (ft/s) = 6.81 Wetted Perim (ft) = 18.66Crit Depth, Yc (ft) = 1.29Top Width (ft) = 18.30EGL (ft) = 1.84Froude No. = 1.26

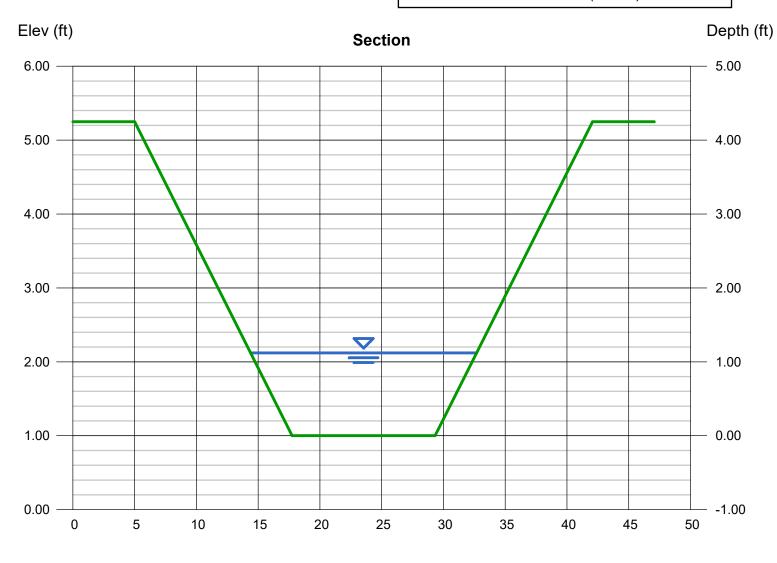
Recommended BMP:

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 25 2023

SECTION M-M ROADSIDE SWALE

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Tra	hez	2010	uai

Bottom Width (ft) = 13.00 Side Slopes (z:1) = 3.00, 3.00 Total Depth (ft) = 4.88 Invert Elev (ft) = 1.00 Slope (%) = 3.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 157.30

Highlighted

Depth (ft) = 1.27Q (cfs) = 157.30Area (sqft) = 21.35Velocity (ft/s) = 7.37Wetted Perim (ft) = 21.03Crit Depth, Yc (ft) = 1.48Top Width (ft) = 20.62EGL (ft) = 2.11 Froude No. = 1.28

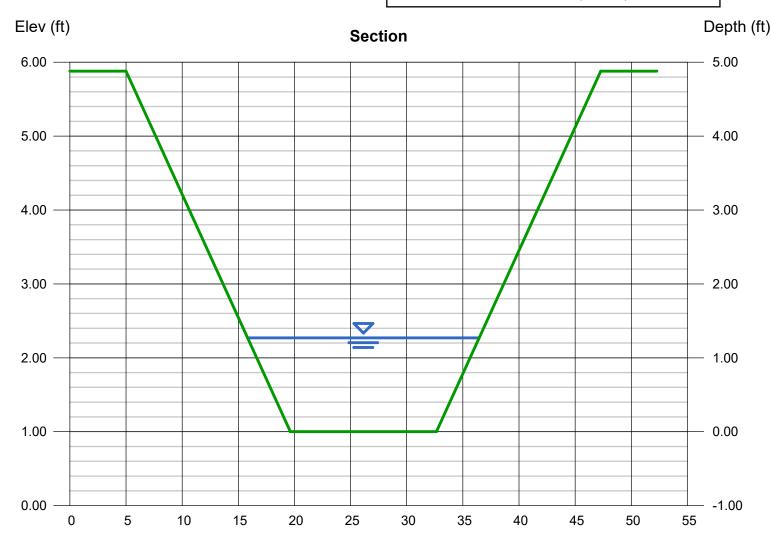
Recommended BMP:

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Nov 13 2023

= 1.67

SECTION N-N NATURAL TERTIARY SWALE

Side Slopes (z:1)	= 11.00, 24.00
Total Donth (ft)	- 170

Total Depth (ft) = 1.70

Invert Elev (ft) = 7446.19 Slope (%) = 6.70 N-Value = 0.035

Calculations

Triangular

Compute by: Known Q Known Q (cfs) = 73.40

Highlighted

Depth (ft) = 0.83Q (cfs) = 73.40Area (sqft) = 12.06Velocity (ft/s) = 6.09Wetted Perim (ft) = 29.10Crit Depth, Yc (ft) = 1.02Top Width (ft) = 29.05EGL (ft) = 1.41

Recommended BMP:

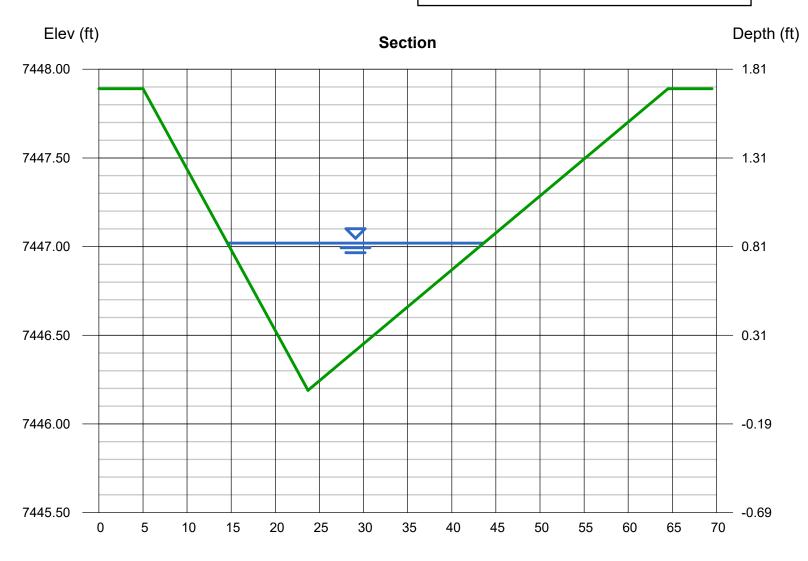
Froude No.

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION O-O NATURAL TERTIARY SWALE

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D 11	١.	,.	11

Bottom Width (ft) = 15.00 Side Slopes (z:1) = 4.00, 5.00 Total Depth (ft) = 12.00 Invert Elev (ft) = 1.00 Slope (%) = 5.30 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 73.40

Highlighted

Depth (ft) = 0.64Q (cfs) = 73.40Area (sqft) = 11.44Velocity (ft/s) = 6.41 Wetted Perim (ft) = 20.90Crit Depth, Yc (ft) = 0.84Top Width (ft) = 20.76EGL (ft) = 1.28Froude No. = 1.52

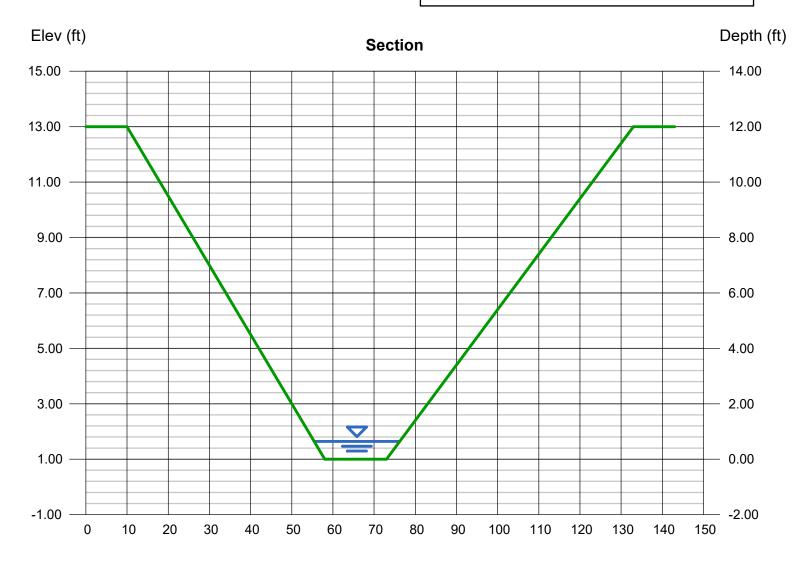
Recommended BMP:

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 18 2023

SECTION P-P NATURAL TERTIARY SWALE

Side Slopes (z:1)	= 5.00, 7.00
Total Depth (ft)	= 15.00
	4.00

Invert Elev (ft) = 1.00 Slope (%) = 5.10 N-Value = 0.035

Calculations

Triangular

Compute by: Known Q Known Q (cfs) = 40.00

Depth (ft) = 1.05 Q (cfs) = 40.00 Area (sqft) = 6.61 Velocity (ft/s) = 6.05

Area (sqft) = 6.61

Velocity (ft/s) = 6.05

Wetted Perim (ft) = 12.78

Crit Depth, Yc (ft) = 1.23

Top Width (ft) = 12.60

EGL (ft) = 1.62

Froude No. = 1.47

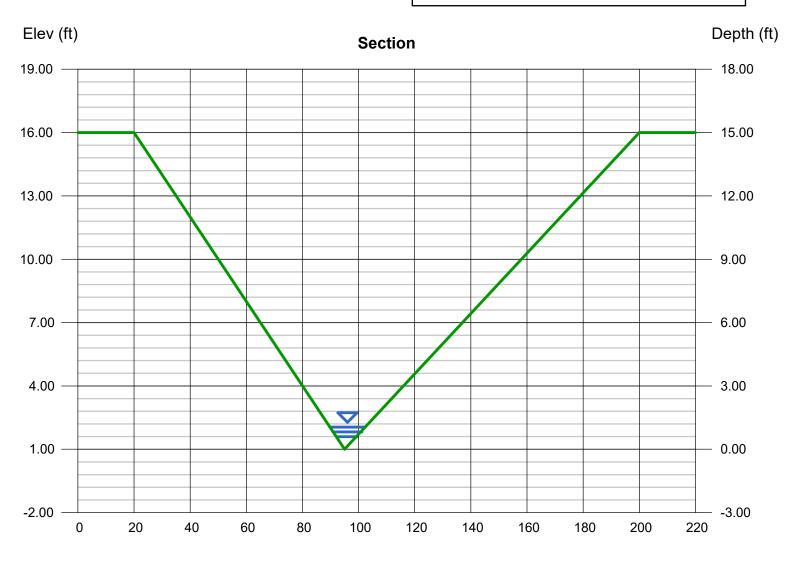
Recommended BMP:

Highlighted

Rollmax Permanent Turf Reinforcement Mat

TMAX (or equiv.)

Permissible Velocity (ft/s) = 25.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 25 2023

SECTION Q-Q ROADSIDE SWALE

Trapezoidal

Bottom Width (ft) = 11.80 Side Slopes (z:1) = 3.00, 3.00 Total Depth (ft) = 4.25 Invert Elev (ft) = 1.00 Slope (%) = 6.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 114.00 Highlighted

Depth (ft) = 0.92Q (cfs) = 114.00Area (sqft) = 13.40Velocity (ft/s) = 8.51 Wetted Perim (ft) = 17.62Crit Depth, Yc (ft) = 1.28Top Width (ft) = 17.32EGL (ft) = 2.05Froude No. = 1.71

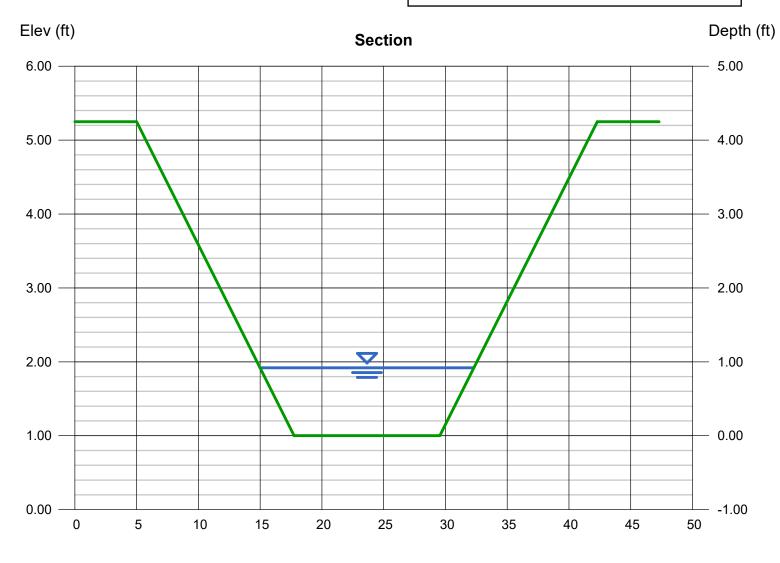
Recommended BMP:

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 25 2023

SECTION R-R ROADSIDE SWALE

Trapezoid	al
-----------	----

Bottom Width (ft) = 8.00 Side Slopes (z:1) = 4.00, 3.00 Total Depth (ft) = 3.25 Invert Elev (ft) = 1.00 Slope (%) = 6.00 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 32.90

Highlighted

Depth (ft) = 0.55Q (cfs) = 32.90Area (sqft) = 5.46Velocity (ft/s) = 6.03Wetted Perim (ft) = 12.01Crit Depth, Yc (ft) = 0.73Top Width (ft) = 11.85EGL (ft) = 1.11 Froude No. = 1.57

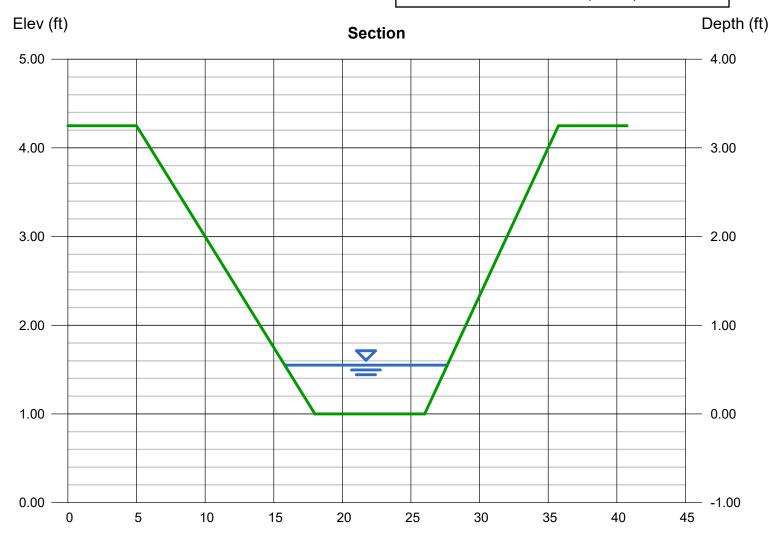
Recommended BMP:

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 25 2023

SECTION S-S ROADSIDE SWALE

Trapezoidal	
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 2.75
Invert Elev (ft)	= 1.00
OL (0/)	5.50

Invert Elev (ft) = 1.00 Slope (%) = 5.50 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 20.40

Depth (ft) = 0.50 Q (cfs) = 20.40 Area (sqft) = 3.87 Velocity (ft/s) = 5.26 Wetted Perim (ft) = 9.64 Crit Depth, Yc (ft) = 0.63

Top Width (ft) = 9.50 EGL (ft) = 0.93

Froude No. = 1.45

Recommended BMP:

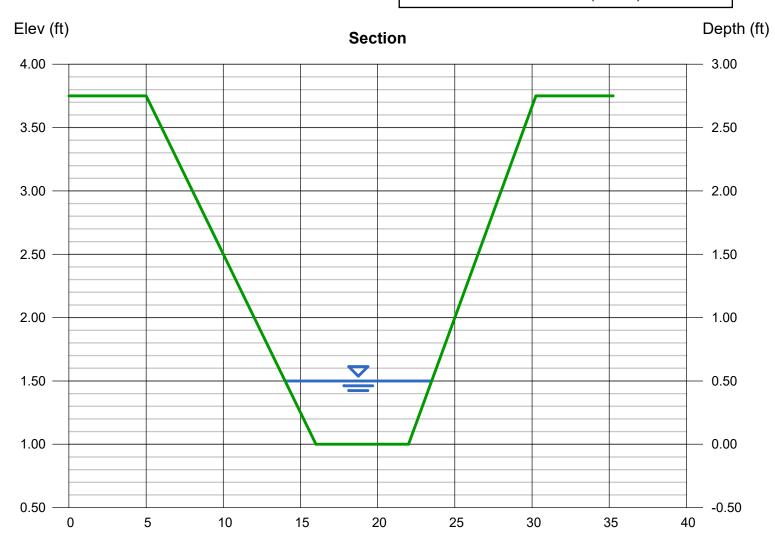
Highlighted

North American Green

Rollmax Permanent Turf Reinforcement Mat

P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0



Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Monday, Nov 13 2023

SECTION T-T NATURAL TERTIARY SWALE

Triangular

Side Slopes (z:1) = 11.00, 18.00

Total Depth (ft) = 1.50

Invert Elev (ft) = 7469.41 Slope (%) = 5.20 N-Value = 0.035

Calculations

Compute by: Known Q Known Q (cfs) = 73.40

Highlighted

= 0.94Depth (ft) Q (cfs) = 73.40Area (sqft) = 12.81Velocity (ft/s) = 5.73Wetted Perim (ft) = 27.33Crit Depth, Yc (ft) = 1.10Top Width (ft) = 27.26EGL (ft) = 1.45Froude No. = 1.47

Recommended BMP:

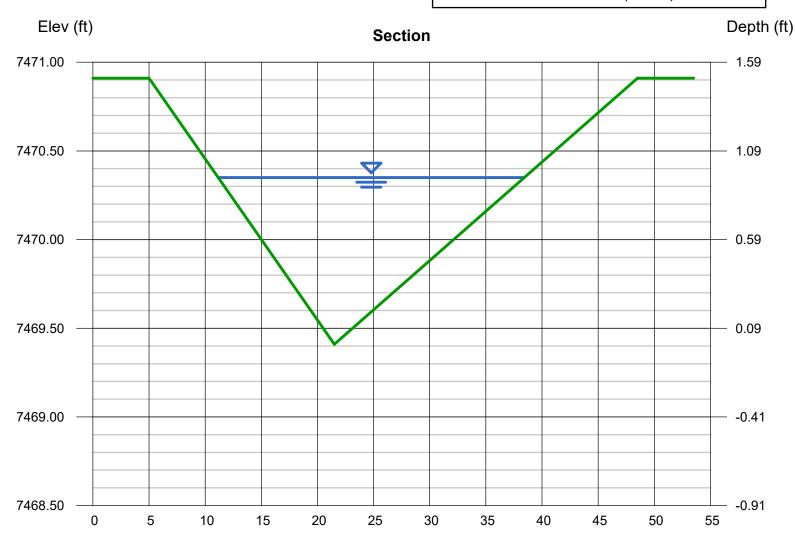
North American Green

Rollmax Permanent Turf Reinforcement Mat

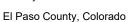
P300 (or equiv.)

Permissible Velocity (ft/s) = 9.0

Permissible Shear Stress (lb/ft^2) = 3.0



Reach (ft)





APPENDIX D

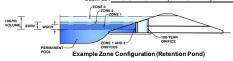
WATER QUALITY AND DETENTION CALCULATIONS

Provide spillway riprap, and trickle channel calculations. Also please move the forebay calcs to Appendix D with the other pond calcs.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 3 Basin ID: DESIGN POINT 2 (FLATS AREA)



Watershed Information

tershed Information		
Selected BMP Type =	EDB	
Watershed Area =	25.30	acres
Watershed Length =	1,800	ft
Watershed Length to Centroid =	400	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	32.24%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1 br Dainfall Donths -	Licor 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.		
Water Quality Capture Volume (WQCV) =	0.334	acre-feet
Excess Urban Runoff Volume (EURV) =	0.842	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.828	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.315	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.762	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	2.426	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	2.934	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	3.607	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	4.918	acre-feet
Approximate 2-yr Detention Volume =	0.607	acre-feet
Approximate 5-yr Detention Volume =	0.863	acre-feet
Approximate 10-yr Detention Volume =	1.239	acre-feet
Approximate 25-yr Detention Volume =	1.423	acre-feet
Approximate 50-yr Detention Volume =	1.498	acre-feet
Approximate 100-yr Detention Volume =	1.758	acre-feet

Optional Use	r Override:
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches
	•

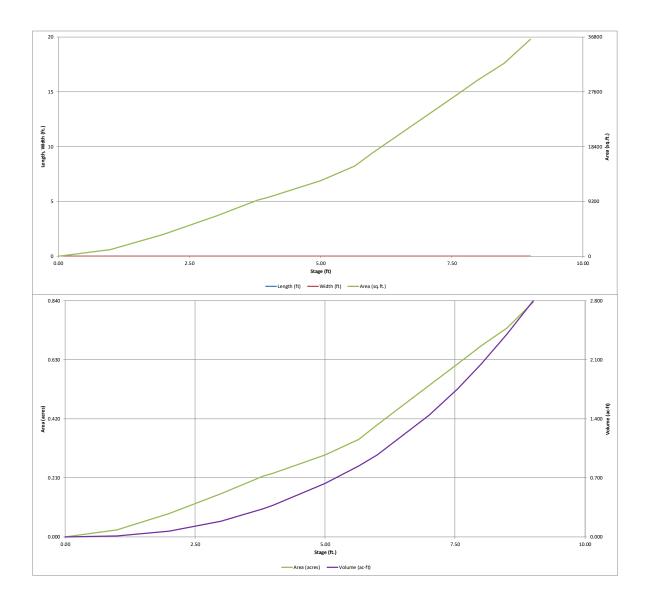
Define Zones and Basin Geometry

Define Zones and Dasin Geometry		
Zone 1 Volume (WQCV) =	0.334	acre-f
Zone 2 Volume (EURV - Zone 1) =	0.508	acre-f
Zone 3 Volume (100-year - Zones 1 & 2) =	0.916	acre-f
Total Detention Basin Volume =	1.758	acre-f
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 (Vtotal) =	user	acre-feet

	Stage - Storage	Stage	Optional Override	Length	Width	Area	Optional Override	Area	Volume	Volume
7555	Description Top of Micropool	(ft) 	Stage (ft) 0.00	(ft) 	(ft) 	(ft²) 	Area (ft ²)	(acre) 0.000	(ft ³)	(ac-ft)
7559	7560		1.00	_		_	1,088	0.025	544	0.012
				_		-				0.012
	7561		2.00				3,595	0.083	2,885	0.066
	7562 WOCV		3.00	-		-	6,689 9,400	0.154	8,027	0.184
	WQCV 7563			-		-			14,543 16,372	
			4.00 5.00	-		-	9,843	0.226		0.376
	7564 EURV						12,671	0.291	27,629	0.634
			5.65	-		-	15,107		36,656	0.842
	7565		6.00	-		-	17,364	0.399	42,339	0.972
	7566 100-YR		7.00 7.55	-		-	23,443 26,800	0.538 0.615	62,742 76,559	1.440 1.758
				_		_				2.049
	7567 CREST = 7567.5		8.00	_		-	29,574	0.679	89,243	
	7568		8.50 9.00	-		-	32,380 36,416	0.743 0.836	104,732 121,931	2.404
	/508		9.00	_		_	30,410	0.030	121,931	2./99
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MHFD-Detention_PondA.xksm, Basin 11/17/2023, 11:22 AM

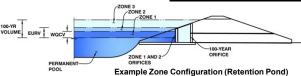


MHFD-Detention_PondA.xksm, Basin 11/17/2023, 11:22 AM

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 3 Basin ID: DESIGN POINT 2 (FLATS AREA)



	Estimated	Estimated	
	Stage (ft)	Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.81	0.334	Orifice Plate
Zone 2 (EURV)	5.66	0.508	Orifice Plate
Zone 3 (100-year)	7.56	0.916	Weir&Pipe (Restrict)
•	Total (all zones)	1.758	

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

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

Calculated Parameters for Underdrain Underdrain Orifice Area N/A Underdrain Orifice Centroid : feet N/A

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) Depth at top of Zone using Orifice Plate 5.50 ft (relative to basin bottom at Stage = 0 ft) Orifice Plate: Orifice Vertical Spacing N/A inches Orifice Plate: Orifice Area per Row = N/A sa, inches 5.9' per plans. Verify

Calculated Parameters for Plate WQ Orifice Area per Row N/A ft² Elliptical Half-Width N/A feet Elliptical Slot Centroid N/A feet ft² Elliptical Slot Area : N/A

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

Row 1 (required) Row 2 (optional) Row 3 (optional) Row 4 (optional) Row 5 (optional) Row 6 (optional) Row 7 (optional) Row 8 (optional) Stage of Orifice Centroid (ft 0.00 2.00 Orifice Area (sq. inches) 1.20 2.15

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

User Input: Vertical Orifice (Circular or Rectangular)

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

N/A

Calculated Parameters for Vertical Orif Not Selected Not Selected Vertical Orifice Area N/A N/A Vertical Orifice Centroid : N/A N/A

User Input: Overflow Weir (Dropbox with Flat or	Calculated Parameters for Overflow W				
	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	6.00	N/A	ft (relative to basin bottom at Stage = 0 ft) Height of Grate Upper Edge, H_t =	6.00	N/A
Overflow Weir Front Edge Length =	6.00	N/A	feet Overflow Weir Slope Length =	3.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V Grate Open Area / 100-yr Orifice Area =	10.83	N/A
Horiz. Length of Weir Sides =	3.00	N/A	feet Overflow Grate Open Area w/o Debris =	12.53	N/A
Overflow Grate Type =	Type C Grate	N/A	Overflow Grate Onen Area w/ Debris =	6.26	N/A

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

50%

8.50

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla Zone 3 Restrictor Not Selected Zone 3 Restrictor Not Selected Depth to Invert of Outlet Pipe 0.50 N/A Outlet Orifice Area N/A ft (distance below basin bottom at Stage = 0 ft) 1.16 24.00 Outlet Orifice Centroid N/A Outlet Pipe Diameter N/A inches 0.46 Restrictor Plate Height Above Pipe Invert = 9.50 inches Half-Central Angle of Restrictor Plate on Pipe = 1.36 N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

ft (relative to basin bottom at Stage = 0 ft)

В

Spillway Crest Length = 25.00 Spillway End Slopes = 4.00 Freeboard above Max Water Surface = 1.00

Spillway Invert Stage=

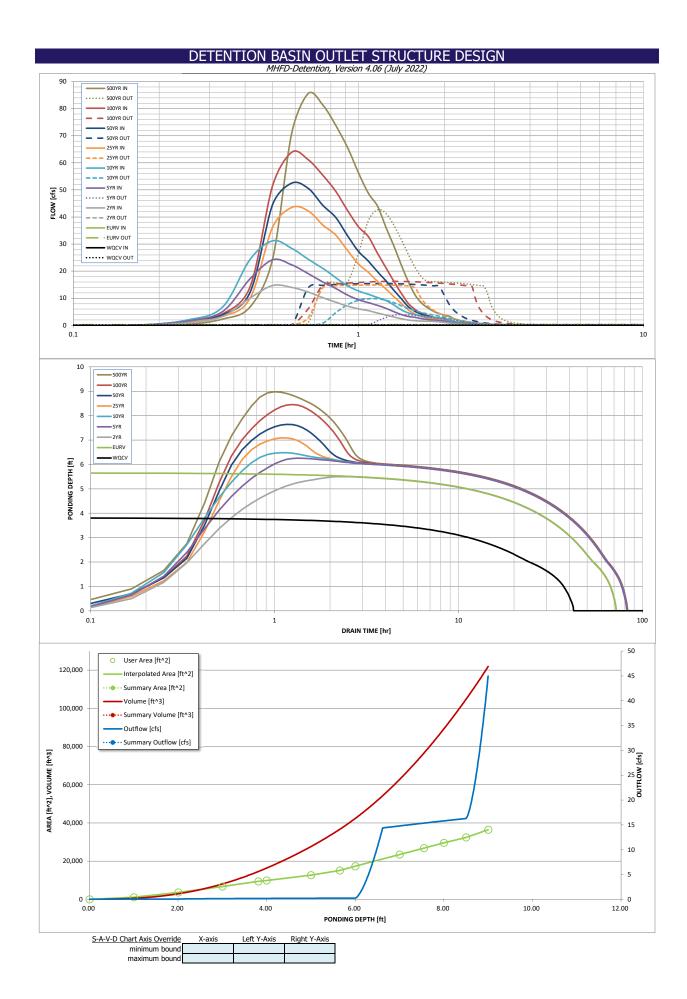
Debris Clogging % =

Add spillway detail in CDs so this can be verified

		Calculated Paramet	ters for Spillway
	Spillway Design Flow Depth=	0.83	feet
	Stage at Top of Freeboard =	10.33	feet
	Basin Area at Top of Freeboard =	0.84	acres
3a	sin Volume at Top of Freeboard =	2.80	acre-ft

Routed Hydrograph Results	The user can overi	ride the default CUF	HP hydrographs and	d runoff volumes by	entering new value	es in the Inflow Hyd	lrographs table (Col	lumns W through Al
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.334	0.842	0.828	1.315	1.762	2.426	2.934	3.607
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.828	1.315	1.762	2.426	2.934	3.607
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.0	10.9	16.1	28.3	35.4	44.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.16	0.43	0.64	1.12	1.40	1.75
Peak Inflow Q (cfs) =	N/A	N/A	14.7	24.2	31.2	43.5	52.5	63.9
Peak Outflow Q (cfs) =	0.2	0.2	0.2	4.0	9.8	14.9	15.4	16.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.5	0.4	0.4
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.3	0.8	1.2	1.2	1.3
Max Velocity through Grate 2 (fps) =		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	64	64	70	67	63	61	59
Time to Drain 99% of Inflow Volume (hours) =	40	68	68	77	76	74	73	72
Maximum Ponding Depth (ft) =	3.82	5.66	5.50	6.25	6.48	7.08	7.64	8.45
Area at Maximum Ponding Depth (acres) =	0.22	0.35	0.33	0.43	0.46	0.55	0.63	0.74
Maximum Volume Stored (acre-ft) =	0.336	0.845	0.787	1.076	1.175	1.484	1.807	2.367

MHFD-Detention PondA.xlsm, Outlet Structure 11/17/2023, 11:22 AM



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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]		10 Year [cfs]			100 Year [cfs]	
	0:00:00									
5.00 min	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	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	1.55	1.93	1.30	1.63	1.60	2.30
	0:20:00	0.00	0.00	3.31	5.09	6.71	3.28	3.83	4.27	6.78
	0:25:00	0.00	0.00	10.10	17.17	24.32	10.02	12.14	14.18	24.52
	0:30:00	0.00	0.00	14.72	24.19	31.21	36.23	44.60	51.55	71.06
	0:35:00	0.00	0.00	14.02	22.32	28.42	43.51	52.50	63.88	85.54
	0:40:00	0.00	0.00	12.28	19.07	24.39	42.25	50.54	61.11	81.34
	0:45:00	0.00	0.00	10.21	16.02	21.02	37.05	44.30	55.38	73.68
	0:50:00	0.00	0.00	8.54	13.61	17.56	33.24	39.74	49.35	65.56
	0:55:00 1:00:00	0.00	0.00	7.10	11.14	14.54 12.70	27.55	33.02	42.33 36.39	56.29 48.75
	1:05:00	0.00	0.00	6.09 5.42	9.46 8.36	11.44	22.63 19.54	27.28 23.70	32.74	44.02
	1:10:00	0.00	0.00	4.56	7.40	10.29	16.23	19.78	26.60	36.09
	1:15:00	0.00	0.00	3.78	6.26	9.17	13.39	16.39	21.23	29.15
	1:20:00	0.00	0.00	3.06	5.04	7.49	10.53	12.85	16.11	22.03
	1:25:00	0.00	0.00	2.43	3.98	5.69	8.02	9.72	11.67	15.91
	1:30:00	0.00	0.00	1.95	3.27	4.54	5.61	6.78	7.95	11.07
	1:35:00	0.00	0.00	1.69	2.93	3.89	4.16	5.11	5.78	8.20
	1:40:00	0.00	0.00	1.58	2.50	3.46	3.30	4.09	4.51	6.45
	1:45:00 1:50:00	0.00	0.00	1.52 1.48	2.18 1.95	3.15 2.95	2.76	3.43 2.98	3.62 3.00	5.22 4.37
	1:55:00	0.00	0.00	1.48	1.77	2.70	2.39 2.16	2.70	2.58	3.77
	2:00:00	0.00	0.00	1.13	1.60	2.33	2.00	2.50	2.28	3.35
	2:05:00	0.00	0.00	0.86	1.20	1.74	1.48	1.85	1.64	2.41
	2:10:00	0.00	0.00	0.64	0.88	1.26	1.08	1.34	1.19	1.74
	2:15:00	0.00	0.00	0.48	0.65	0.90	0.78	0.97	0.87	1.26
	2:20:00	0.00	0.00	0.35	0.47	0.65	0.57	0.70	0.64	0.93
	2:25:00	0.00	0.00	0.26	0.33	0.47	0.40	0.50	0.46	0.66
	2:30:00	0.00	0.00	0.18	0.23	0.33	0.29	0.35	0.32	0.47
	2:35:00 2:40:00	0.00	0.00	0.13	0.16 0.10	0.23 0.15	0.20 0.14	0.25 0.17	0.23 0.15	0.33 0.22
	2:45:00	0.00	0.00	0.05	0.10	0.13	0.14	0.17	0.13	0.22
	2:50:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.06
	2:55:00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.01	0.02
	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 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 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 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 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 5:15:00	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
	5:25:00	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 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
ļ	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	D : D : E	E (
	Design Procedure Form:	Extended Detention Basin (EDB)	
	Pishadh as PE		Sheen of 3
Designer: Company:	Richard Lyon, PE HR Green		
Date:	August 2, 2023		
Project:	Flying Horse North Filing 3 - Pond A		
Location:	El Paso County, Colorado		
6. Trickle Channel		Choose One	
A) T	Observation of the control of the co	© Concrete	
A) Type of Trick	KIE Channel	Soft Bottom	
E) 01 (T)		0 0000 000	
F) Slope of Tric	okie Channel	S = 0.0100 ft / ft	
7 Migrapped and (Putlat Structura		
7. Micropool and 0	Juliot Oil dold!6		l
A) Depth of Mid	cropool (2.5-feet minimum)	D _M = 2.5 ft	l
B) Surface Area	a of Micropool (10 ft ² minimum)	$A_{M} = 50$ sq ft	
C) Outlet Type			
C) Odder Type		Choose One	
		Orifice Plate	
		Other (Describe):	
D) Smallest Dir	nension of Orifice Opening Based on Hydrograph Routing		
(Use UD-Deten		D _{crifice} =inches	SEE MHFD
E) Total Outlet A	Area	A _{ot} = square inches	CALCULATIONS
, .			
Initial Surcharge	e Volume		
A) Denth of Init	ial Suraharga Valuma	D _{IS} = 6 in	
	ial Surcharge Volume commended depth is 4 inches)	D _{IS} = 6 in	
P) Minimum Initi	ial Surcharge Volume	V _{IS} = 41 cu ft	
	lume of 0.3% of the WQCV)	V _{IS} – 41 Cult	
C) Initial Surcha	arge Provided Above Micropool	V _s = 25.0 cu ft	
O) Illidai Guione	inge i Tovided Above Micropool	v _s 25.0 cu it	
9. Trash Rack			
	1 0 0 A A + 00 E+/ -0 005D		
A) Water Quali	ty Screen Open Area: A _t = A _{ot} * 38.5*(e ^{-0.095D})	A _t = square inches	
	en (If specifying an alternative to the materials recommended indicate "other" and enter the ratio of the total open are to the		
	for the material specified.)		
	Other (Y/N): N		
	Oulei (1/N).	-	
C) Ratio of Tota	l Open Area to Total Area (only for type 'Other')	User Ratio =	l
· ·			l
D) Total Water	Quality Screen Area (based on screen type)	A _{total} =sq. in.	
	sign Volume (EURV or WQCV)	H=feet	SEE MHFD
(Based on o	design concept chosen under 1E)		CALCULATIONS
F) Height of Wa	iter Quality Screen (H _{TR})	H _{TR} = inches	
G) Width of Wa	ter Quality Screen Opening (W _{opening})	W _{opening} = inches	
	inches is recommended)	opoling	

UD-BMP_v3.07_Pond A, EDB 8/2/2023, 9:49 AM

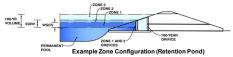
	Design Procedure Form:	Extended Detention Basin (EDB)					
Company: HF Date: Au Project: Fly	Richard Lyon, PE HR Green August 2, 2023 Flying Horse North Filing 3 - Pond A El Paso County, Colorado						
B) Slope of Overflow	xment protection for 100-year and greater overtopping:	Soil rip-rap Ze = 4.00 ft / ft Choose One					
12. Access A) Describe Sediment Removal Procedures Notes:		15' width maintenance path from cul-de-sac with max 2.0% cross slope and max 15% longitudinal slope provided to access forebay and outlet structure.					

UD-BMP_v3.07_Pond A, EDB 8/2/2023, 9:49 AM

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 3 Basin ID: POND B - DESIGN POINT 17 (SW POND ESTATES AREA)



Watershed Information

tersifed Information					
Selected BMP Type =	EDB				
Watershed Area =	128.40	acres			
Watershed Length =	4,000	ft			
Watershed Length to Centroid =	665	ft			
Watershed Slope =	0.050	ft/ft			
Watershed Imperviousness =	10.04%	percent			
Percentage Hydrologic Soil Group A =	0.0%	percent			
Percentage Hydrologic Soil Group B =	100.0%	percent			
Percentage Hydrologic Soil Groups C/D =	0.0%	percent			
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 Hydro	graph Procedu	ıre.
Water Quality Capture Volume (WQCV) =	0.719	acre-feet
Excess Urban Runoff Volume (EURV) =	1.212	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.712	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	3.777	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	5.836	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	9.505	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	12.010	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	15.612	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	22.181	acre-feet
Approximate 2-yr Detention Volume =	0.774	acre-feet
Approximate 5-yr Detention Volume =	1.214	acre-feet
Approximate 10-yr Detention Volume =	2.515	acre-feet
Approximate 25-yr Detention Volume =	3.510	acre-feet
Approximate 50-yr Detention Volume =	3.673	acre-feet
Approximate 100-yr Detention Volume =	4.746	acre-feet

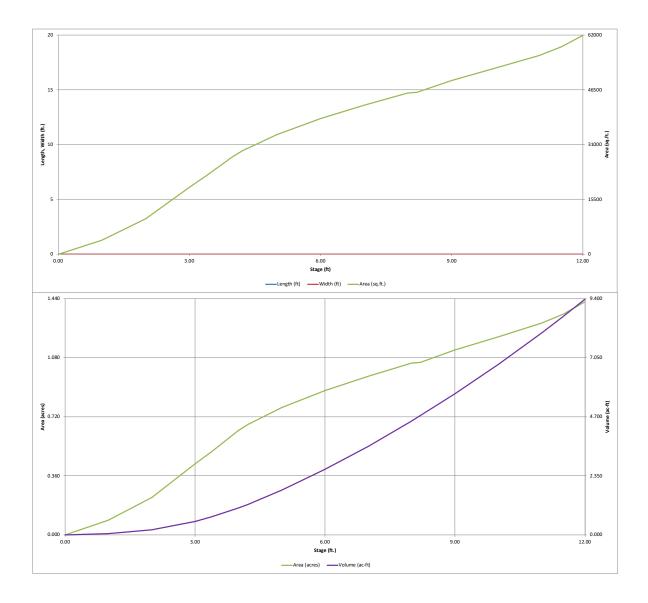
Optional Usei	r Overrides
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Define Zones and bas	iii deoilleu y		
Zone	1 Volume (WQCV) =	0.719	acre-t
Zone 2 Volum	e (EURV - Zone 1) =	0.493	acre-t
Zone 3 Volume (100-y	vear - Zones 1 & 2) =	3.534	acre-t
Total Dete	ntion Basin Volume =	4.746	acre-t
Initial Surch	arge Volume (ISV) =	user	ft 3
Initial Sur	harge Depth (ISD) =	user	ft
Total Available Dete	ntion Depth (H _{total}) =	user	ft
Depth of Tr	ickle Channel (H _{TC}) =	user	ft
Slope of Tr	ickle 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	ft²
Surcharge Volume Length $(L_{ISV}) =$	user	ft
Surcharge Volume Width $(W_{ISV}) =$	user	ft
Depth of Basin Floor (HFLOOR) =	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	ft²
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	ft²
Volume of Main Basin (V _{MAIN}) =	user	ft ³
Calculated Total Basin Volume (V_{total}) =	user	acre-fe

_			1							
	Depth Increment =	1.00	ft Optional				Optional		1	
	Stage - Storage	Stage	Override	Length	Width	Area	Override	Area	Volume	Volume
	Description	(ft)	Stage (ft)	(ft)	(ft)	(ft²)	Area (ft 2)	(acre)	(ft ³)	(ac-ft)
7365	Top of Micropool		0.00				0	0.000		
	7366		1.00				3,911	0.090	1,955	0.045
	7367		2.00				9,957	0.229	8,889	0.204
	7368		3.00				18,895	0.434	23,315	0.535
	wqcv		3.39				22,200	0.510	31,329	0.719
	7369		4.00			-	27,693	0.636	46,546	1.069
	EURV		4.22				29,300	0.673	52,815	1.212
	7370		5.00				33,822	0.776	77,433	1.778
	7371		6.00	-		-	38,334	0.880	113,511	2.606
	7372		7.00			-	42,141	0.967	153,748	3.530
	7373		8.00			-	45,586	1.047	197,612	4.537
	100-YR		8.20				45,800	1.051	206,751	4.746
	7374		9.00				49,080	1.127	244,703	5.618
	7375		10.00				52,621	1.208	295,553	6.785
errides	7376		11.00			-	56,208	1.290	349,968	8.034
-feet	CREST=7376.5		11.50				58,604	1.345	378,671	8.693
-feet	7377		12.00	ŀ	-	+	61,950	1.422	408,809	9.385
es				-		-				
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MHFD-Detention_PondBv2.xlsm, Basin 11/17/2023, 11:18 AM

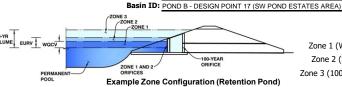


MHFD-Detention_PondBv2.xism, Basin 11/17/2023, 11:18 AM

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO.



	Estimated	Estimated	
_	Stage (ft)	Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.40	0.719	Orifice Plate
Zone 2 (EURV)	4.22	0.493	Orifice Plate
Zone 3 (100-year)	8.20	3.534	Weir&Pipe (Restrict)
·	Total (all zones)	4.746	

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

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

Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

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

Centroid of Lowest Orifice =

Depth at top of Zone using Orifice Plate =

Orifice Plate: Orifice Vertical Spacing =

Orifice Plate: Orifice Area per Row =

e =	0.00	ft (relative to	b basin bottom at Stage = 0 ft)
e =	4.50	ft (relative to	b basin bottom at Stage = 0 ft)
g =	N/A	inches	V: 6 - 4 O l
N =	N/A	sq. inches	Verify 4.8 per plans

 BMP)
 Calculated Parameters for Plate

 WQ Orifice Area per Row =
 N/A
 ft²

 Elliptical Half-Width =
 N/A
 feet

 Elliptical Slot Centroid =
 N/A
 feet

 Elliptical Slot Area =
 N/A
 ft²

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

	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	4.22						
Orifice Area (sq. inches)	4.16	0.50						

	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)	` ' '	` '	1	` '	``	``	` '	` '
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

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

	Calculated Parameters for Vertical Orif				
	Not Selected	Not Selected			
Vertical Orifice Area =	N/A	N/A			
Vertical Orifice Centroid =	N/A	N/A			

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	
Overflow Weir Front Edge Height, Ho =	4.50	N/A	ft (relative to basin bottom at Stage = 0 ft) Height of G
Overflow Weir Front Edge Length =	12.00	N/A	feet Overflow
Overflow Weir Grate Slope =	0.00	N/A	H:V Grate Open Area
Horiz. Length of Weir Sides =	12.00	N/A	feet Overflow Grate O
Overflow Grate Type =	Type C Grate	N/A	Overflow Grate 0
Debris Clogging % =	50%	N/A	%

tiet Pipe)	Calculated Parame	ters for Overflow W
	Zone 3 Weir	Not Selected
ft) Height of Grate Upper Edge, H_t =	4.50	N/A
Overflow Weir Slope Length =	12.00	N/A
Grate Open Area / 100-yr Orifice Area =	18.33	N/A
Overflow Grate Open Area w/o Debris =	100.22	N/A
Overflow Grate Open Area w/ Debris =	50.11	N/A

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (dista
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	26.00		inches

ft (distance below basin bottom at Stage = 0 ft) inches

 $\frac{\text{Calculated Parameters for Outlet Pipe w/ Flow Restriction Place}}{\text{Zone 3 Restrictor}} \frac{\text{Zone 3 Restrictor}}{\text{Not Selected}} = \frac{5.47}{\text{N/A}} \frac{\text{N/A}}{\text{N/A}}$ $\frac{\text{Outlet Orifice Centroid}}{\text{Control of Place Orifice Centroid}} = \frac{1.20}{2.03} \frac{\text{N/A}}{\text{N/A}}$ $\frac{\text{N/A}}{\text{N/A}} = \frac{1.20}{2.03} \frac{\text{N/A}}{\text{N/A}}$

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	11.50	ft (r
Spillway Crest Length =	50.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	3.30	feet

(relative to basin bottom at Stage = 0 ft)

Add spillway detail in CDs so this can be verified

	Calculated Paramet	ters for Spillway
Spillway Design Flow Depth=	1.34	feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =	1.42	acres
Basin Volume at Top of Freeboard =	9.38	acre-ft

Routed Hydrograph Results

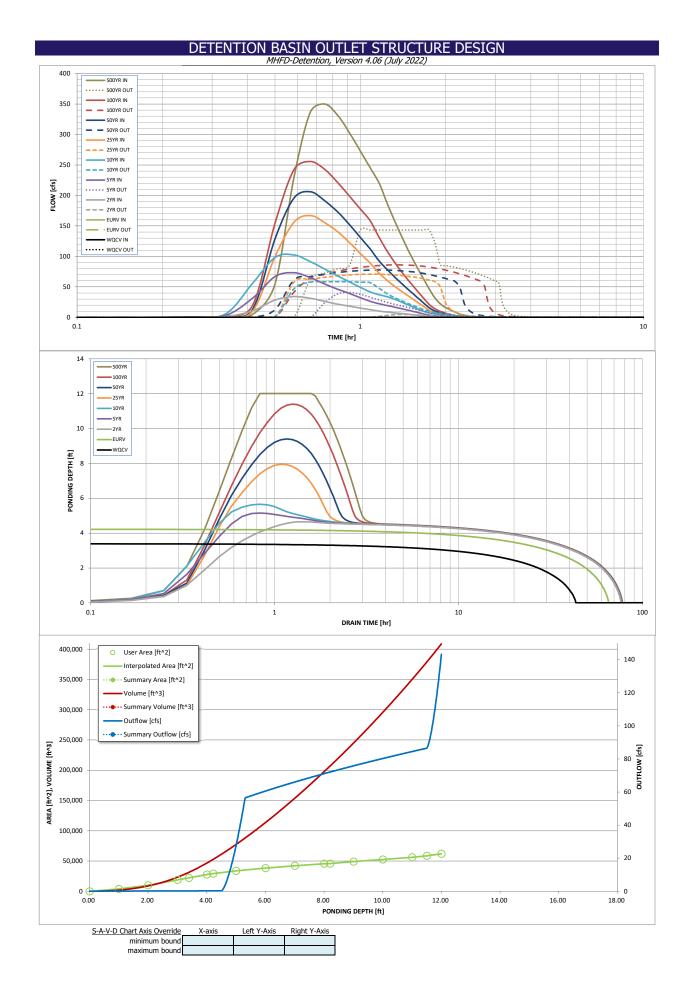
Design Storm Return Period
One-Hour Rainfall Depth (in)

OF

one nou raman bepar (iii) -
CUHP Runoff Volume (acre-ft) =
Inflow Hydrograph Volume (acre-ft) =
CUHP Predevelopment Peak Q (cfs) =
PTIONAL Override Predevelopment Peak Q (cfs) =
Predevelopment Unit Peak Flow, q (cfs/acre) =
Peak Inflow Q (cfs) =
Peak Outflow Q (cfs) =
Ratio Peak Outflow to Predevelopment Q =
Structure Controlling Flow =
Max Velocity through Grate 1 (fps) =
Max Velocity through Grate 2 (fps) =
Time to Drain 97% of Inflow Volume (hours) =
Time to Drain 99% of Inflow Volume (hours) =
Maximum Ponding Depth (ft) =

Area at Maximum Ponding Depth (acres) Maximum Volume Stored (acre-ft)

_	rne user can overi	ide the default Cur	ap nyarographs and	i runorr volumes by	entering new value	es in the Innow Hyd	rographs table (Col	umns w through Ai
1 =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
) =	0.719	1.212	1.712	3.777	5.836	9.505	12.010	15.612
) =	N/A	N/A	1.712	3.777	5.836	9.505	12.010	15.612
) =	N/A	N/A	21.6	60.5	90.2	156.2	196.0	245.6
) =	N/A	N/A						
) =	N/A	N/A	0.17	0.47	0.70	1.22	1.53	1.91
) =	N/A	N/A	34.0	73.1	102.2	167.0	206.1	255.5
) =	0.3	0.3	4.7	40.8	58.6	70.9	77.6	86.1
) =	N/A	N/A	N/A	0.7	0.6	0.5	0.4	0.4
<i>i</i> =	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
) =	N/A	N/A	0.04	0.4	0.6	0.7	0.8	0.9
) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
) =	40	61	71	66	62	56	52	46
) =	42	64	74	72	71	68	66	64
) =	3.39	4.22	4.65	5.15	5.66	7.95	9.40	11.40
) =	0.51	0.67	0.73	0.79	0.84	1.04	1.16	1.33
) =	0.719	1.212	1.507	1.887	2.304	4.484	6.063	8.546



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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]		10 Year [cfs]		50 Year [cfs]		
5.00 min	0:00:00									
5.00 min	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	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.51	0.63	0.00	0.54	0.52	0.78
	0:20:00	0.00	0.00	1.21	2.95	5.26	1.21	1.42	1.51	4.98
	0:25:00	0.00	0.00	10.68	31.36	55.82	10.14	13.30	19.55	54.54
	0:30:00	0.00	0.00	28.42	66.78	98.24	99.45	128.55	154.20	230.29
	0:35:00	0.00	0.00	33.98	73.15	102.23	156.12	195.91	242.38	336.87
	0:40:00	0.00	0.00	31.23	65.13	91.38	167.03	206.14	255.53	349.97
	0:45:00	0.00	0.00	26.10	54.48	79.00	155.12	190.98	242.47	330.99
	0:50:00	0.00	0.00	21.53	46.03	67.71	140.15	172.64	220.73	302.46
	0:55:00	0.00	0.00	18.23	39.06	58.09	122.53	151.98	198.55	273.07
	1:00:00	0.00	0.00	15.28	32.32	49.23	104.82	131.10	177.90	245.38
	1:05:00	0.00	0.00	12.59 10.20	26.33 22.16	41.63 36.87	88.96 72.26	112.21 92.16	158.58 130.72	219.77 184.53
	1:15:00	0.00	0.00	8.53	19.20	33.63	59.86	77.41	107.13	154.57
	1:20:00	0.00	0.00	7.16	16.31	29.08	49.68	64.52	87.81	127.57
	1:25:00	0.00	0.00	5.93	13.56	23.88	40.98	53.21	71.37	103.66
	1:30:00	0.00	0.00	4.73	10.92	18.95	32.94	42.85	57.26	83.12
	1:35:00	0.00	0.00	3.56	8.38	14.35	25.48	33.28	44.28	64.35
	1:40:00	0.00	0.00	2.43	5.66	10.13	18.37	24.23	32.16	47.03
	1:45:00	0.00	0.00	1.53	3.55	7.20	11.75	15.84	21.26	32.02
	1:50:00	0.00	0.00	1.09	2.48	5.63	7.42	10.47	14.13	22.22
	1:55:00	0.00	0.00	0.87	1.95	4.59	4.93	7.35	9.78	16.10
	2:00:00	0.00	0.00	0.73	1.60	3.70	3.44	5.43	6.88	11.94
	2:05:00 2:10:00	0.00	0.00	0.57 0.43	1.24 0.93	2.88 2.17	2.31 1.55	3.82 2.64	4.59 2.88	8.37 5.55
	2:15:00	0.00	0.00	0.43	0.69	1.59	1.03	1.80	1.68	3.50
	2:20:00	0.00	0.00	0.24	0.51	1.13	0.66	1.20	0.92	2.13
	2:25:00	0.00	0.00	0.18	0.37	0.78	0.45	0.83	0.60	1.42
	2:30:00	0.00	0.00	0.14	0.27	0.53	0.32	0.58	0.44	0.99
	2:35:00	0.00	0.00	0.11	0.19	0.37	0.22	0.41	0.33	0.73
	2:40:00	0.00	0.00	0.08	0.13	0.28	0.16	0.30	0.25	0.55
	2:45:00	0.00	0.00	0.06	0.09	0.20	0.12	0.23	0.19	0.42
	2:50:00	0.00	0.00	0.04	0.05	0.14	0.09	0.16	0.14	0.30
	2:55:00 3:00:00	0.00	0.00	0.03	0.03	0.09	0.06	0.11	0.09	0.21
	3:05:00	0.00	0.00	0.02	0.02	0.05 0.02	0.04	0.07 0.04	0.06	0.13 0.07
	3:10:00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.01	0.03
	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 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 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 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 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 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 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
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Design Procedure Form: Extended Detention Basin (EDB)					
	UD-BMP	(Version 3.07, March 2018) Sheet 1 of 3			
Designer:	Richard Lyon, PE				
Company:	HR Green				
Date:	August 2, 2023				
Project:	Flying Horse North Filing 3 - Pond B				
Location:	El Paso County, Colorado				
Basin Storage	Volume				
A) Effective Imp	perviousness of Tributary Area, I _a	l _a = 10.1 %			
B) Tributary Are	ea's Imperviousness Ratio (i = I _a / 100)	i = 0.101			
C) Contributing	g Watershed Area	Area = 127.600 ac			
	heds Outside of the Denver Region, Depth of Average	$d_6 = 0.42$ in			
Runoπ Proc	ducing Storm	r Choose One			
E) Design Con		Water Quality Capture Volume (WQCV)			
(Select EUR	V when also designing for flood control)	Excess Urban Runoff Volume (EURV)			
	ime (WQCV) Based on 40-hour Drain Time	V _{DESIGN} = ac-ft			
	1.0 * (0.91 * i ³ - 1.19 * i ² + 0.78 * i) / 12 * Area)				
	heds Outside of the Denver Region,	V _{DESIGN OTHER} = ac-ft			
Water Qual	ity Capture Volume (WQCV) Design Volume				
(∨ wqcv othe	$_{\rm fit} = (d_6^*(V_{\rm DESIGN}/0.43))$				
	of Water Quality Capture Volume (WQCV) Design Volume	V _{DESIGN USER} = 0.719 ac-ft			
, ,	fferent WQCV Design Volume is desired)				
	ologic Soil Groups of Tributary Watershed	UCC - W			
	age of Watershed consisting of Type A Soils age of Watershed consisting of Type B Soils	$\begin{array}{c c} \operatorname{HSG}_{A} = & 0 & \% \\ \operatorname{HSG}_{B} = & 100 & \% \end{array}$			
iii) Percen	tage of Watershed consisting of Type C/D Soils	HSG _{C/D} = 0 %			
	an Runoff Volume (EURV) Design Volume				
	x: EURV _A = 1.68 * i ^{1.28}	EURV _{DESIGN} = ac-f t			
	l: EURV _B = 1.36 * i ^{1.08} c/D: EURV _{C/D} = 1.20 * i ^{1.08}				
K) Hear Input	of Excess Urban Runoff Volume (EURV) Design Volume	EURV _{DESIGN USER} = 1.212 ac-f t			
	fferent EURV Design Volume is desired)	LOTV DESIGN USER 1.212 do-11			
	ength to Width Ratio	L:W= 2.0:1			
(A basin length	to width ratio of at least 2:1 will improve TSS reduction.)				
Basin Side Slop	nes				
					
	num Side Slopes distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft			
(HORIZONTAI	uistance per unit ventical, 4.1 or natter preferred)				
4. Inlet		Upstream roadside swales will be piped to a Rock Chute (rip-rap rundown) to the forebay.			
		All other flows will enter as sheet flow, there are no concentrated flows other than the chute.			
A) Describe me inflow locati	eans of providing energy dissipation at concentrated				
iiiiow iocati					
5. Forebay					
•					
A) Minimum Fo	orebay Volume ₁ = 3% of the WQCV)	V _{FMIN} = ac-ft			
B) Actual Fore	bay Volume	V _F = 0.022 ac-ft			
C) Forebay Dep					
(D _F	= <u>18</u> inch maximum)	D _F = 18.0 in			
D) Forebay Dis	charge				
i) Undetain	ed 100-year Peak Discharge	Q ₁₀₀ = 282.00 cfs			
ii) Forebay (Q _F = 0.0	Discharge Design Flow 12 * Q ₁₀₀)	Q _F = 5.64 cfs			
E) Forebay Dis	charge besign	Choose One Berm With Pipe Flow too small for berm w/ pipe			
		Wall with Rect. Notch			
		Wall with V-Notch Weir			
E) D: D	ing Size (minimum 9 inghes)	Calculated $D_P =$			
r) bischarge P	ipe Size (minimum 8-inches)				
G) Rectangular	Notch Width	Calculated W _N = 14.7 in			

UD-BMP_v3.07_Pond B, EDB 8/2/2023, 9:50 AM

Designer: Richard Lyon, PE Company: HR Green Date: August 2, 2023 Project: Flying Horse North Filing 3 - Pond B Location: El Paso County, Colorado	Sheet 2 of 3
Company: HR Green Date: August 2, 2023 Project: Flying Horse North Filing 3 - Pond B	
Date: August 2, 2023 Project: Flying Horse North Filing 3 - Pond B	
Project: Flying Horse North Filing 3 - Pond B	
· · · · · · · · · · · · · · · · · · ·	
6. Trickle Channel	
A) Type of Trickle Channel Soft Bottom FOR A CONCRETE TE SLOPE SHOULD BE E 0.004 AND 0.010 FT/F	BETWEEN
F) Slope of Trickle Channel S = 0.0250 ft / ft	
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum) $D_{M} = 2.5 mtext{ft}$	
B) Surface Area of Micropool (10 ft² minimum) A _M = 50 sq ft	
C) Outlet Type Choose One Choose One Other (Describe):	
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) D _{orifice} =inches	SEE MHFD
E) Total Outlet Area A _{ct} = square inches	ALCULATIONS
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	
B) Minimum Initial Surcharge Volume V _{IS} = 94 cu ft (Minimum volume of 0.3% of the WQCV)	
C) Initial Surcharge Provided Above Micropool V_s = 25.0 cu ft	
9. Trash Rack	
A) Water Quality Screen Open Area: A _t = A _{ct} * 38.5*(e ^{-0.095D}) A _t =square inches	
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other') User Ratio =	
D) Total Water Quality Screen Area (based on screen type) Atotal =sq. in.	
	SEE MHFD
F) Height of Water Quality Screen (H _{TR}) H _{TR} = inches	ALCULATIONS
G) Width of Water Quality Screen Opening (Wopening) (Minimum of 12 inches is recommended) Wopening =	

UD-BMP_v3.07_Pond B, EDB 8/2/2023, 9:50 AM

	Design Procedure For	m: Extended Detention Basin (EDB)
Designer: Company: Date: Project: Location:	Richard Lyon, PE HR Green August 2, 2023 Flying Horse North Filing 3 - Pond B El Paso County, Colorado	Sheet 3 of 3
B) Slope of Ove	nbankment protection for 100-year and greater overtopping: rerflow Embankment distance per unit vertical, 4:1 or flatter preferred)	Soil rip-rap Ze = 4.00 ft / ft Choose One O Irrigated Not Irrigated
12. Access A) Describe Se	ediment Removal Procedures	15' width maintenance path from cul-de-sac with max 2.0% cross slope and max 15% longitudinal slope provided to access forebay and outlet structure.

UD-BMP_v3.07_Pond B, EDB 8/2/2023, 9:50 AM

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 3



EDB

248.90

5,500

0.017

percent

percent

acre-feet

1.19 inches

1.75 inches 2.00 inches

2.52 inches

Please provide pond certification letter for Pond 8 as reference to this updated spreadsheet.

	Depth Increment =		π							
	Stage - Storage	Stage	Optional Override	Length	Width	Area	Optional Override	Area	Volume	Volume
	Description	(ft)	Stage (ft)	(ft)	(ft)	(ft ²)	Area (ft ²)	(acre)	(ft 3)	(ac-ft)
7369.5	Top of Micropool		0.00	1	-	1	384	0.009		
	7370		0.50	-		-	384	0.009	192	0.004
	7372		2.50	-		-	18,082	0.415	18,658	0.428
	7374		4.50	-		-	40,004	0.918	76,744	1.762
	7376		6.50	-		-	61,465	1.411	178,213	4.091
	7378		8.50	-		-	69,433	1.594	309,111	7.096
	7380		10.50	1		1	77,895	1.788	456,439	10.478
	7382		12.50				88.522	2.032	622.856	14.299

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.

Selected BMP Type =

Watershed Area =

Watershed Imperviousness = 8.79%

Watershed Length =

Watershed Length to Centroid = Watershed Slope =

Percentage Hydrologic Soil Group A = 0.0%

Percentage Hydrologic Soil Group B = 100.0%

Percentage Hydrologic Soil Groups C/D = 0.0%

Target WQCV Drain Time = 40.0

Watershed Information

the embedded Colorado Urban Hydrograph Procedure.					
Water Quality Capture Volume (WQCV) =	1.244	acre-feet			
Excess Urban Runoff Volume (EURV) =	2.035	acre-feet			
2-yr Runoff Volume (P1 = 1.19 in.) =	3.100	acre-feet			
5-yr Runoff Volume (P1 = 1.5 in.) =	7.058	acre-feet			
10-yr Runoff Volume (P1 = 1.75 in.) =	11.036	acre-feet			
25-yr Runoff Volume (P1 = 2 in.) =	18.224	acre-feet			
50-yr Runoff Volume (P1 = 2.25 in.) =	23.083	acre-feet			
100-yr Runoff Volume (P1 = 2.52 in.) =	30.120	acre-feet			
500-yr Runoff Volume (P1 = 3.14 in.) =	42.887	acre-feet			
Approximate 2-yr Detention Volume =	1.282	acre-feet			
Approximate 5-yr Detention Volume =	2.033	acre-feet			
Approximate 10-yr Detention Volume =	4.473	acre-feet			
Approximate 25-yr Detention Volume =	6.375	acre-feet			
Approximate 50-yr Detention Volume =	6.643	acre-feet			
Approximate 100-yr Detention Volume =	8.649	acre-feet			

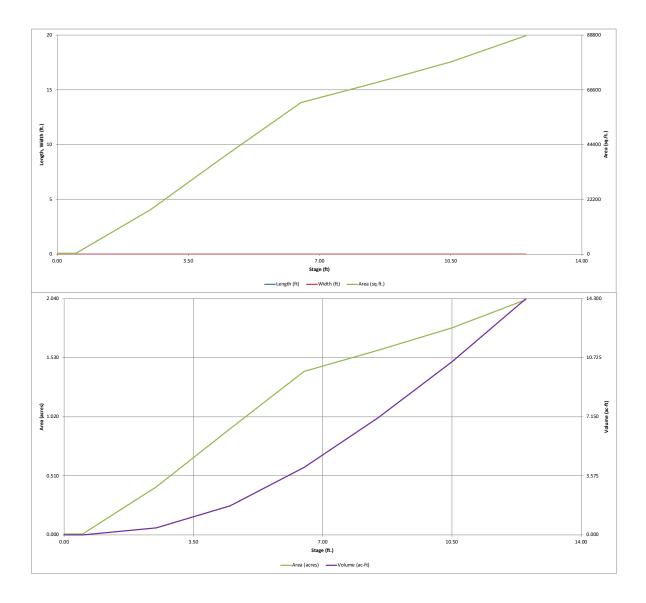
THIS CALCULATION UTILIZES
THE AS-BUILT CONDITIONS OF
POND 8 IN FILING NO. 1 WITH
CHANGES TO THE WATERSHED
AREA AND PERCENT
IMPERVIOUSNESS ONLY.

Define Zones and Basin Geometry		
Zone 1 Volume (WQCV) =	1.244	acre-fe
Zone 2 Volume (EURV - Zone 1) =	0.791	acre-fe
Zone 3 Volume (100-year - Zones 1 & 2) =	6.614	acre-fe
Total Detention Basin Volume =	8.649	acre-fe
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 (Smain) =	user	H:V
Basin Length-to-Width Ratio (R _{L/W}) =	user	
		_
Initial Surcharge Area (Arsy) =	user	ft ²

Initial Surcharge Area (A _{ISV}) =	user	ft²
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	ft²
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 $(A_{MAIN}) =$		ft²
Volume of Main Basin (V _{MAIN}) =	user	ft ³
Calculated Total Basin Volume (Vtotal) =	user	acre-fee
		•

IMPERVIOUSNESS ONLY.									
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Pond 8_DP10_HRG, Basin 8/2/2023, 10.40 AM



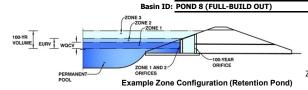
Pond 8_DP10_HRG, Basin 8/2/2023, 10.40 AM

THIS CALCULATION UTILIZES THE AS-BUILT CONDITIONS OF POND 8 IN FILING NO. 1 WITH CHANGES TO THE WATERSHED AREA AND PERCENT IMPERVIOUSNESS ONLY. AS-BUILT CONDITIONS FOR THE OUTLET STRUCTURE ARE SHOWN BELOW AND CHANGES TO WQCV, EURV, AND 100-YEAR RELEASE RATES AND TIME DEVIATE SLIGHTLY FROM THE ORIGINAL DESIGN IN THE 2018 CLASSIC CONSULTING FDR/PDR DUE TO LESS WATERSHED AREA AND PERCENT IMPERVIOUSNESS

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 3



	Estimated	Estimated	
	Stage (ft)	Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.89	1.244	Orifice Plate
Zone 2 (EURV)	4.79	0.791	Orifice Plate
one 3 (100-year)	9.45	6.614	Weir&Pipe (Restrict)
•	Total (all zones)	8.649	

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

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

	Calculated Parameters for Underdrain				
Underdrain Orifice Area =	N/A	ft ²			
Underdrain Orifice Centroid =	N/A	feet			

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP) Calculated Parameters for Plate ft (relative to basin bottom at Stage = 0 ft) WQ Orifice Area per Row = 3.715E-02 Centroid of Lowest Orifice = 0.00 Depth at top of Zone using Orifice Plate = 5.43 ft (relative to basin bottom at Stage = 0 ft) Elliptical Half-Width = N/A feet Orifice Plate: Orifice Vertical Spacing = Elliptical Slot Centroid N/A feet N/A inches Orifice Plate: Orifice Area per Row = Elliptical Slot Area = 5.35 sg. inches (use rectangular openings) N/A

User Input: Stage and

N/A

50%

N/A

Stage

Debris Clogging % =

ind Total Area of Each Orific	e Row (numbered	rrom lowest to nigr	iest)					5.25
	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.80	3.60					
Orifice Area (sq. inches)	5.35	5.35	5.35					

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

User Input: Vertical Orifice (Circular or Rectangular) Calculated Parameters for Vertical Orifice Not Selected Not Selected Not Selected Not Selected Invert of Vertical Orifice N/A N/A ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Area N/A N/A Depth at top of Zone using Vertical Orifice N/A N/A ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Centroid N/A N/A feet Vertical Orifice Diameter = N/A

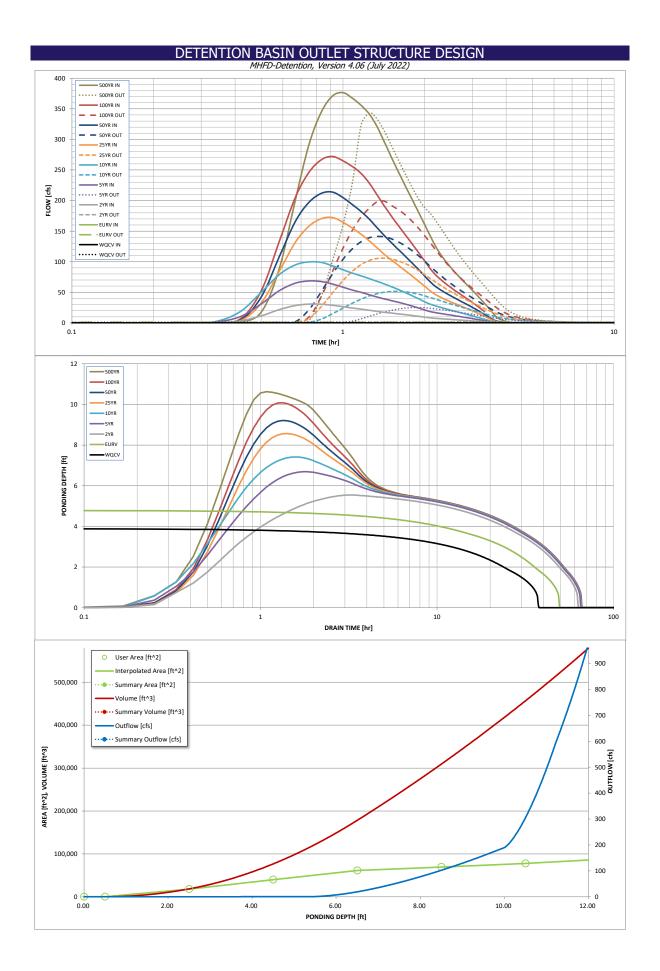
User Input: Overflow Weir (Dropbox with Flat of	Calculated Parame	ters for Overflow V	Veir			
	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	l
Overflow Weir Front Edge Height, Ho =	5.43	N/A	ft (relative to basin bottom at Stage = 0 ft) Height of Grate Upper Edge, H_t =	6.43	N/A	feet
Overflow Weir Front Edge Length =	16.00	N/A	feet Overflow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V Grate Open Area / 100-yr Orifice Area =	2.47	N/A	l
Horiz. Length of Weir Sides =	4.00	N/A	feet Overflow Grate Open Area w/o Debris =	45.91	N/A	ft ²
Overflow Grate Type =	Type C Grate	N/A	Overflow Grate Onen Area w/ Dehris =	22.96	N/A	ft ²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice) Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate Zone 3 Restrictor Not Selected Zone 3 Restrictor Not Selected Depth to Invert of Outlet Pipe 0.50 N/A ft (distance below basin bottom at Stage = 0 ft) Outlet Orifice Area 18.61 N/A Outlet Pipe Diameter Outlet Orifice Centroid 2.38 60.00 N/A N/A feet inches Half-Central Angle of Restrictor Plate on Pipe = Restrictor Plate Height Above Pipe Invert = 54.00 inches 2.50 N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)							
Spillway Invert Stage=	10.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.10	feet		
Spillway Crest Length =	75.00	feet	Stage at Top of Freeboard =	12.10	feet		
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.98	acres		
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	13.50	acre-ft		

Routed Hydrograph Results	The user can over	ride the default CU	IHP hydrographs an	d runoff volumes b	y entering new vall	ues in the Inflow H	ydrographs table (C	olumns W through	1 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	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.244	2.035	3.100	7.058	11.036	18.224	23.083	30.120	42.887
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.100	7.058	11.036	18.224	23.083	30.120	42.887
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	19.9	56.1	87.4	161.1	202.7	260.2	364.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.08	0.23	0.35	0.65	0.81	1.05	1.47
Peak Inflow Q (cfs) =	N/A	N/A	30.6	68.5	99.7	172.1	213.7	272.0	376.5
Peak Outflow Q (cfs) =	0.7	0.9	1.5	25.1	51.6	105.8	141.4	199.2	343.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.7	0.7	0.8	0.9
Structure Controlling Flow =	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.01	0.5	1.1	2.3	3.1	4.2	5.0
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) =	35	45	57	53	49	43	40	35	28
Time to Drain 99% of Inflow Volume (hours) =	37	48	61	60	58	55	53	50	47
Maximum Ponding Depth (ft) =	3.89	4.79	5.54	6.69	7.41	8.56	9.21	10.07	10.62
Area at Maximum Ponding Depth (acres) =	0.76	0.99	1.17	1.43	1.49	1.60	1.66	1.75	1.80
Maximum Volume Stored (acre-ft) =	1.248	2.038	2.850	4.347	5.413	7.192	8.236	9.718	10.676

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Pond 8_DP10_HRG, Outlet Structure 8/2/2023, 10:40 AM

DETENTION BASIN OUTLET STRUCTURE DESIGN

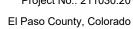
Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	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	0.01	0.00	0.03
	0:15:00	0.00	0.00	0.07	0.12	0.14	0.10	0.13	0.12	0.21
	0:20:00	0.00	0.00	0.36	0.89	1.53	0.40	0.49	0.51	1.53
	0:30:00	0.00	0.00	3.14 11.55	9.79 30.95	17.86 50.07	3.06 32.69	3.99 42.54	5.87 52.66	17.59 89.66
	0:35:00	0.00	0.00	21.73	52.71	79.26	85.10	108.79	134.03	200.11
	0:40:00	0.00	0.00	28.31	64.92	94.61	131.48	165.51	204.86	292.04
	0:45:00	0.00	0.00	30.61	68.51	99.73	158.19	197.26	246.41	345.32
	0:50:00	0.00	0.00	30.36	67.43	98.75	170.53	211.86	266.92	371.14
	0:55:00 1:00:00	0.00	0.00	28.65 26.29	63.37 58.15	93.21 86.71	172.13 164.62	213.72 204.72	271.98 264.93	376.54 367.28
	1:05:00	0.00	0.00	24.20	53.65	81.42	154.77	193.42	255.65	355.73
	1:10:00	0.00	0.00	22.41	49.78	76.77	144.93	182.14	244.46	341.58
	1:15:00	0.00	0.00	20.60	45.99	72.28	134.26	169.64	228.60	321.45
	1:20:00	0.00	0.00	18.82	42.36	67.97	122.92	156.00	209.89	297.28
	1:25:00	0.00	0.00	17.30	39.30	63.83	112.56	143.29	191.99	273.39
	1:30:00	0.00	0.00	16.05 14.88	36.68 34.17	59.60 55.28	103.73 95.61	132.25 121.98	176.22 161.81	251.52 231.20
	1:40:00	0.00	0.00	13.76	31.62	50.98	88.00	112.32	148.66	212.45
	1:45:00	0.00	0.00	12.65	28.99	46.75	80.73	103.09	136.28	194.74
	1:50:00	0.00	0.00	11.54	26.33	42.62	73.68	94.17	124.32	177.70
	1:55:00	0.00	0.00	10.43	23.67	38.55	66.74	85.41	112.69	161.18
	2:00:00	0.00	0.00	9.32 8.29	21.04 18.75	34.48 30.99	59.92 53.23	76.81 68.37	101.38 90.39	145.15 129.89
	2:10:00	0.00	0.00	7.52	17.10	28.39	47.68	61.40	81.20	117.19
	2:15:00	0.00	0.00	6.96	15.85	26.25	43.51	56.11	74.09	107.07
	2:20:00	0.00	0.00	6.47	14.73	24.29	40.06	51.66	68.05	98.34
	2:25:00	0.00	0.00	6.01	13.66	22.45	37.01	47.68	62.65	90.47
	2:30:00	0.00	0.00	5.56	12.63	20.68	34.24	44.05	57.74	83.26
	2:40:00	0.00	0.00	5.13 4.70	11.63 10.65	18.98 17.34	31.64 29.13	40.65 37.39	53.16 48.88	76.55 70.28
	2:45:00	0.00	0.00	4.29	9.69	15.76	26.73	34.28	44.89	64.43
	2:50:00	0.00	0.00	3.89	8.75	14.23	24.37	31.25	41.03	58.81
	2:55:00	0.00	0.00	3.48	7.83	12.76	22.04	28.27	37.20	53.29
	3:00:00 3:05:00	0.00	0.00	3.08	6.91	11.32	19.73	25.32	33.39	47.81
	3:10:00	0.00	0.00	2.69	6.01 5.11	9.90 8.48	17.42 15.13	22.38 19.46	29.58 25.77	42.35 36.90
	3:15:00	0.00	0.00	1.90	4.21	7.07	12.83	16.53	21.97	31.46
	3:20:00	0.00	0.00	1.50	3.33	5.67	10.54	13.62	18.18	26.03
	3:25:00	0.00	0.00	1.11	2.44	4.27	8.25	10.71	14.39	20.61
	3:30:00 3:35:00	0.00	0.00	0.73	1.58	2.92	5.97	7.82	10.62	15.25
	3:40:00	0.00	0.00	0.42 0.25	0.93 0.62	1.99 1.49	3.76 2.32	5.02 3.23	6.99 4.57	10.33 7.05
	3:45:00	0.00	0.00	0.18	0.47	1.17	1.47	2.17	3.07	4.94
	3:50:00	0.00	0.00	0.14	0.37	0.93	0.96	1.48	2.04	3.43
	3:55:00	0.00	0.00	0.11	0.29	0.73	0.62	1.00	1.31	2.32
	4:00:00 4:05:00	0.00	0.00	0.09	0.23	0.57	0.41	0.69	0.80	1.52
	4:05:00	0.00	0.00	0.07 0.05	0.18 0.13	0.43 0.31	0.27 0.17	0.47 0.31	0.44 0.23	0.93 0.55
	4:15:00	0.00	0.00	0.04	0.10	0.22	0.12	0.22	0.15	0.37
	4:20:00 4:25:00	0.00	0.00	0.04	0.07	0.15 0.11	0.08	0.16 0.12	0.12	0.27 0.21
	4:25:00	0.00	0.00	0.03	0.05	0.11	0.06	0.12	0.09	0.21
	4:35:00	0.00	0.00	0.02	0.02	0.06	0.03	0.07	0.05	0.13
	4:40:00 4:45:00	0.00	0.00	0.01 0.01	0.01 0.01	0.04	0.02	0.05 0.03	0.04 0.03	0.09 0.06
	4:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	4:55:00 5:00:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02 0.01
	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 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 5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00 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
•										

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APPENDIX E

REFERNCE MATERIALS



U.S. Department of Transportation

Federal Highway Administration

Hydraulic Engineering Circular No. 15, Third Edition

Design of Roadside Channels with Flexible Linings



Table 2.1. Typical Roughness Coefficients for Selected Linings

			Manning's n	1
Lining Category	Lining Type	Maximum	Typical	Minimum
	Concrete	0.015	0.013	0.011
	Grouted Riprap	0.040	0.030	0.028
Rigid	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare Soil ²	0.025	0.020	0.016
Offilified	Rock Cut (smooth, uniform)	0.045	0.035	0.025
	Open-weave textile	0.028	0.025	0.022
RECP	Erosion control blankets	0.045	0.035	0.028
	Turf reinforcement mat	0.036	0.030	0.024

¹Based on data from Kouwen, et al. (1980), Cox, et al. (1970), McWhorter, et al. (1968) and Thibodeaux (1968).

Table 2.2. Typical Roughness Coefficients for Riprap, Cobble, and Gravel Linings

			Manning's n for Selected Flow Depths ¹		
Lining Category	Lining Type	0.15 m (0.5 ft)	0.50 m (1.6 ft)	1.0 m (3.3 ft)	
Gravel Mulch	D_{50} = 25 mm (1 in.)	0.040	0.033	0.031	
Graver Mulcii	$D_{50} = 50 \text{ mm } (2 \text{ in.})$	0.056	0.042	0.038	
Cobbles	$D_{50} = 0.10 \text{ m} (0.33 \text{ ft})$	2	0.055	0.047	
Rock Riprap	D ₅₀ = 0.15 m (0.5 ft)	2	0.069	0.056	
Rock Ripiap	D ₅₀ = 0.30 m (1.0 ft)	2	2	0.080	

¹Based on Equation 6.1 (Blodgett and McConaughy, 1985). Manning's n estimated assuming a trapezoidal channel with 1:3 side slopes and 0.6 m (2 ft) bottom width.

2.2 SHEAR STRESS

2.2.1 Equilibrium Concepts

Most highway drainage channels cannot tolerate bank instability and possible lateral migration. Stable channel design concepts focus on evaluating and defining a channel configuration that will perform within acceptable limits of stability. Methods for evaluation and definition of a stable configuration depend on whether the channel boundaries can be viewed as:

- essentially rigid (static)
- movable (dynamic).

In the first case, stability is achieved when the material forming the channel boundary effectively resists the erosive forces of the flow. Under such conditions the channel bed and banks are in

²Minimum value accounts for grain roughness. Typical and maximum values incorporate varying degrees of form roughness.

²Shallow relative depth (average depth to D_{50} ratio less than 1.5) requires use of Equation 6.2 (Bathurst, et al., 1981) and is slope-dependent. See Section 6.1.

protected. Therefore permissible shear stress is not significantly affected by the erodibility of the underlying soil. However, if the lining moves, the underlying soil will be exposed to the erosive force of the flow.

Table 2.3 provides typical examples of permissible shear stress for selected lining types. Representative values for different soil types are based on the methods found in Chapter 4 while those for gravel mulch and riprap are based on methods found in Chapter 7. Vegetative and RECP lining performance relates to how well they protect the underlying soil from shear stresses so these linings do not have permissible shear stresses independent of soil types. Chapters 4 (vegetation) and 5 (RECPs) describe the methods for analyzing these linings. Permissible shear stress for gabion mattresses depends on rock size and mattress thickness as is described in Section 7.2.

Table 2.3. Typical Permissible Shear Stresses for Bare Soil and Stone Linings

		Permissible	Shear Stress
Lining Category	Lining Type	N/m ²	lb/ft ²
Bare Soil ¹	Clayey sands	1.8-4.5	0.037-0.095
Cohesive (PI = 10)	Inorganic silts	1.1-4.0	0.027-0.11
Collesive (F1 = 10)	Silty sands	1.1-3.4	0.024-0.072
	Clayey sands	4.5	0.094
Bare Soil ¹	Inorganic silts	4.0	0.083
Cohesive (PI ≥ 20)	Silty sands	3.5	0.072
	Inorganic clays	6.6	0.14
	Finer than coarse sand	1.0	0.02
5 0 112	D ₇₅ <1.3 mm (0.05 in)		
Bare Soil ²	Fine gravel	5.6	0.12
Non-cohesive (PI < 10)	D ₇₅ =7.5 mm (0.3 in)		
	Gravel	11	0.24
	D ₇₅ =15 mm (0.6 in)		
	Coarse gravel	19	0.4
Gravel Mulch ³	D_{50} = 25 mm (1 in)		
	Very coarse gravel	38	0.8
	$D_{50} = 50 \text{ mm } (2 \text{ in})$		
Rock Riprap ³	$D_{50} = 0.15 \text{ m} (0.5 \text{ ft})$	113	2.4
TOOK Triplap	$D_{50} = 0.30 \text{ m} (1.0 \text{ ft})$	227	4.8

¹Based on Equation 4.6 assuming a soil void ratio of 0.5 (USDA, 1987).

2.3 DESIGN PARAMETERS

2.3.1 Design Discharge Frequency

Design flow rates for permanent roadside and median drainage channel linings usually have a 5 or 10-year return period. A lower return period flow is allowable if a transitional lining is to be used, typically the mean annual storm (approximately a 2-year return period, i.e., 50 percent probability of occurrence in a year). Transitional channel linings are often used during the establishment of vegetation. The probability of damage during this relatively short time is low,

²Based on Equation 4.5 derived from USDA (1987)

³Based on Equation 6.7 with Shield's parameter equal to 0.047.

TABLE 10-1

COMPOSITE ROUGHNESS COEFFICIENTS FOR UNLINED OPEN CHANNELS (Reference: Chow, Ven Te, 1959; Open-Channel Hydraulics)

$$n = (n_0 + n_1 + n_2 + n_3 + n_4)m$$
 (10-2)

	Channel Conditions	<u>Value</u>
Material Type n o	Earth Fine Gravel Coarse Gravel	0.020 0.024 0.028
Degree of Irregularity	Smooth Minor Moderate Severe	0.000 0.005 0.010 0.020
Variation of Channel Cross Section n2	Gradual Alternating Occasionally Alternating Frequently	0.000 0.005 0.010 - 0.015
Relative Effect of Obstructions n ₃	Negligible Minor Appreciable Severe	0.000 0.010 - 0.015 0.020 - 0.030 0.040 - 0.060
Vegetation n ₄	Low Medium High Very High	0.005 - 0.010 0.010 - 0.025 0.025 - 0.050 0.050 - 0.100
Degree of Meandering m	Minor Appreciable Severe	1.000 - 1.200 1.200 - 1.500 1.500

- significant uncertainty regarding the design discharge
- consequences of failure are high

The basic procedure for flexible lining design consists of the following steps and is summarized in Figure 3.1. (An alternative process for determining an allowable discharge given slope and shape is presented in Section 3.6.)

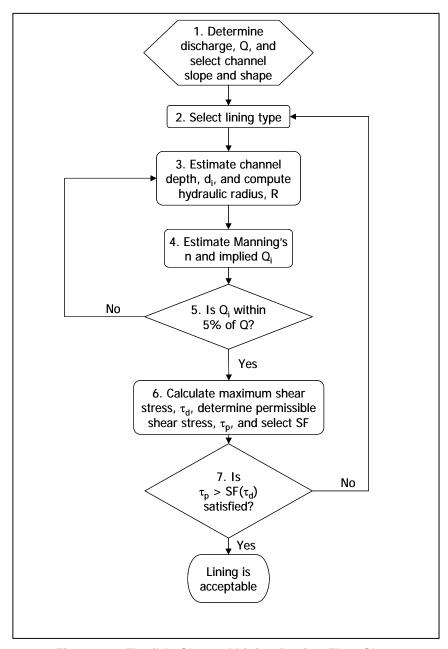


Figure 3.1. Flexible Channel Lining Design Flow Chart



ROLLEDEROSION CONTROL

SYSTEMS BROCHURE







Temporary RollMax[™] Solutions

Erosion control has never been so simple yet effective. North American Green RollMax™ temporary Erosion Control Blankets (ECBs) provide immediate erosion protection and vegetation establishment assistance, then degrade once the vegetation's root and stem systems are mature enough to stabilize the soil.

Our high-quality temporary solutions are available in varying functional longevities and materials:

- ► Short-term photodegradable blankets with a functional longevity of 45 days up to 12 months
- Extended-term and long-term photodegradable blankets for protection up to 36 months
- Short-term biodegradable blankets for protection up to 12 months
- Extended-term and long-term biodegradable products for protection and mulching from 18 to 24 months

ERONET™ EROSION CONTROL BLANKETS

North American Green EroNet™ ECBs incorporate photodegradable nettings, which means they are broken down by the ultraviolet rays in sunlight. These temporary products can be used in a variety of scenarios, including moderate to steep slopes, medium-to high-flow channels, shorelines and other areas needing protection until permanent vegetation establishment.

EroNet[™] C125[®] Long-Term Photodegradable Double-Net Coconut Blanket

The C125° ECB is made of 100% coconut fiber stitched between heavyweight UV-stabilized polypropylene nets. It offers excellent durability, erosion control and longevity for severe slopes, steep embankments, high-flow channels and other areas where vegetation may take up to 36 months to grow in.





The EroNet temporary ECBs are designed to provide immediate erosion protection and vegetation establishment assistance, and then degrade after the vegetation is mature enough to permanently stabilize the underlying soil. Both short-term and extended-term ECBs are available.



EroNet™ SC150® Extended-Term Photodegradable Double-Net Straw/Coconut Blanket

With a layer of 70% straw and 30% coconut fiber stitched between a heavyweight UV-stabilized polypropylene top net and a lightweight photodegradable polypropylene bottom net, the SC150° ECB has increased durability, erosion control capabilities and longevity. It is suitable for steeper slopes, medium-flow channels and other areas where it may take vegetation up to 24 months to grow in.

EroNet™ S150° Short-Term Photodegradable Double-Net Straw Blanket

The S150 ECB is made with a 100% straw fiber matrix stitched between lightweight photodegradable polypropylene top and bottom nets. The S150 ECB's double-net construction has greater structural integrity than single net blankets for use on steeper slopes and in channels with moderate water flow. It provides erosion protection and mulching for up to 12 months.

EroNet™ DS150™ Ultra Short-Term Photodegradable Double-Net Straw Blanket

The DS150™ ECB is suitable for high maintenance areas where close mowing will occur soon after installation. Special additives in the thread and top and bottom net ensure it degrades in adequate sunlight within 60 days.

EroNet[™] S75® Short-Term Photodegradable Single-Net Straw Blanket

The S75° ECB protects and mulches moderate slopes and low-flow channels in low maintenance areas for up to 12 months. It is constructed of 100% straw fiber stitched with degradable thread to a lightweight photodegradable polypropylene top net.

EroNet™ DS75™ Ultra Short-Term Photodegradable Single-Net Straw Blanket

Designed for high maintenance areas where close mowing will occur soon after installation, the DS75™ ECB degrades within 45 days because of special additives in the thread and top net that facilitate rapid breakdown in adequate sunlight.



Every site has its own unique characteristics and challenges. EroNet Erosion Control Blankets are available in varying longevities to suit a variety of scenarios and conditions.



With our Erosion Control Materials Design Software (ECMDS), you can select either short-term, extended-term or long-term EroNet blankets based on your specific design needs.



Permanent RollMax[™] Solutions

Back in the day, rock riprap, articulated concrete blocks and poured concrete were the only way to deal with erosion in high-flow channels, on shorelines and other areas where water and/or wind exceed the shear limits of unreinforced vegetation.

Not anymore. North American Green permanent Turf Reinforcement Mats (TRMs) use 100% synthetic components or a composite of synthetic and natural materials for long-term erosion protection and vegetation establishment. Whether com-pared to rock riprap or concrete, the RollMax™ Systems' permanent TRMs offer a number of significant advantages:

- Prevent loss of precious topsoil to wind and water erosion
- ▶ Permanently reinforce vegetation root and stem structures
- Provide excellent conditions for quick, healthy vegetation growth
- ► Stabilize slopes from erosion to keep roadways safe and clean
- Protect water quality in lakes, rivers and streams
- ▶ Protect dormant seeding during winter months
- ► Easily conform to landscape features
- Lightweight for easy handling and transportation

VMax® C-TRMs combine three-dimensional matting with

VMAX® COMPOSITE TURF REINFORCEMENT MATS

fiber matrix material for permanent erosion control on severe slopes, spillways, stream banks, shorelines and in high- to extreme-flow channels. These extensively tested products provide maximum performance through all three phases of reinforced vegetative lining development: unvegetated, establishment, and maturity. Incorporating the best performance features of temporary and permanent North American Green erosion control products, VMax C-TRMs deliver these tangible benefits:

- Surface-applied for the highest level of immediate soil protection
- Less than one third of the installed cost of rock or concrete
- ► No heavy equipment needed to install
- ▶ More attractive and effective "Green" alternative than rock riprap or concrete

VMax® High-Performance TRMs (HPTRMs)

VMax® HPTRMs utilize patent-pending woven 3-D structures that are soil-filled for use in areas experiencing high stress and strain. The VMax HPTRMs are designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces. Our HPTRMs are excellent for increased bearing capacity of vegetated soils subjected to heavy loads from maintenance equipment and other vehicular traffic.



The TRMs easily conform to various landscape features to prevent the loss of precious topsoil.



The RollMax TRMs are installed in a one-step operation directly over the prepared seedbed saving time and money and ensuring the highest level of erosion control and vegetation reinforcement.



VMAx® TMaxTM Permanent HPTRM

The TMax HPTRM woven polypropylene technology is designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces up to 15 pfs (kN/m2), and with the highest tensile strength on the market up to 5,000 lbs/ft (73 kN/m). TMax maybe used as an alternative to hard armor system in extreme erosion control applications.

VMax® P550® Permanent TRM

P550° TRM has a polypropylene fiber matrix augmenting the permanent netting structure with permanent mulching and erosion control performance. Unvegetated, the P550 TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 4.0 lbs/ft² (191 Pa). The ultra-strong structure drives the vegetated shear resistance up to 14 lbs/ft² (672 Pa). The P550 TRM may be used as an alternative for poured concrete or articulated concrete blocks in extreme erosion control projects.

VMax® C350® Permanent TRM

A 100% coconut fiber matrix supplements the C350's permanent three-dimensional netting structure with initial mulching and erosion control performance for up to 36 months. Unvegetated, the C350° TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.2 lbs/ft² (153 Pa) and boosts permanent vegetation performance up to 12 lbs/ft² (576 Pa). This environmentally friendly alternative to 30 in. (76 cm) or larger rock riprap is ideal for severe erosion control projects.



To boost performance of the VMax turf reinforcement mats in critical applications, combine with our ShoreMax® flexible transition mat to create a system that can dramatically elevate the permissible shear stress and velocity protection beyond many hard armor solutions.

VMax® SC250® Permanent TRM

The SC250° permanent TRM has a 70% straw/30% coconut fiber matrix to enhance initial mulching and erosion control performance for up to 24 months. Unvegetated, SC250 TRMs reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft², and increases permanent vegetation performance up to 10 lbs/ft² (480 Pa) for a green alternative to rock riprap.

ERONET™ PERMANENT EROSION CONTROL BLANKETS

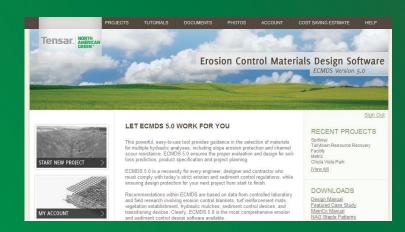
The EroNet™ Permanent ECB provides immediate erosion protection and vegetation establishment assistance until vegetation roots and stems mature.

EroNet™ P300® Permanent Erosion Control Blankets

The P300° permanent erosion control blanket consists of UV-stabilized polypropylene fiber stitched between heavyweight UV-stabilized polypropylene top and bottom nets. These mats reduce soil loss and protect vegetation from being washed away or uprooted, even under high stress. Unvegetated, they reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft² (144 Pa), and protect vegetation from being washed away or uprooted when exposed to shear stresses up to 8 lbs/ft² (383 Pa).



VMax Mats are perfect for pipe outlets, channel bottoms, shoreline transition zones, and other areas subjected to highly turbulent water flows.



Design and Installation Tools

SHIFT, CONTROL, ENTER

Professional guidance on RECP selection, design and project planning is at your fingertips with Tensar's proprietary Erosion Control Materials Design Software (ECMDS®). This web-based program incorporates design methodologies from the Federal Highway Administration and United States Department of Agriculture to analyze your specific site conditions, and make quantified recommendations based on data from controlled laboratory and field research. ECMDS is a must-have if you face tough erosion and sediment control regulations. Best of all, it's free of charge, compliments of North American Green. To learn more and access the software directly, go to www.ECMDS.com.

INSTRUCTIONS INCLUDED

Proper anchoring patterns and rates must be used to achieve optimal results in RECP installation. View our installation guides for stapling patterns. Site specific staple pattern recommendations based on soil type and severity of application may be acquired through our ECMDS.



HOLD ON TIGHT

When under the pressure of severe conditions, even the best erosion control products can't function to their full potential without proper installation and anchoring. North American Green supplies a wide variety of fastener options for nearly every application and soil type.

For use in cohesive soils, wire staples are a cost-effective means to fasten RECPs. Available in 6 in., 8 in., 10 in. and 12 in. lengths, our U-shaped staples can reach to various depths to ensure adequate pull-out resistance. For installation using our handy Pin Pounder installation tool, 6 in. V-top staples or 6 in. circle top pins are available.

Our biodegradable BioStakes® are available in 4 in. and 6 in. lengths and provide an environmentally friendly alternative to metal staples. For an even more durable, deeper reaching yet all-natural anchoring option, our wood EcoStakes® are available in 6 in., 12 in., 18 in. and 24 in. lengths.

For severe applications needing the ultimate, long-lasting hold, try our 12 and 18 in. rebar staples, our 12 in. plastic ShoreMax® stakes, or our complete line of percussion earth anchors. The Tensar earth anchors reach deep into the soil strata to offer enhanced anchoring in the worst conditions. Our variety of earth anchors are designed for durability and holding power under extreme hydraulic stresses and adverse soil conditions (*Table 1*).

For more information on the RollMax Systems or other systems within the North American Green Erosion Control Solutions, call **800-772-2040** or visit **nagreen.com**.

	Earth Anchor Options									
		EA.	400	EA 680						
	Tendon Type (3/32 in. x 36 in.)	Assembly Description	Fast Install	Economic Anchor	Stainless	Galvanized	Stainless	Galvanized		
tions Plate	Copper Stop Sleeve with Stainless Steel Washer	Manually crimped to the stainless steel cable to secure the face plate.		х	х		х			
End Piece Options with a PVC Face Plate	Grip End Piece with Stainless Steel Washer	Three-dimensional, self-securing metal end piece that does not require manual crimping for tendon tensioning.	х	х	х	х	х	х		
End Pi	Wedge Grip Piece	Self-securing end piece that installs flush to the face plate. Does not require manual crimping for tendon tensioning.	х		х	х	х	х		
	Aluminum Stop Sleeve with Stainless Steel Washer	Manually crimped to the galvanized cable to secure the face plate.		х		х		х		

The complete line of RollMax^{**} products offers a variety of options for both short-term and permanent erosion control needs. Reference the RollMax Products Chart below to find the right solution for your next project.



RollMax Product Selection Chart

TEMPORARY									
	Product Description	Longevity	Applications	Design Permissible Shear Stress lbs/ft² (Pa)	Design Permissible Velocity ft/s (m/s)				
ERONET									
DS75	1.5 lb., accelerated photodegradable, polypropylene top net, 100% straw fiber matrix	45 days	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)				
DS150	1.5 lb., photodegradable, polypropylene top & bottom net, 100% straw fiber matrix	60 days	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)				
S75	1.5 lb., photodegradable, polypropylene top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)				
S150	1.5 lb., photodegradable, polypropylene top 6 bottom net, 100% straw fiber matrix	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)				
SC150	2.9 lb., UV-stable polypropylene top net, 70% straw/30% coconut fiber matrix, 1.5 lb., photodegradable polypropylene bottom net	24 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.0 (96)	Unvegetated 8.0 (2.44)				
C125	2.9 lb., UV stable polypropylene top & bottom nets, 100% coconut fiber matrix	36 months	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.25 (108)	Unvegetated 10.0 (3.05)				
BIONET									
S75BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.60 (76)	Unvegetated 5.0 (1.52)				
\$150BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix, 7.7 lb., woven biodegradable jute bottom net	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.85 (88)	Unvegetated 6.0 (1.83)				
SC150BN	9.3 lb., leno woven biodegradable jute top net, 70% straw/30% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	18 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.10 (100)	Unvegetated 8.0 (2.44)				

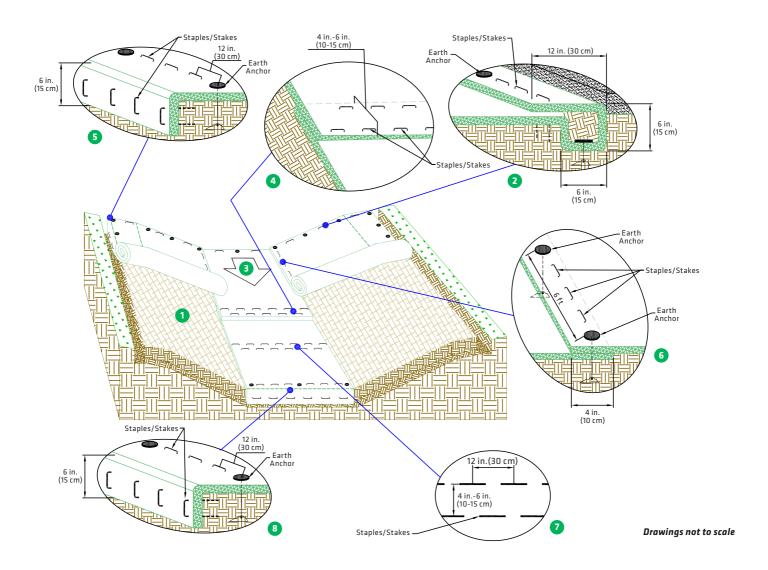






TEMPORARY								
	Product Description	Longevity	Applications	Design Permissible Shear Stress lbs/ft² (Pa)	Design Permissible Velocity ft/s (m/s)			
BIONET CONT'D								
C125BN	9.3 lb., leno woven biodegradable jute top net, 100% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	24 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)			
	143 lb., (700 g) woven biodegradable coir top net, 100% coconut fiber matrix, 7.7 lb., woven biodegrdable jute bottom net	36 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)			
C700BN		PERM	ANENT					
ERONET								
	5.0 lb., UV-stable polypropylene top net, 100% polypropylene fiber matrix, 3.0 lb., UV-stable polypropylene bottom net	Permanent	High Flow Channels 1:1 Slopes	Unvegetated 3.0 (144) Vegetated 8.0 (383)	Unvegetated 9.0 (2.7) Vegetated 16.0 (4.9)			
P300								
VMAX								
	5.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 70% straw/30% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.0 (144) Vegetated 10.0 (480)	Unvegetated 9.5 (2.9) Vegetated 15.0 (4.6)			
SC250								
	8.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.2 (153) Vegetated 12.0 (576)	Unvegetated 10.5 (3.2) Vegetated 20.0 (6.0)			
C350								
	24.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% polypropylene fiber matrix	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Unvegetated 4.0 (191) Vegetated 14.0 (672)	Unvegetated 12.5 (3.8) Vegetated 25.0 (7.6)			
P550								
TMax	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 15.0 (718)	Vegetated 25.0 (7.6)			
W3000	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 16.0 (766)	Vegetated 25.0 (7.6)			

Channel Installation Detail

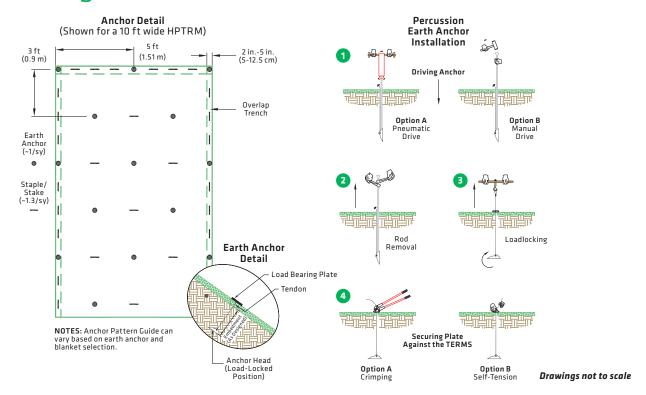


GENERAL INSTALLATION

- Prepare soil before installing the HPTRM, including any necessary application of soil amendments such as lime or fertilizer. See seeding and vegetating section for details regarding preseeding, overseeding or use with sod.
- 2. Begin at the top of the channel by anchoring the HPTRM in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench with approximately 12 in. (30 cm) of HPTRM extended beyond the upslope portion of the trench. Anchor the HPTRM with a row of anchors/staples/ stakes spaced approximately 12 in. (30 cm) apart in the bottom of the trench. Backfill and compact the trench after stapling. Compact soil and fold remaining 12 in. (30 cm) portion of HPTRM back over compacted soil. Secure HPTRM over soil with a row of anchors/staples/stakes spaced approximately 12 in. (30 cm) across the width of the HPTRM.
- 3. Roll center HPTRM in direction of water flow in bottom of channel. HPTRMs will unroll with appropriate side against the soil surface. All HPTRMs must be securely fastened to soil surface by placing anchors/staples/stakes in appropriate locations as shown in the anchoring detail.

- **4.** Place consecutive HPTRMs end over end (shingle style) with a 4 in. x 6 in. (10 cm-15 cm) overlap. Use a double row of staples/ stakes staggered 12 in. (30 cm) apart and 12 in. (30 cm) on center to secure HPTRMs.
- 5. Full length edge of HPTRMs at top of side slopes must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.
- Adjacent HPTRMs must be overlapped approximately 4 in. (10 cm) and fastened.
- 7. In high flow channel applications, a staple/stake check slot is recommended at 30 ft to 40 ft (9 m-12 m) intervals. Use a double row of staples/stakes staggered 4 in. (10 cm) apart and 12 in. (30 cm) on center over entire width of the channel.
- 8. The terminal end of the HPTRMs must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.

Anchoring Detail



ANCHORING DETAIL

The performance of ground anchoring devices is highly dependent on numerous site/project specific variables. It is the sole responsibility of the project engineer and/or contractor to select the appropriate anchor type and length. Anchoring shall be selected to hold the mat in intimate contact with the soil subgrade and resist pullout in accordance with the project's design intent.

- Staples and/or stakes should be at least 6 in. (15 cm) in length and with sufficient ground penetration to resist pullout. Longer staples and/or stakes may be needed in looser soils.
- 2. The percussion earth anchor assembly consists of an anchor head, a tendon, a faceplate, and an end-piece device. See North American Green® Earth Anchor specification for detailed information on assembly components and associated pull-out strength.

PERCUSSION EARTH ANCHOR INSTALLATION

- Insert the drive rod into the assembly's anchor head then use either a sledge hammer or vibratory hammer to drive the anchor to their desired depth.
- 2. After the desired anchor depth is achieved, retract the drive rod.
- Lock the anchor assembly by swiftly pulling the cable upwards until the anchor head rotates as signaled by sudden resistance to pulling. A hooked setting tool may be used to aid in this step.

NOTE: Larger anchors may require more force to set the anchor. This can be achieved through using simple mechanical equipment for greater leverage, such as a fulcrum, manual or hydraulic jack, winch, or post puller.

4. Secure the faceplate to the High-performance Turf Reinforcement Mat (HPTRM) surface by locking the end-piece. If using a copper or aluminum stop, crimp the ferrule to

secure. If using a self-tensioning end-piece (grip or wedge grip) set by simply tightening the end-piece against the faceplate. If desired, cut the remaining cable assembly, above end-piece, to desired length.

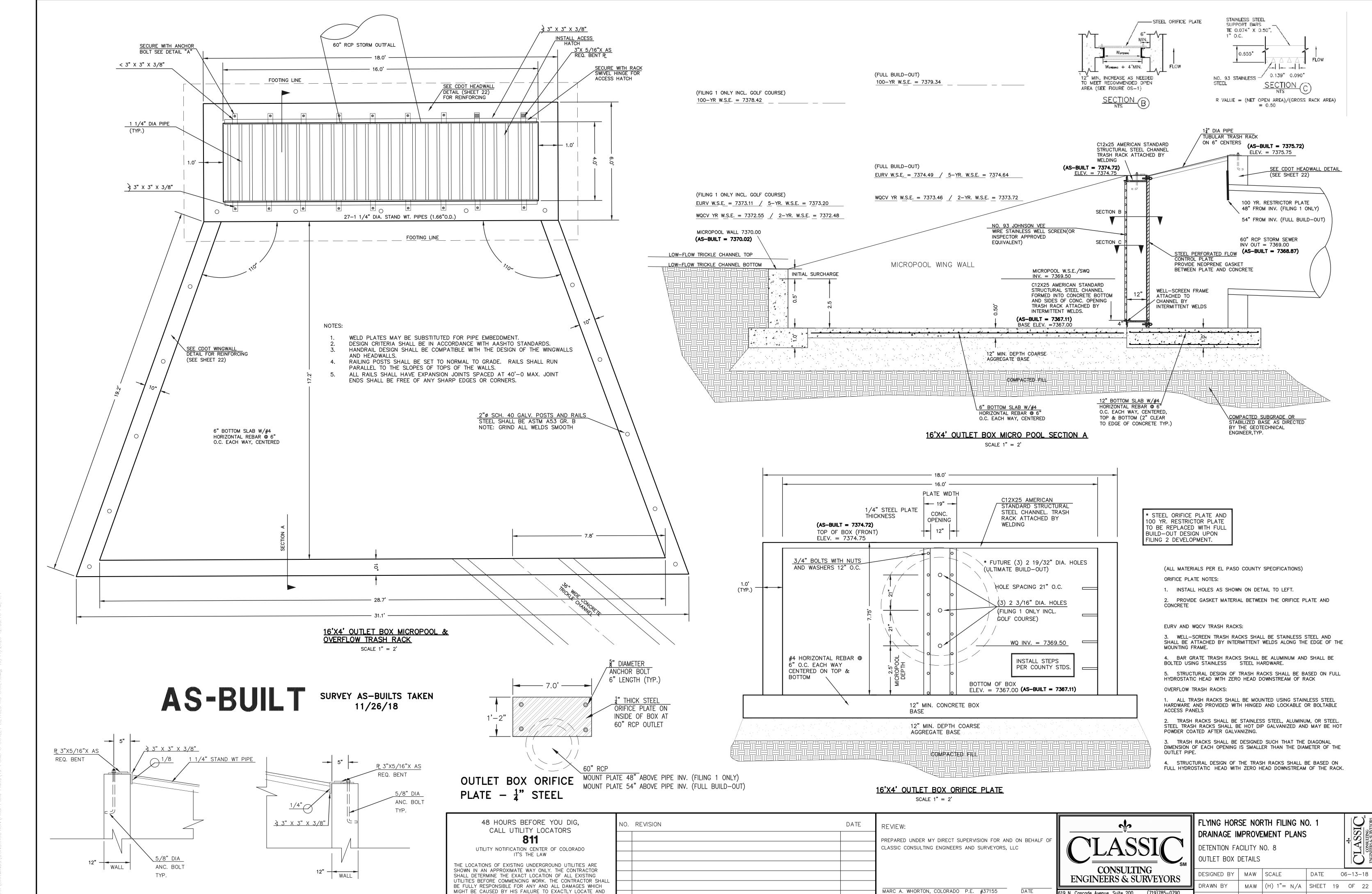
SEEDING AND VEGETATING

When using a Composite Turf Reinforcement Mat (C-TRM) with fiber components:

- Pre-seed prepared soils prior to the installation of the C-TRM. Install matting as directed. C-TRM does not require soil infill or a top dressing of seed. Overseeding may be done as a secondary form of seeding.
- Sod may be installed in place of seeding on top of the C-TRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.

When using a woven HPTRM:

- 1. Install the HPTRM as directed prior to seed and soil filling.
- 2. Place seed into the installed HPTRM. After seeding, spread a layer of fine soil into the mat. Using the flat side of a rake, broom or other tool, completely fill the voids. Smooth soil-fill in order to just expose the top of the HPTRM matrix. Do not place excessive soil above the mat.
- Additional seed, hydraulic mulching of the use of a temporary Erosion Control Blanket (ECB) can be applied over the soil-filled mat for increased protection.
- 4. Sod may be installed in place of seeding. Install HPTRM, and soil-fill as outlined above. Place sod directly onto the soil-filled HPTRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.
- **5.** Consult with a manufacturer's technical representative for installation assistance if unique conditions apply.



PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

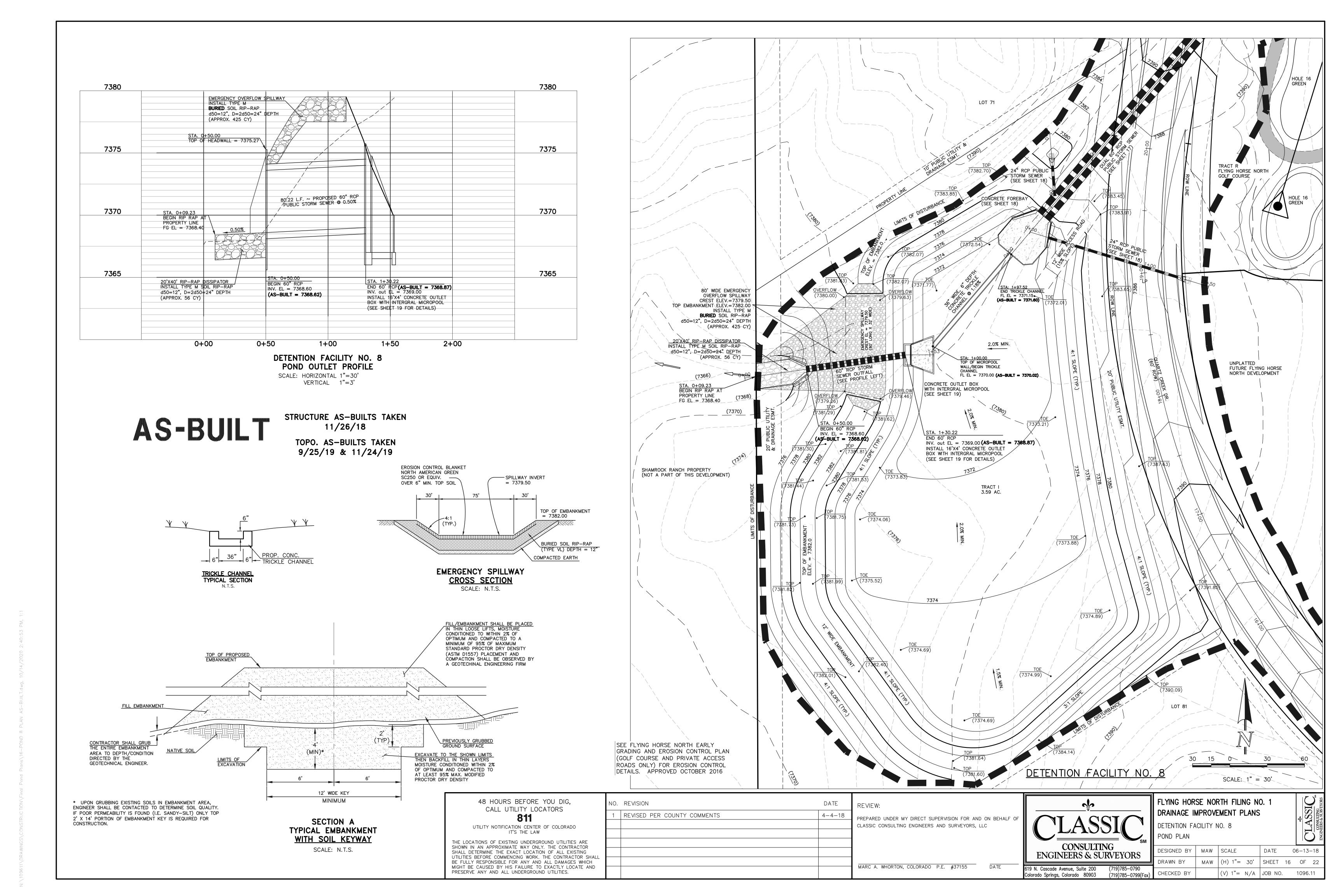
619 N. Cascade Avenue, Suite 200

Colorado Springs, Colorado 80903

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(719)785-0799(Fax)

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Colorado Springs, Colorado 80903 (719)785-0799(Fax)



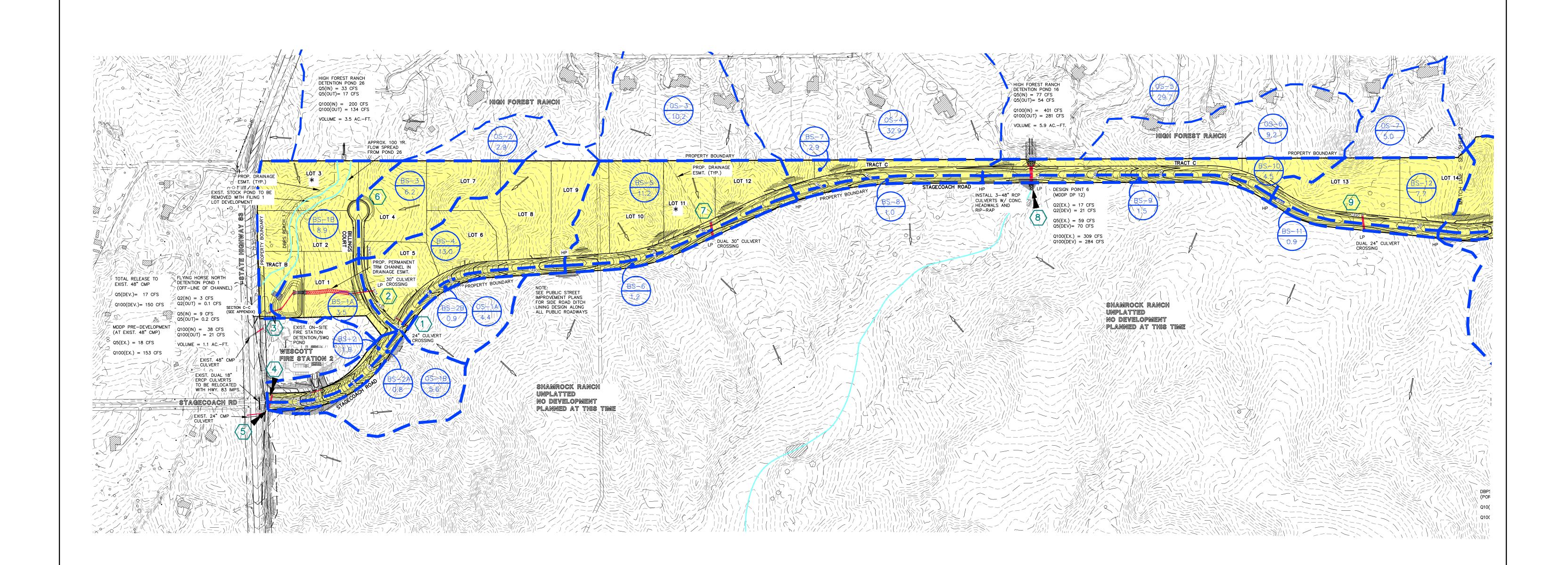


APPENDIX F

DRAINAGE MAPS

We need to know how much of the proposed area of disturbance (not just the impervious surfaces) is treated vs untreated and if there are any exclusions that apply to the untreated areas. So please create a basic overview map (or modify an existing drainage map) with color shading/hatching that shows areas tributary to each PBMP (pond, runoff reduction, etc.) and those disturbed areas that are not treated by a PBMP, with the applicable exclusion labeled (ex: 20% up to 1ac of development can be excluded per ECM App I.7.1.C.1 and exclusions listed in ECM App I.7.1.B.#). An accompanying summary table on this map would also be very helpful (example provided):

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Trib to Pond A (ac)	Disturbed Area Treated via Runoff Reduction (ac)	Disturbed Area Excluded from WQ per ECM App I.7.1.C.1 (ac)		Applicable WQ Exclusions (App I.7.1.B.#)
Α	4.50	4.50	4.50	-	-	-	
В	1.25	1.25	-	1.25	-	-	
С	6.00	4.00	-	-	-	4.00	ECM App I.7.1.B.5
D	2.50	2.50	1.00	-	0.50	1.00	ECM App I.7.1.B.7
E	3.00	-	3.00	-	-	-	
F	8.25	-	-	-	-	-	
Total	25.50	12.25	8.50	1.25	0.50	5.00	
Comments		values in Columns 4-7 must be greater than or equal to the value in	[Values in this column can be more than Column 3 if over-treating non-disturbed areas of the same land-use.]	[See RR calc spreadsheet.]	[Total must be <20% of site and <1ac.]		
		Total Proposed Disturbed Area (ac)		d Treated Area ac)	Total Proposed Disturbed Area Excluded from WQ (ac)		Non-Excluded Area to be Treated (value must ≤ Total Proposed Treated Area) (ac)
		12.25	9.	75	5.	50	6.75

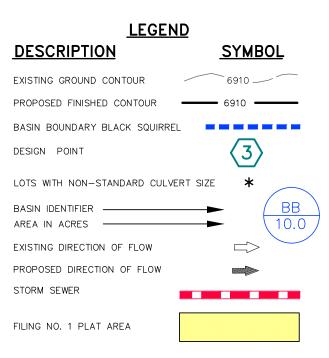


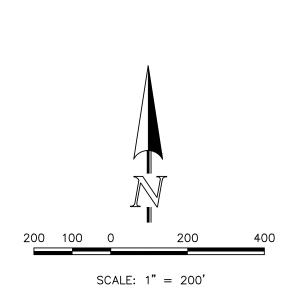
BASIN SUMMARY - DEVELOPED CONDITIONS

		COMPOSITE	TOTAL	Q	Q	Q
BASIN	AREA	CN	LAG TIME	2 Yr.	5 Yr.	100 Yr.
(label)	(acres)		(hours)	(cfs)	(cfs)	(cfs)
OS-1A	4.40	61.0	0.20	0.4	1.6	7.7
OS-1B	5.60	61.0	0.21	0.5	1.9	9.4
EX-DP-3 (Pre-Dev.)	36.00	60.0	0.25	0.5	4.8	41.3
OS-2	2.90	61.0	0.20	0.1	0.6	4.0
OS-3	10.20	65.0	0.19	1.0	3.8	17.9
OS-4	32.90	65.0	0.23	2.8	11.2	53.6
OS-5	29.70	65.0	0.39	1.9	7.1	37.0
OS-6	9.20	65.0	0.21	0.9	3.2	15.5
OS-7	5.00	65.0	0.18	0.5	2.0	9.0
BS-1A	3.50	65.0	0.17	0.4	1.4	6.3
BS-1B	8.90	65.0	0.20	0.4	2.4	13.8
BS-2	1.90	89.0	0.35	2.9	4.2	8.4
BS-2A	0.80	89.0	0.13	1.2	1.8	3.5
BS-2B	0.90	89.0	0.12	1.4	2.0	4.0
BS-3	6.20	65.0	0.20	0.6	2.3	10.8
BS-4	13.00	67.0	0.23	1.9	5.5	23.6
BS-5	11.20	65.0	0.18	1.1	4.4	20.1
BS-6	1.20	89.0	0.09	1.9	2.8	5.4
BS-7	2.90	65.0	0.13	4.4	6.4	12.8
BS-8	1.00	89.0	0.12	1.6	2.2	4.5
BS-9	1.50	89.0	0.13	2.3	3.3	6.6
BS-10	4.50	65.0	0.24	6.0	8.7	17.5
BS-11	0.90	89.0	0.08	1.5	2.1	4.1
BS-12	7.70	65.0	0.19	0.8	3.0	13.8

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-1 DEV	OS-1A, BS-2B	1.6	3.4	11
DP-2 DEV	DP-1, BS-4	3.2	8.8	35
TOTAL INFLOW TO POND 1 (UD Detention hydrograph)	DP-1, DP-2, BS-1A	4	7	38
DP-3 DEV (Pond Pack routing)	OS-2, BS-3, BS-1B, Release from FHN Pond 1	1	6	39
DP-4 DEV	BS-2	2.9	4.2	8
DP-5 DEV	OS-1B, BS-2A	1.5	3.5	13
DP-6 DEV	OS-2, BS-3	0.6	2.8	15
DP-7 DEV	OS-3, BS-5	2.1	8.2	38
DP-8 DEV	OS-4, OS-5, OS-6, BS-7, BS-10, Release from Exist. HFR Pond 16	20.9	70.4	284
DP-9 DEV	OS-7, BS-12	1.3	5.0	23

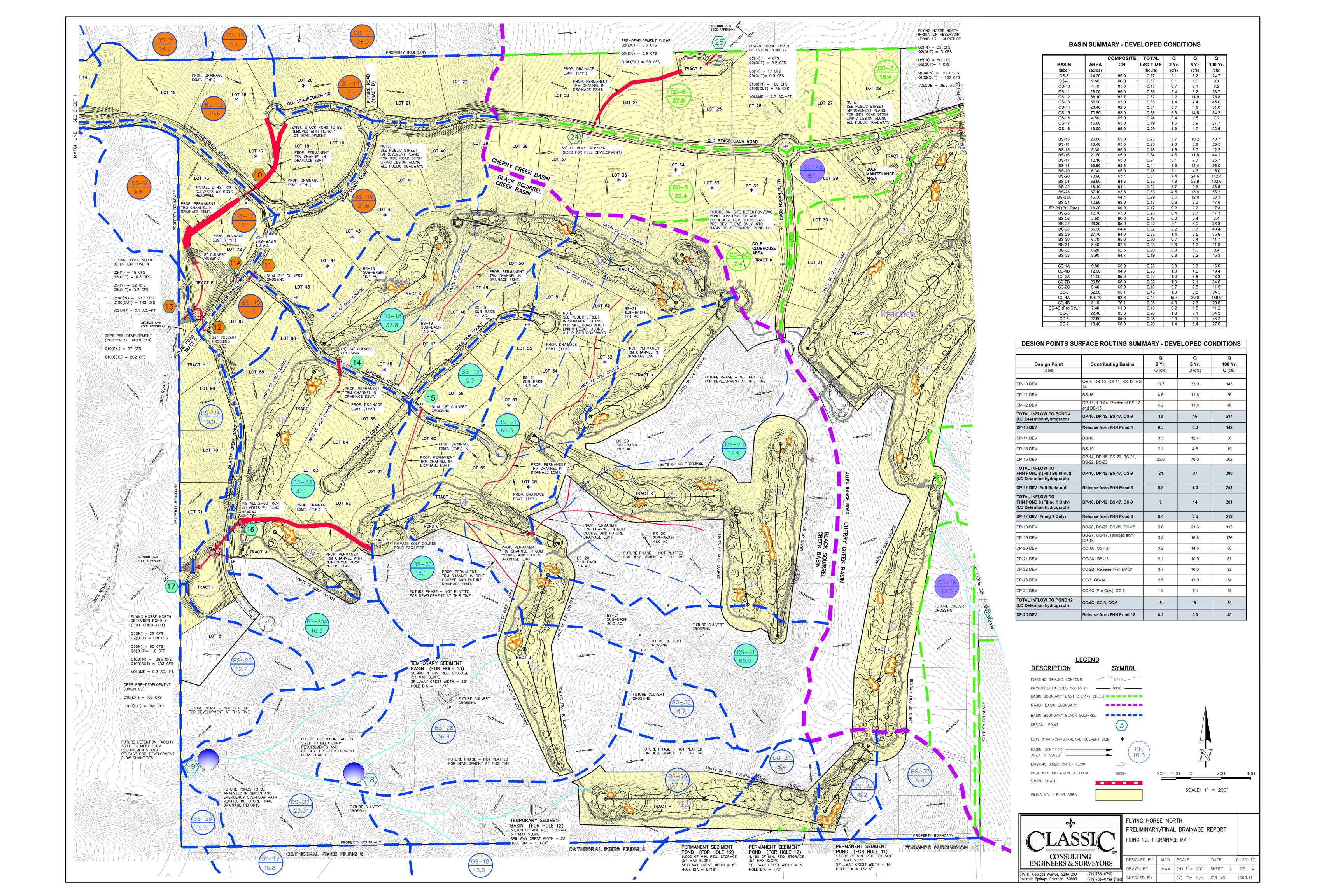


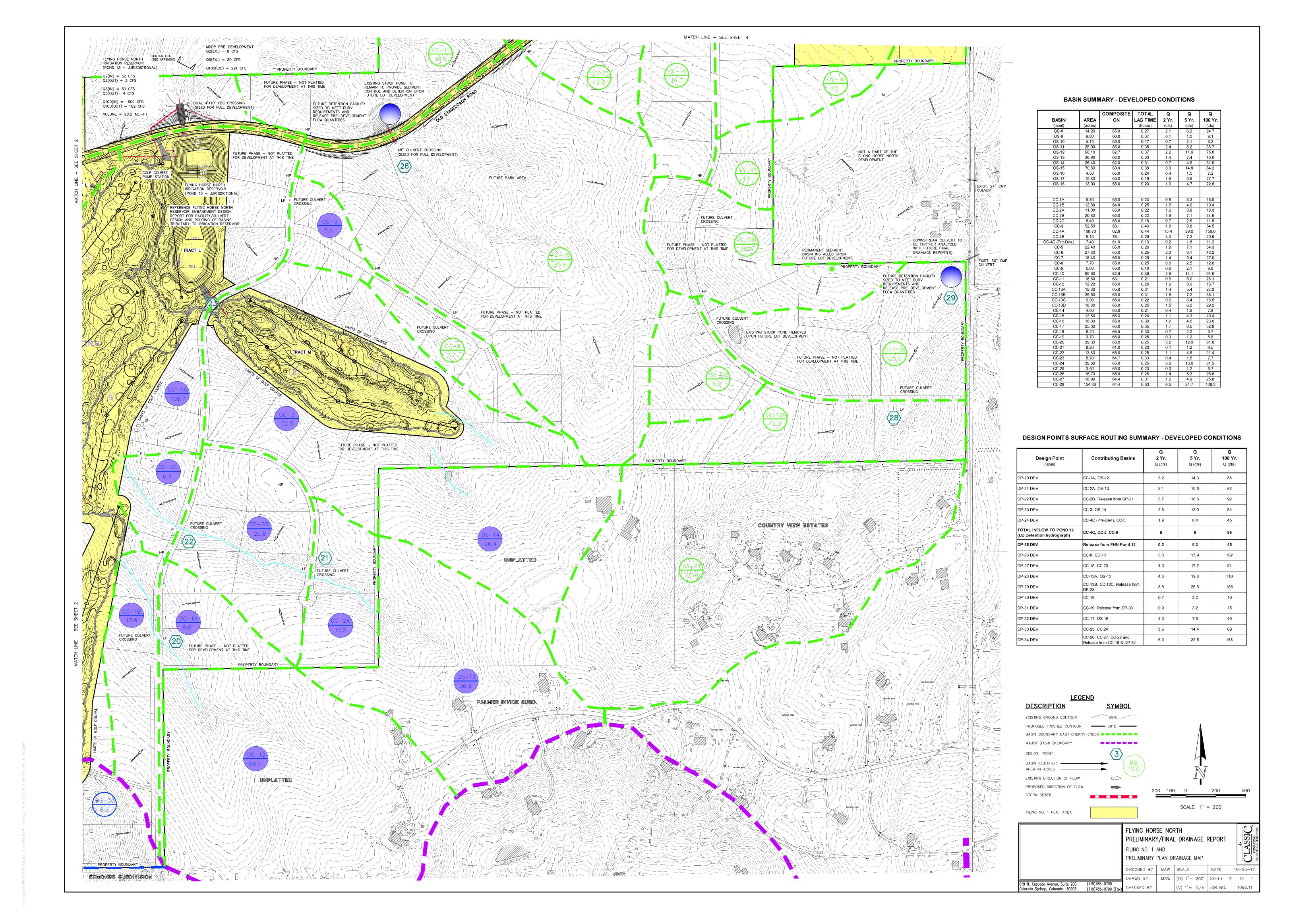


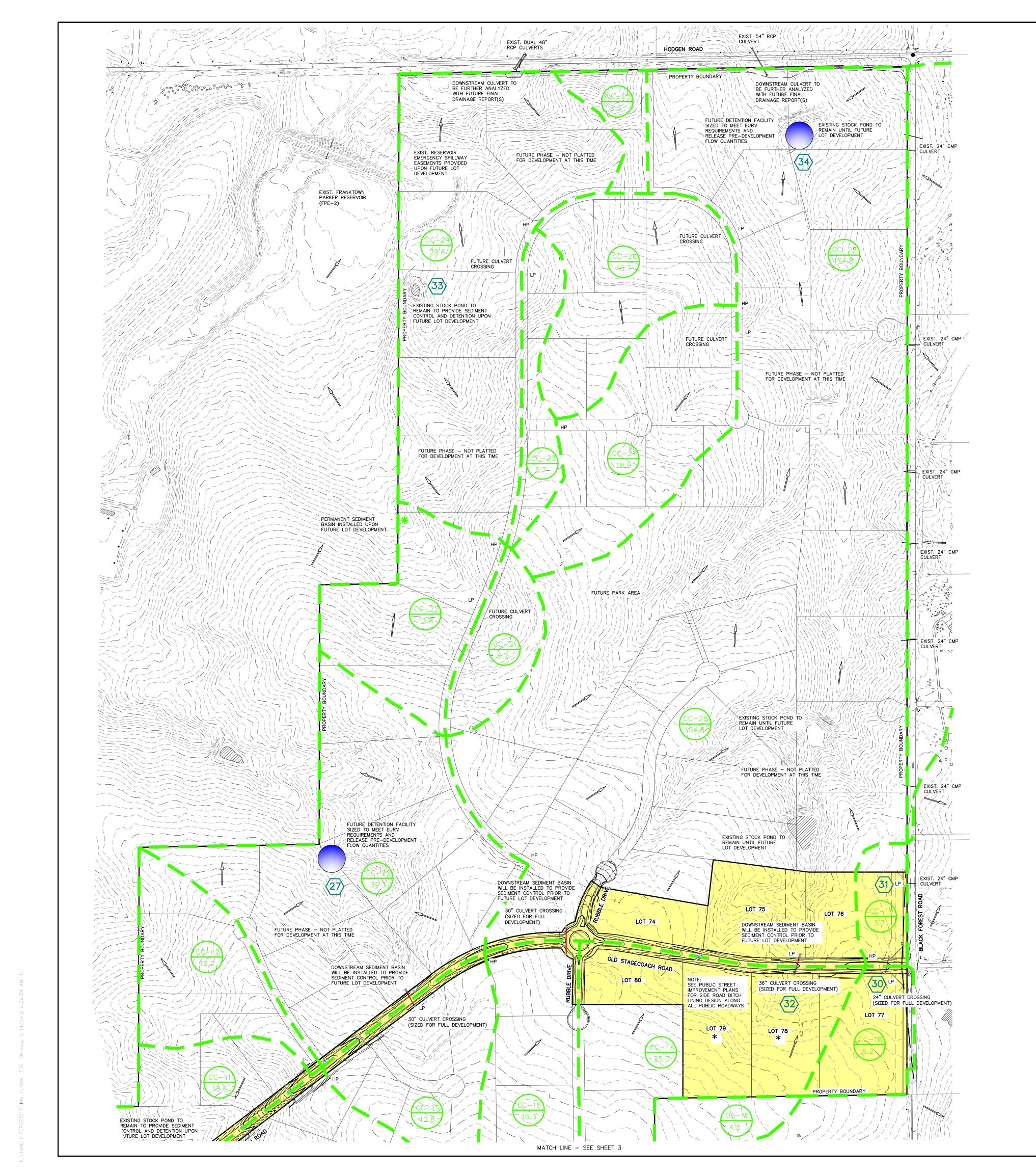


FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 DRAINAGE MAD

SM					
YORS	DESIGNED BY MAW		SCALE	DATE 10-20-17	
	DRAWN BY	MAW	(H) 1"= 200'	SHEET 1	OF 4
85-0790 85-0799 (Fax)	CHECKED BY		(V) 1"= N/A	JOB NO.	1096.11





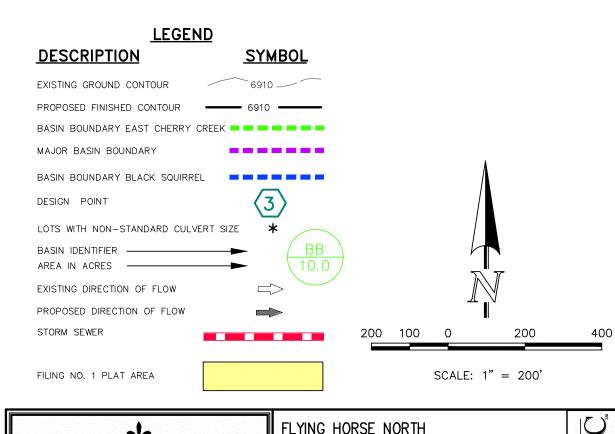


BASIN SUMMARY - DEVELOPED CONDITIONS

		COMPOSITE	TOTAL	Q	Q	Q
BASIN	AREA	CN	LAG TIME	2 Yr.	5 Yr.	100 Yr.
(label)	(acres)		(hours)	(cfs)	(cfs)	(cfs)
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168





Colorado Springs, Colorado 80903 (719)785-0799 (Fax)

FLYING HORSE NORTH PRELIMINARY/FINAL DRAINAGE REPORT RELIMINARY PLAN DRAINAGE MAP

DESIGNED BY MAW SCALE

DATE 10-17-17 DRAWN BY MAW (H) 1"= 200' SHEET 4 OF 4 CHECKED BY (V) 1"= N/A JOB NO.

