Final Drainage Report

Widefield Parks and Recreation Facility Expansion
El Paso County, Colorado

Prepared for:
Widefield School District 3
1820 Main Street
Colorado Springs, CO 80911
Contact: Dave Gish

Prepared by:
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Project #: 096958002 July 27

Prepared: July 27, 2022

PCD File Number: PPR-2213

Kimley»Horn

CERTIFICATION

DESIGN ENGINEER'S STATEMENT

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

SIGNATURE (Affix Seal): Eric Henderson 7/28/22

Colorado P.E. No. 49487 Date

OWNER/DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all of the requirements specified in this Drainage Report and Plan.

Widefield School District 3
Name of Developer

E Hulen 7-29-2022

Authorized Signature Date

Eric Hulen
Printed Name

Director
Title

755 Aspen Drive, Colorado Springs, CO 80911
Address:

EL PASO COUNTY

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

APPROVED
Engineering Department
09/21/2022 2:39:15 PM
dsdnijkamp
EPC Planning & Community Development Department

Joshua Palmer, P.E.
Interim County Engineer/ ECM Administrator

Conditions:

TABLE OF CONTENTS

INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed recreation center expansion ("the Project") for LKA Partners. The Project is located within the jurisdictional limits of El Paso County ("the County"). Thus, the guidelines for the hydrologic and hydraulic design components were based on the criteria for the County and City of Colorado Springs, described below.

LOCATION

The 39.26-acre parcel (TSN: 6513100001, 6513100003, 6512300003) is bounded between Widick St. to the east and Aspen Dr. to the west. A vicinity map has been provided in the **Appendix A** of this report.

DESCRIPTION OF PROPERTY

The Project is located on approximately 39.26 acres of land consisting of an existing park, with five (5) baseball fields, soccer field, parking lots, playground equipment, dirt trail around the perimeter, tennis courts, public library, aquatic center, and hardscape. The Project consists of a new recreation center with associated sidewalk and hardscape extensions, and a proposed onsite full spectrum detention basin. With the exception of pavement replacement over the proposed sanitary sewer service connection, the existing parking lot to the west of the proposed recreation building will remain undisturbed and be restriped. The Site does not currently provide water quality or detention for the Project area. The existing land use per El Paso County's Assessor is Exempt, Political Subdivision (Public School Use).

The existing topography consists of slopes ranging from 1% to 30% and generally slopes from Northeast to Southwest.

NRCS soil data is available for this Site and it has been noted that soils onsite are generally USCS Type A. The NRCS soil data can be found in **Appendix B**. There are no major drainage ways or irrigation facilities within the Site.

Improvements will consist of mowing, clearing and grubbing, weed control, paved access road construction, building pad grading, one detention pond, culverts, drainage swales, and native seeding.

An updated Topographic field survey was completed for the Project by Drexel, Barrell & CO, dated August 6, 2021 and is the basis for design for the drainage improvements.

DRAINAGE BASINS

MAJOR BASIN DESCRIPTIONS

The Site improvements are located in Zone X, as determined by the Flood Insurance Rate Map (FIRM) number 08041C0763G and 08041C0951G effective date, December 7, 2018 (see

Appendix A). Please note, a Portion of the Northwest corner of the Site is adjacent to an existing drainageway. An effective LOMR (17-08-1467P, dated 1/15/2019) is in place for this drainageway. The building and proposed parking area will not be within this drainageway.

The Project is located within El Paso County's Windmill Gulch Drainage Basin.

EXISTING SUB-BASIN DESCRIPTIONS

Site runoff flows from north to south via sheet and concentrated flows over developed land to Constitution Ave. Off-site flows entering the site are negligible and are not anticipated. Below is a description of the existing onsite sub-basins.

Sub-Basin EX-1

Sub-Basin EX-1 consists of a part of the northwest portion of the site. Drainage flows overland from south to north and conveys through the existing parking lot to the northwest corner at Design Point 1. Runoff during the 5-year and 100-year events are 8.19 cfs and 17.22 cfs, respectively. This sub-basin has an area of 3.07 acres. The impervious value for this basin is 61%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

Sub-Basin EX-2

Sub-Basin EX-2 consists of a part of the northwest portion of the site. Drainage flows overland from east to west and is conveyed down an existing grass hill to the southwest corner at Design Point 2. Runoff during the 5-year and 100-year events are 1.03 cfs and 5.56 cfs, respectively. This sub-basin has an area of 2.06 acres. The impervious value for this basin is 5%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

Sub-Basin EX-3

Sub-Basin EX-3 consists of a part of the western portion of the site. Drainage flows overland from east to west and conveys through the existing road and landscaping to the western edge at Design Point 3. Runoff during the 5-year and 100-year events are 5.79 cfs and 14.55 cfs, respectively. This sub-basin has an area of 4.38 acres. The impervious value for this basin is 38%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

Sub-Basin EX-4

Sub-Basin EX-4 consists of a part of the western portion of the site. Drainage flows overland from east to west and conveys through the existing parking lot and landscaping to the western edge at Design Point 4. Runoff during the 5-year and 100-year events are 4.00 cfs and 10.34 cfs, respectively. This sub-basin has an area of 3.10 acres. The impervious value for this basin is 35%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

Sub-Basin EX-5

Sub-Basin EX-5 consists of a part of the southwestern portion of the site. Drainage flows overland from North to South and conveys through the existing landscaping to the Southwest corner at Design Point 5. Runoff during the 5-year and 100-year events are 1.91 cfs and 8.93 cfs, respectively. This sub-basin has an area of 3.97 acres. The impervious value for this basin is 9%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

Sub-Basin EX-6

Sub-Basin EX-6 consists the central majority of the site. Drainage flows overland from North to South and conveys through the existing landscaping into the existing concrete channel, which conveys to the southwest corner at Design Point 6 where flows enter an existing 24" CMP storm pipe which connects to the public storm system in Lindstrom Drive south of the Site. Runoff during the 5-year and 100-year events are 8.19 cfs and 41.69 cfs, respectively. This sub-basin has an area of 22.43 acres. The impervious value for this basin is 7%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

Sub-Basin EX-7

Sub-Basin EX-7 consists of a part of the southeast portion of the site which includes an existing parking lot and tree lawn area adjacent to Widick Street. Drainage flows overland from north to south and conveys through the existing parking lot off-site to Widick Street at Design Point 7. Runoff during the 5-year and 100-year events are 2.04 cfs and 4.07 cfs, respectively. This sub-basin has an area of 0.79 acres. The impervious value for this basin is 70%. Refer to **Appendix D** for the Existing Conditions Drainage Map.

PROPOSED RATIONAL SUB-BASIN DESCRIPTIONS

Sub-Basin EX-1

Sub-Basin EX-1 consists of a portion of the northwest part of the site. Runoff from this basin will be directed to design point 1 where it will follow existing drainage patterns and enter the curb and gutter within Aspen Drive. This sub-basin has an area of 3.07 acres. The impervious value for this basin is 61%. The basin will generate runoff of 8.19 cfs and 17.22 cfs in the minor and major storm event.

Sub-Basin EX-2

Sub-Basin EX-2 consists of a portion of the northwest part of the site. Runoff from this basin will be directed to design point 2 where it will follow existing drainage patterns and exit the site along the property line. This sub-basin has an area of 2.06 acres. The impervious value for this basin is 5%. The basin will generate runoff of 1.03 cfs and 5.56 cfs in the minor and major storm event.

Sub-Basin EX-3

Sub-Basin EX-3 consists of a portion of the western part of the site. Runoff from this basin will be directed to design point 3 where it will follow existing drainage patterns and exit the site at the property line. This sub-basin has an area of 4.38 acres. The impervious value for this basin is 38%. The basin will generate runoff of 5.79 cfs and 14.55 cfs in the minor and major storm event.

Sub-Basin EX-4

Sub-Basin EX-4 consists of the existing parking lot at the eastern side of the site. Runoff from this basin will be directed to design point 4 where it will follow existing drainage patterns and

enter the existing curb and gutter within Widick Street. This sub-basin has an area of 0.79 acres. The impervious value for this basin is 70%. The basin will generate runoff of 2.04 cfs and 4.07 cfs in the minor and major storm event.

Sub-Basin A1

Sub-Basin A1 consists of a portion of the existing landscaping and drive aisle along the northern property line. Runoff from this basin will be directed to design point 5 where it will enter a proposed 15' Type-R inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 2.49 acres. The impervious value for this basin is 54%. The basin will generate runoff of 5.35 cfs and 11.73 cfs in the minor and major storm event.

Sub-Basin A2

Sub-Basin A2 consists of a portion of the proposed parking area and landscaping to the north of the proposed building. Runoff from this basin will be directed to design point 6 where it will enter a proposed area inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 0.35 acres. The impervious value for this basin is 68%. The basin will generate runoff of 1.15 cfs and 2.31 cfs in the minor and major storm event.

Sub-Basin A3

Sub-Basin A3 consists of a portion of the sidewalk and landscaping to the northeast of the proposed building. Runoff from this basin will be directed to design point 7 where it will enter a proposed area inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 0.09 acres. The impervious value for this basin is 6%. The basin will generate runoff of 0.06 cfs and 0.30 cfs in the minor and major storm event.

Sub-Basin A4

Sub-Basin A4 consists of a portion of the sidewalk and landscaping to the northeast of the proposed building. Runoff from this basin will be directed to design point 8 where it will enter a proposed area inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 0.83 acres. The impervious value for this basin is 17%. The basin will generate runoff of 0.68 cfs and 2.40 cfs in the minor and major storm event.

Sub-Basin A5

Sub-Basin A5 consists of a portion of the sidewalk and landscaping to the northeast of the proposed building. Runoff from this basin will be directed to design point 9 where it will enter a proposed area inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 0.82 acres. The impervious value for this basin is 13%. The basin will generate runoff of 0.56 cfs and 2.26 cfs in the minor and major storm event.

Sub-Basin A6

Sub-Basin A6 consists of a portion of the sidewalk and landscaping to the northeast of the proposed building. Runoff from this basin will be directed to design point 10 where it will enter a proposed area inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 0.73 acres. The impervious value for this basin is 4%. The basin will generate runoff of 0.28 cfs and 1.70 cfs in the minor and major storm event.

Sub-Basin A7

Sub-Basin A7 consists of the entirety of the proposed building and roof area. Runoff from this basin will be directed to design point 11 where it will enter the proposed roof drain system, which will convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 1.04 acres. The impervious value for this basin is 90%. The basin will generate runoff of 3.92 cfs and 7.30 cfs in the minor and major storm event.

Sub-Basin A8

Sub-Basin A8 consists of the majority of the proposed parking area located directly west of the proposed building. Runoff from this basin will be directed to design point 12 where it will enter a proposed 5’ Type-R inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 0.43 acres. The impervious value for this basin is 83%. The basin will generate runoff of 1.70 cfs and 3.21 cfs in the minor and major storm event.

Sub-Basin A9

Sub-Basin A9 consists an existing offsite basin with a small portion of the proposed parking area on the western side of the proposed building. Runoff from this basin will be directed to design point 13 where it will follow existing drainage patterns and exit the site at the property line. This sub-basin has an area of 3.41 acres. The impervious value for this basin is 34%. The basin will generate runoff of 4.42 cfs and 11.61 cfs in the minor and major storm event. Within This basin contains approx. 0.49 acres of disturbed impervious area, which qualifies under the WQ exclusion (please see Proposed Drainage Map for total area). The remainder of the basin is undisturbed.

Sub-Basin A10

Sub-Basin A10 consists of an existing offsite basin with a section of proposed landscaping at the southwest corner of the site. Runoff from this basin will be directed to design point 14 where it will follow existing drainage patterns and exit the site at the property line. This sub-basin has an area of 4.06 acres. The impervious value for this basin is 8%. The basin will generate runoff of 1.92 cfs and 9.02 cfs in the minor and major storm event. This basin contains approx. 0.44 acres of disturbed impervious area, which qualifies under the WQ exclusion I.7.1.C.1.a *Water Quality Capture Volume (WQCV) Standard* as the disturbed area is under 20%, not exceeding 1 acre (please see Proposed Drainage Map for total area). The remainder of the basin is undisturbed.

Sub-Basin A11

Sub-Basin A11 consists of the proposed parking lot and landscaping on the south side of the proposed building. Runoff from this basin will be directed to design point 15 where it enter a proposed area inlet and convey via the proposed private storm sewer system to the proposed onsite extended detention basin. This sub-basin has an area of 1.16 acres. The impervious value for this basin is 56%. The basin will generate runoff of 2.51 cfs and 5.41 cfs in the minor and major storm event.

Sub-Basin A12

Sub-Basin A12 consists of the central majority of the site. Runoff from this basin will be directed to design point 16 where flow directly into the existing concrete channel, which conveys directly to the proposed extended detention basin. This sub-basin has an area of 14.10 acres. The impervious value for this basin is 5%. The basin will generate runoff of 5.26 cfs and 28.67 cfs in the minor and major storm event.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities are designed to be in compliance with the City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)” dated October 2018 (”the MANUAL”), El Paso County “Engineering Criteria Manual” (“the Engineering Manual”), Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014 (“the Colorado Springs MANUAL”).

There are no known master plans or studies for the site.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the existing and proposed drainage analysis per the MANUAL. The rainfall depths for site were determined from equation 6-1, equation 6-2 utilizing Figures 6-6, 6-11, 6-12, and 6 -17 from the MANUAL. Refer to **Table 1** below for the rainfall depths utilized for the site and **Appendix B** for the hydrologic calculations for the site.

Table 1: *Rainfall Depths*

	Duration (HRS)
Storm Event	**1 HR**
5 Year	1.52
100 Year	2.55

Calculations for the runoff coefficients and percent impervious are included in the **Appendix B**. Rational method was used to determine the peak flows for the project. These flows were used to determine the size of the proposed inlets, culvert, storm drain system and on-site swales.

The proposed impervious values in Table 6-6 of the DCM were utilized in this report for the final design. Refer to **Appendix B** of this report for Table 6-6.

The Site is providing one full spectrum detention pond. The Site is maintaining the historic drainage patterns as much as possible.

There are no additional provisions selected or deviations from the criteria in both the MANUAL and Colorado Springs MANUAL.

HYDRAULIC CRITERIA

Applicable design methods were utilized to size the proposed pond, which includes the use of the UD-Detention spreadsheet and rational calculations spreadsheet.

Proposed drainage features on-site have been analyzed and sized for the following design storm events:

- Major Storm: 100-year Storm Event

One full spectrum detention pond is proposed in order to maintain historic flows and water quality. The detention pond known as the South Pond. The South Pond is in the southwest corner of the Site with a proposed volume of 1.43 ac-ft and designed for the 100-year storm event. The pond has a discharge rate of 7.7 cfs in the 100-year condition. Water from the South Pond is discharged into an existing culvert at the southwest corner of the site and ultimately outfalls to Fountain Creek. Pond calculations are provided in the **Appendix C**.

Curb and gutter, inlets, concrete and grass lined swales, and storm drain pipes are designed to carry flows to the South Pond. The storm drain pipe calculations are provided in the **Appendix C** and the design points are provided in the Proposed Drainage Map located in **Appendix D**. The pond is designed to release the 100-year flow rates below the pre-development flow rate.

Emergency overflows will be routed over the western side of the pond. It will follow existing drainage conditions and cross the property line to the West, where it will avoid the single family residence and enter the Grand Boulevard right of way.

Due to the sub-basins that follow existing drainage patterns and do not enter the pond, an additional CIA calculation has been included in **Appendix C** to include all tributary areas.

THE FOUR STEP PROCESS

The Project was designed in accordance with the four-step process to minimize adverse impacts of urbanization, as outlined in the County's "Four-Step Process" for selecting structural BMPs (ECM Section I.7.2 BMP Selection).

Step 1. **Employ Runoff Reduction Practices**- The project is proposing an expansion to an existing school building that will be designed to minimize the impact to the current existing terrain. The Site's proposed paved roadways and building footprint will increase the Site's impervious area; however, drainage swales will be constructed to slow down the runoff velocity and reduce runoff peaks. A full spectrum detention pond will be used to capture stormwater and maintain flows discharging off site at or below historic levels.

Step 2. Stabilize Drainageways– Stabilizing proposed drainage swales by designing them with slopes that control the flow rates. Placement of riprap upstream and downstream of culverts to help reduce erosion of the drainage swales. Rock chutes will be constructed to reduce the velocities of runoff entering the ponds at the channel locations. We anticipate this will minimize erosion.

Step 3. Provide Water Quality Capture Volume (WQCV) –Permanent water quality measures and detention facilities will be provided with the Project. More specifically, this project proposes the construction of an Extended Detention Basin to provide for the required water quality capture volume.

Step 4. Consider Need for Industrial and Commercial BMPs – The proposed project is proposing a new recreation center; therefore, covering of storage/handling areas and spill containment and control will not need to be provided.

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed drainage patterns will match the historic patterns. To maintain historic flows, a full spectrum detention pond is being proposed and will capture and control the flows from the proposed development to convey flows with a series of swales, parking lot sheet flow, and a storm drain system.

Provided in the **Appendix B** are hydrologic calculations utilizing the Rational method for the existing and proposed conditions. Provided in **Appendix C** are the hydraulic calculations for the proposed conditions, including the proposed detention basin sizing. As previously mentioned, the existing drainage map and proposed drainage map can be found in **Appendix D.**

SPECIFIC DETAILS

The existing conditions of the Site have flows conveying from the northeast to the southwest corner and spill into the existing culvert that conveys South underneath the existing properties. Runoff conditions for the Site were developed utilizing the Rational Method described in the Hydrologic Criteria section of this report.

Sub-basins EX-1 – EX-4 and A1-A12 consist of a proposed recreation center and detention

pond. Flows are conveyed from the north side of the Site to the southwest corner of the Site. On site flows enter the South Pond which then release controlled flows into the existing 24" CMP culvert that conveys flows south underneath the adjacent property's drive access. The 24" CMP has a 100% flow capacity of 41.59 cfs. The proposed pond has a 100 year discharge rate of 14.7 cfs. Therefore the pipe has capacity for the released flows.

The hydrologic calculations, hydraulic calculations, and Drainage Maps are included in the **Appendix B, Appendix C,** and **Appendix D** of this report for reference.

The Site will disturb more than 1 acre and will require a Colorado Discharge Permit System (CDPS) General Permit for Stormwater Discharge Associated with Construction Activities from the Colorado Department of Public Health and Environment (CDPHE).

Since the Site was previously platted, there are no associated drainage and bridge fees due at this time.

In the existing condition, the site does not provide water quality or 100-year detention. The pond has been sized to account for 22.04 acres of tributary area which consists of; all of the disturbed site area except for 0.92 acres which cannot be captured and the undisturbed areas upstream or tributary to the pond area. The remaining undisturbed acreage on-site flows off-site as part of the project matching the historical drainage patterns and is therefore not part of the pond sizing.

SUMMARY

The proposed drainage design is to maintain the historic drainage patterns, the overall imperviousness and release rates for the Site. Runoff from the Site will flow through an existing storm drain system to an existing El Paso County drainage basin: The Windmill Gulch Drainage Basin. The basin ultimately discharges to Fountain Creek. The drainage design presented within this report conforms to the criteria presented in both the MANUAL and the Colorado Springs MANUAL. Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments, including Fountain Creek.

REFERENCES

1. City of Colorado Springs “Drainage Criteria Manual (DCM) Volume 1”, dated May, 2014
2. El Paso County “Drainage Criteria Manual”, dated October 31, 2018
3. El Paso County “Engineering Criteria Manual” Revision 6, dated December 13, 2016
4. Chapter 6 and Section 3.2.1. of Chapter 13-City of Colorado Springs Drainage Criteria Manual, May 2014.
5. Urban Drainage and Flood Control District Drainage Criteria Manual (UDFCDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.
6. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0763G and 08041C0951G effective date, December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

APPENDIX

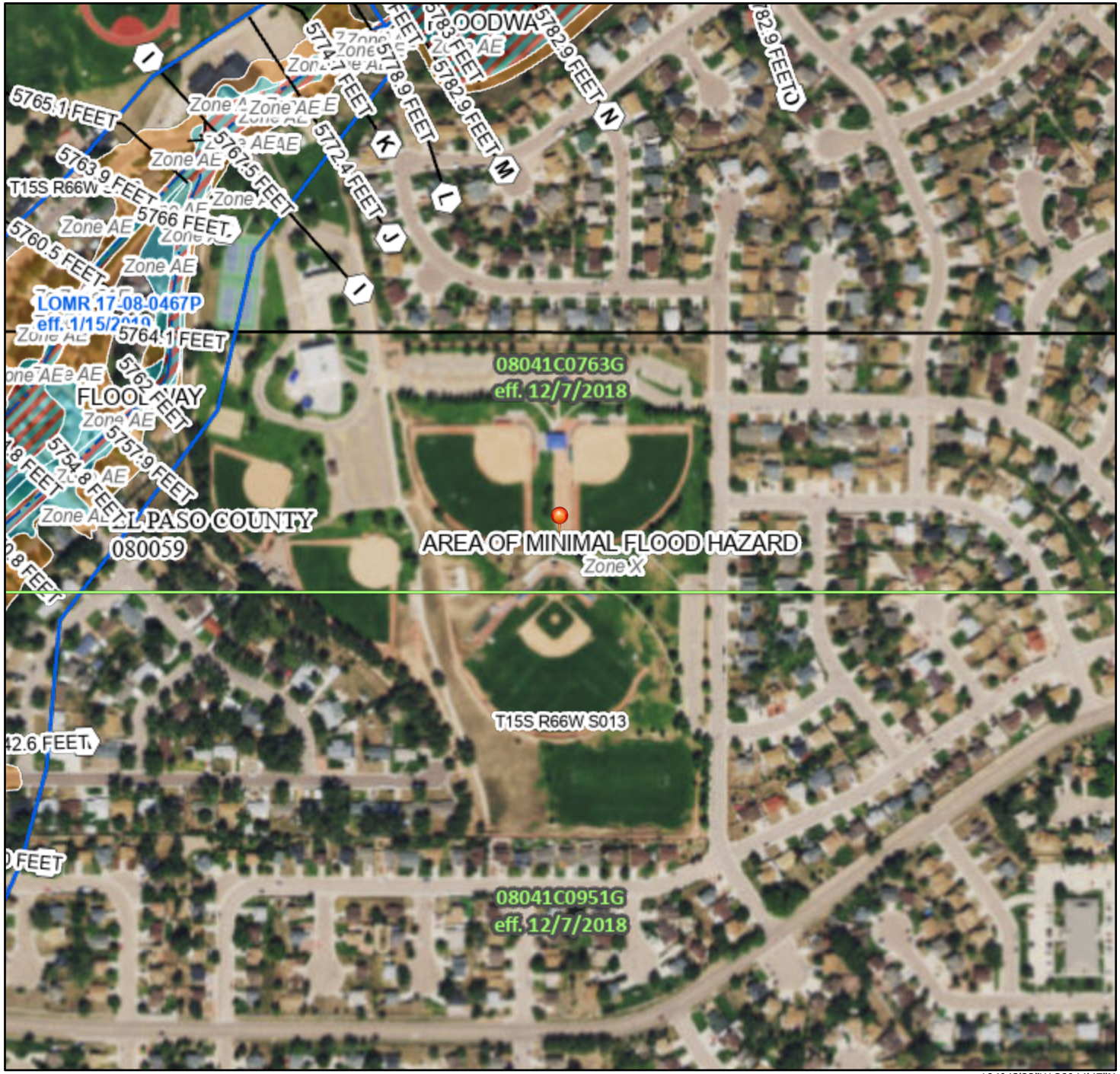
APPENDIX A: FIGURES

VICINITY MAP

National Flood Hazard Layer FIRMette

FEMA

104°44'W 38°45'16"N



104°43'22"W 38°44'47"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 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*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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 accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/2/2022 at 5:31 PM 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

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for El Paso County Area, Colorado

November 29, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 14, 2018—Sep 23, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	12.2	100.0%
Totals for Area of Interest		**12.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent

Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

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$$I = \frac{28.5\ P_1}{(10+T_D)^{0.786}}$$

Where:

I = rainfall intensity (inches per hour)

P_1 = one-hour rainfall depth (inches) from Table 6-2 One-hour Point Rainfall D
City of Colorado Springs Drainage Design

T_C = storm duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.52	1.75	2.55

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.05	5.16	5.94	8.65
10	3.23	4.11	4.73	6.90
15	2.71	3.45	3.97	5.79
30	1.87	2.38	2.75	4.00
60	1.21	1.54	1.77	2.58
120	0.74	0.94	1.09	1.58

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SUMMARY - EXISTING RUNOFF TABLE						
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-1	3.07	8.19	17.22	8.19	17.22
2	EX-2	2.06	1.03	5.56	1.03	5.56
3	EX-3	4.38	5.79	14.55	5.79	14.55
4	EX-4	3.10	4.00	10.34	4.00	10.34
5	EX-5	3.97	1.91	8.93	1.91	8.93
6	EX-6	22.43	8.19	41.69	8.19	41.69
7	EX-7	0.79	2.04	4.07	2.04	4.07

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Weighted Imperviousness Calculations - Existing Conditions

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
EX-1	133517	3.07	0.176676	90%	0.71	0.73	0.75	0.81	1.213981	2%	0.03	0.09	0.17	0.36	1.674472	100%	0.89	0.90	0.92	0.96	61%	0.54	0.57	0.61	0.71
EX-2	89883	2.06	0	90%	0.71	0.73	0.75	0.81	1.990404	2%	0.03	0.09	0.17	0.36	0.073026	100%	0.89	0.90	0.92	0.96	5%	0.06	0.12	0.20	0.38
EX-3	190790	4.38	0.270432	90%	0.71	0.73	0.75	0.81	2.72702	2%	0.03	0.09	0.17	0.36	1.382484	100%	0.89	0.90	0.92	0.96	38%	0.34	0.39	0.44	0.58
EX-4	134827	3.10	0.016483	90%	0.71	0.73	0.75	0.81	2.036501	2%	0.03	0.09	0.17	0.36	1.042218	100%	0.89	0.90	0.92	0.96	35%	0.32	0.37	0.43	0.56
EX-5	173141	3.97	0.068641	90%	0.71	0.73	0.75	0.81	3.698852	2%	0.03	0.09	0.17	0.36	0.207277	100%	0.89	0.90	0.92	0.96	9%	0.09	0.14	0.22	0.40
EX-6	976946	22.43	0.021327	90%	0.71	0.73	0.75	0.81	21.37679	2%	0.03	0.09	0.17	0.36	1.029477	100%	0.89	0.90	0.92	0.96	7%	0.07	0.13	0.20	0.39
EX-7	34437	0.79	0	90%	0.71	0.73	0.75	0.81	0.241965	2%	0.03	0.09	0.17	0.36	0.5486	100%	0.89	0.90	0.92	0.96	70%	0.63	0.65	0.69	0.78
TOTAL	1,733,541	39.80	0.55	90%	0.71	0.73	0.75	0.81	33.29	2%	0.03	0.09	0.17	0.36	5.96	100%	0.89	0.90	0.92	0.96	18%	0.17	0.22	0.29	0.46

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Akers Road - Drainage Report
Existing Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00			Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00			Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
1	EX-1	133,517	3.07	0.57	68	4.8%	4.8	624	6.1%	20.00	4.9	2.1	6.9	692	13.8	6.9
2	EX-2	89,883	2.06	0.12	100	11.7%	7.9	187	9.1%	7.00	2.1	1.5	9.4	287	11.6	9.4
3	EX-3	190,790	4.38	0.39	100	2.5%	9.6	873	6.8%	10.00	2.6	5.6	15.2	973	15.4	15.2
4	EX-4	134,827	3.10	0.37	100	3.5%	8.9	672	4.9%	7.00	1.5	7.2	16.1	772	14.3	14.3
5	EX-5	173,141	3.97	0.14	100	10.3%	8.1	969	2.0%	7.00	1.0	16.3	24.4	1069	15.9	15.9
6	EX-6	976,946	22.43	0.13	100	6.1%	9.7	2015	5.0%	10.00	2.2	15.0	24.7	2115	21.8	21.8
7	EX-7	34,437	0.79	0.65	100	4.4%	5.0	678	3.5%	10.00	1.9	6.0	11.0	778	14.3	11.0

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Akers Road - Drainage Report
Existing Runoff Calculations ***Design Storm 5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-1	3.07	0.57	6.9	1.75	4.69	8.19				8.19	
2	EX-2	2.06	0.12	9.4	0.24	4.22	1.03				1.03	
3	EX-3	4.38	0.39	15.2	1.69	3.43	5.79				5.79	
4	EX-4	3.10	0.37	14.3	1.13	3.53	4.00				4.00	
5	EX-5	3.97	0.14	15.9	0.57	3.36	1.91				1.91	
6	EX-6	22.43	0.13	21.8	2.87	2.86	8.19				8.19	
7	EX-7	0.79	0.65	11.0	0.52	3.95	2.04				2.04	

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Akers Road - Drainage Report
Existing Runoff Calculations ***Design Storm 100 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-1	3.07	0.71	6.9	2.19	7.87	17.22				17.22	
2	EX-2	2.06	0.38	9.4	0.79	7.07	5.56				5.56	
3	EX-3	4.38	0.58	15.2	2.53	5.76	14.55				14.55	
4	EX-4	3.10	0.56	14.3	1.75	5.92	10.34				10.34	
5	EX-5	3.97	0.40	15.9	1.59	5.63	8.93				8.93	
6	EX-6	22.43	0.39	21.8	8.70	4.79	41.69				41.69	
7	EX-7	0.79	0.78	11.0	0.61	6.63	4.07				4.07	

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$$I = \frac{28.5\ P_1}{(10+T_D)^{0.786}}$$

Where:

I = rainfall intensity (inches per hour)

P_1 = one-hour rainfall depth (inches) from Table 6-2 One-hour Point Rainfall D
City of Colorado Springs Drainage Design

T_C = storm duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.52	1.75	2.55

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.05	5.16	5.94	8.65
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15	2.71	3.45	3.97	5.79
30	1.87	2.38	2.75	4.00
60	1.21	1.54	1.77	2.58
120	0.74	0.94	1.09	1.58

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
EX-1	133517	3.07	0.18	90%	0.71	0.73	0.75	0.81	1.21	2%	0.03	0.09	0.17	0.36	1.67	100%	0.89	0.90	0.92	0.96	61%	0.54	0.57	0.61	0.71
EX-2	89883	2.06	-	90%	0.71	0.73	0.75	0.81	1.99	2%	0.03	0.09	0.17	0.36	0.07	100%	0.89	0.90	0.92	0.96	5%	0.06	0.12	0.20	0.38
EX-3	190790	4.38	0.27	90%	0.71	0.73	0.75	0.81	2.73	2%	0.03	0.09	0.17	0.36	1.38	100%	0.89	0.90	0.92	0.96	38%	0.34	0.39	0.44	0.58
EX-4	34437	0.79	-	90%	0.71	0.73	0.75	0.81	0.24	2%	0.03	0.09	0.17	0.36	0.55	100%	0.89	0.90	0.92	0.96	70%	0.63	0.65	0.69	0.78
A1	108597	2.49	-	90%	0.71	0.73	0.75	0.81	1.17	2%	0.03	0.09	0.17	0.36	1.32	100%	0.89	0.90	0.92	0.96	54%	0.49	0.52	0.57	0.68
A2	15277	0.35	-	90%	0.71	0.73	0.75	0.81	0.12	2%	0.03	0.09	0.17	0.36	0.24	100%	0.89	0.90	0.92	0.96	68%	0.61	0.63	0.67	0.76
A3	3880	0.09	-	90%	0.71	0.73	0.75	0.81	0.09	2%	0.03	0.09	0.17	0.36	0.00	100%	0.89	0.90	0.92	0.96	6%	0.07	0.13	0.20	0.39
A4	36061	0.83	-	90%	0.71	0.73	0.75	0.81	0.70	2%	0.03	0.09	0.17	0.36	0.13	100%	0.89	0.90	0.92	0.96	17%	0.16	0.22	0.29	0.45
A5	35595	0.82	-	90%	0.71	0.73	0.75	0.81	0.73	2%	0.03	0.09	0.17	0.36	0.09	100%	0.89	0.90	0.92	0.96	13%	0.12	0.18	0.25	0.43
A6	31808	0.73	-	90%	0.71	0.73	0.75	0.81	0.72	2%	0.03	0.09	0.17	0.36	0.01	100%	0.89	0.90	0.92	0.96	4%	0.04	0.10	0.18	0.37
A7	45386	1.04	1.04	90%	0.71	0.73	0.75	0.81	-	2%	0.03	0.09	0.17	0.36	-	100%	0.89	0.90	0.92	0.96	90%	0.71	0.73	0.75	0.81
A8	18831	0.43	-	90%	0.71	0.73	0.75	0.81	0.07	2%	0.03	0.09	0.17	0.36	0.36	100%	0.89	0.90	0.92	0.96	83%	0.74	0.76	0.79	0.86
A9	148438	3.41	0.02	90%	0.71	0.73	0.75	0.81	2.29	2%	0.03	0.09	0.17	0.36	1.11	100%	0.89	0.90	0.92	0.96	34%	0.31	0.36	0.42	0.56
A10	176750	4.06	0.07	90%	0.71	0.73	0.75	0.81	3.78	2%	0.03	0.09	0.17	0.36	0.21	100%	0.89	0.90	0.92	0.96	8%	0.09	0.14	0.22	0.40
A11	50356	1.16	-	90%	0.71	0.73	0.75	0.81	0.52	2%	0.03	0.09	0.17	0.36	0.64	100%	0.89	0.90	0.92	0.96	56%	0.51	0.54	0.58	0.69
A12	613982	14.10	0.02	90%	0.71	0.73	0.75	0.81	13.62	2%	0.03	0.09	0.17	0.36	0.45	100%	0.89	0.90	0.92	0.96	5%	0.06	0.12	0.19	0.38
TOTAL	1,733,588	39.80	1.60	90%	0.71	0.73	0.75	0.81	29.97	2%	0.03	0.09	0.17	0.36	8.23	100%	0.89	0.90	0.92	0.96	26%	0.24	0.28	0.35	0.50

Widefield Rec Center - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
1	EX-1	133,517	3.07	0.57	68	4.8%	4.8	624	6.1%	20.00	4.9	2.1	6.9	692	13.8	6.9
2	EX-2	89,883	2.06	0.12	100	11.7%	7.9	187	9.1%	7.00	2.1	1.5	9.4	287	11.6	9.4
3	EX-3	190,790	4.38	0.39	100	2.5%	9.6	873	6.8%	10.00	2.6	5.6	15.2	973	15.4	15.2
4	EX-4	34,437	0.79	0.65	100	4.4%	5.0	678	3.5%	10.00	1.9	6.0	11.0	778	14.3	11.0
5	A1	108,597	2.49	0.52	100	5.5%	6.0	864	3.5%	20.00	3.7	3.8	9.8	964	15.4	9.8
6	A2	15,277	0.35	0.63	50	22.0%	2.2	143	0.5%	20.00	1.4	1.7	5.0	193	11.1	5.0
7	A3	3,880	0.09	0.13	55	22.0%	4.7	0	0.0%	7.00	0.0	0.0	5.0	55	10.3	5.0
8	A4	36,061	0.83	0.22	100	3.3%	10.9	285	12.2%	7.00	2.4	1.9	12.8	385	12.1	12.1
9	A5	35,595	0.82	0.18	100	5.4%	9.6	256	9.2%	7.00	2.1	2.0	11.6	356	12.0	11.6
10	A6	31,808	0.73	0.10	100	9.4%	8.7	345	3.7%	7.00	1.3	4.3	13.0	445	12.5	12.5
11	A7	45,386	1.04	0.73	100	5.0%	4.0	15	5.0%	20.00	4.5	0.1	5.0	115	10.6	5.0
12	A8	18,831	0.43	0.76	100	5.1%	3.6	121	1.5%	20.00	2.4	0.8	5.0	221	11.2	5.0
13	A9	148,438	3.41	0.36	75	3.5%	7.8	731	4.9%	10.00	2.2	5.5	13.3	806	14.5	13.3
14	A10	176,750	4.06	0.14	100	15.0%	7.1	1016	2.7%	7.00	1.2	14.7	21.8	1116	16.2	16.2
15	A11	50,356	1.16	0.54	100	1.2%	9.7	197	4.4%	20.00	4.2	0.8	10.5	297	11.7	10.5
16	A12	613,982	14.10	0.12	100	13.9%	7.5	1273	4.6%	7.00	1.5	14.1	21.6	1373	17.6	17.6

Widefield Rec Center - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *5 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-1	3.07	0.57	6.9	1.75	4.69	8.19				8.19	
2	EX-2	2.06	0.12	9.4	0.24	4.22	1.03				1.03	
3	EX-3	4.38	0.39	15.2	1.69	3.43	5.79				5.79	
4	EX-4	0.79	0.65	11.0	0.52	3.95	2.04				2.04	
5	A1	2.49	0.52	9.8	1.29	4.14	5.35				5.35	
6	A2	0.35	0.63	5.0	0.22	5.16	1.15				1.15	
7	A3	0.09	0.13	5.0	0.01	5.16	0.06				0.06	
8	A4	0.83	0.22	12.1	0.18	3.80	0.68				0.68	
9	A5	0.82	0.18	11.6	0.15	3.87	0.56				0.56	
10	A6	0.73	0.10	12.5	0.08	3.75	0.28				0.28	
11	A7	1.04	0.73	5.0	0.76	5.16	3.92				3.92	
12	A8	0.43	0.76	5.0	0.33	5.16	1.70				1.70	
13	A9	3.41	0.36	13.3	1.21	3.65	4.42				4.42	
14	A10	4.06	0.14	16.2	0.58	3.33	1.92				1.92	
15	A11	1.16	0.54	10.5	0.62	4.04	2.51				2.51	
16	A12	14.10	0.12	17.6	1.65	3.19	5.26				5.26	

Widefield Rec Center - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *100 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-1	3.07	0.71	6.9	2.19	7.87	17.22				17.22	
2	EX-2	2.06	0.38	9.4	0.79	7.07	5.56				5.56	
3	EX-3	4.38	0.58	15.2	2.53	5.76	14.55				14.55	
4	EX-4	0.79	0.78	11.0	0.61	6.63	4.07				4.07	
5	A1	2.49	0.68	9.8	1.69	6.94	11.73				11.73	
6	A2	0.35	0.76	5.0	0.27	8.65	2.31				2.31	
7	A3	0.09	0.39	5.0	0.03	8.65	0.30				0.30	
8	A4	0.83	0.45	12.1	0.38	6.38	2.40				2.40	
9	A5	0.82	0.43	11.6	0.35	6.49	2.26				2.26	
10	A6	0.73	0.37	12.5	0.27	6.29	1.70				1.70	
11	A7	1.04	0.81	5.0	0.84	8.65	7.30				7.30	
12	A8	0.43	0.86	5.0	0.37	8.65	3.21				3.21	
13	A9	3.41	0.56	13.3	1.90	6.12	11.61				11.61	
14	A10	4.06	0.40	16.2	1.62	5.58	9.02				9.02	
15	A11	1.16	0.69	10.5	0.80	6.77	5.41				5.41	
16	A12	14.10	0.38	17.6	5.35	5.36	28.67				28.67	

Widefield Rec Center - Drainage Report
Proposed Runoff Calculations *Design Storm 10 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-1	3.065	0.61	6.9	1.88	5.40	10.15				10.15	
2	EX-2	2.063	0.20	9.4	0.41	4.85	1.97				1.97	
3	EX-3	4.38	0.44	15.2	1.94	3.95	7.66				7.66	
4	EX-4	0.791	0.69	11.0	0.55	4.55	2.48				2.48	
5	A1	2.493	0.57	9.8	1.41	4.76	6.73				6.73	
6	A2	0.351	0.67	5.0	0.24	5.94	1.40				1.40	
7	A3	0.089	0.20	5.0	0.02	5.94	0.11				0.11	
8	A4	0.828	0.29	12.1	0.24	4.38	1.04				1.04	
9	A5	0.817	0.25	11.6	0.21	4.46	0.92				0.92	
10	A6	0.73	0.18	12.5	0.13	4.32	0.57				0.57	
11	A7	1.042	0.75	5.0	0.78	5.94	4.64				4.64	
12	A8	0.432	0.79	5.0	0.34	5.94	2.03				2.03	
13	A9	3.408	0.42	13.3	1.42	4.20	5.96				5.96	
14	A10	4.058	0.22	16.2	0.89	3.83	3.39				3.39	
15	A11	1.156	0.58	10.5	0.68	4.65	3.14				3.14	
16	A12	14.1	0.19	17.6	2.75	3.68	10.09				10.09	

SUMMARY - PROPOSED RUNOFF TABLE						
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-1	3.07	8.19	17.22	8.19	17.22
2	EX-2	2.06	1.03	5.56	1.03	5.56
3	EX-3	4.38	5.79	14.55	5.79	14.55
4	EX-4	0.79	2.04	4.07	2.04	4.07
5	A1	2.49	5.35	11.73	5.35	11.73
6	A2	0.35	1.15	2.31	1.15	2.31
7	A3	0.09	0.06	0.30	0.06	0.30
8	A4	0.83	0.68	2.40	0.68	2.40
9	A5	0.82	0.56	2.26	0.56	2.26
10	A6	0.73	0.28	1.70	0.28	1.70
11	A7	1.04	3.92	7.30	3.92	7.30
12	A8	0.43	1.70	3.21	1.70	3.21
13	A9	3.41	4.42	11.61	4.42	11.61
14	A10	4.06	1.92	9.02	1.92	9.02
15	A11	1.16	2.51	5.41	2.51	5.41
16	A12	14.10	5.26	28.67	5.26	28.67

Table 6-6. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	$C_A = 0.89i$	$C_A = 0.93i$	$C_A = 0.94i$	$C_A = 0.944i$	$C_A = 0.95i$	$C_A = 0.81i + 0.154$
B	$C_B = 0.89i$	$C_B = 0.93i$	$C_B = 0.81i + 0.125$	$C_B = 0.70i + 0.23$	$C_B = 0.59i + 0.364$	$C_B = 0.49i + 0.454$
C/D	$C_{C/D} = 0.89i$	$C_{C/D} = 0.87i + 0.052$	$C_{C/D} = 0.74i + 0.2$	$C_{C/D} = 0.64i + 0.31$	$C_{C/D} = 0.54i + 0.418$	$C_{C/D} = 0.45i + 0.508$

ROOF						
NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	0.80	0.84	0.85	0.85	0.86	0.88
B						
C/D						

LANDSCAPE						
NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	0.02	0.02	0.02	0.02	0.02	0.17
B						
C/D						

PAVEMENT						
NRCS Soil Group	Storm Return Period					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
A	0.89	0.93	0.94	0.94	0.95	0.96
B						
C/D						

I (%)	
ROOF	90.00%
LANDSCAPE	2.00%
PAVEMENT	100.00%

Soil Type
A
B
C/D

APPENDIX C: HYDRAULICS

BASIN IMPERVIOUSNESS (TRIBUTARY TO POND)

		Runoff Coefficient		
Landuse	**I**	**2-YR**	**5-YR**	**100-YR**
Landscape	2%	0.03	0.09	0.36
Roof	90%	0.71	0.73	0.81
Drives&Walks	100%	0.89	0.90	0.96

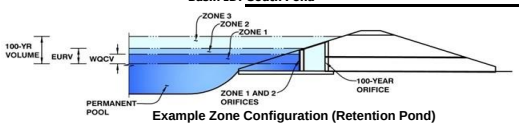
Basin Designation	A_{TOTAL} (AC)	A_{TOTAL} (SF)	$A_{LANDSCAPE}$ (SF)	A_{ROOF} (SF)	$A_{I/DRIVES\ \&\ WALKS}$ (SF)	$I_{WEIGHTED}$
A1	2.49	108,597	51,089	0	57,508	54%
A2	0.35	15,277	5,031	0	10,246	68%
A3	0.09	3,880	3,712	0	168	6%
A4	0.83	36,061	30,410	0	5,651	17%
A5	0.82	35,595	31,719	0	3,876	13%
A6	0.73	31,808	31,304	0	504	4%
A7	1.04	45,386	0	45,386	0	90%
A8	0.43	18,831	3,214	0	15,617	83%
A11	1.16	50,356	22,516	0	27,840	56%
A12	14.10	613,982	593,477	929	19,576	5%
Total	**22.03**	**959,773.00**	**772,472.00**	**46,315.00**	**140,986.00**	**21%**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Widefield Rec Center**

Basin ID: **South Pond**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	22.04	acres
Watershed Length =	1,400	ft
Watershed Length to Centroid =	600	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	21.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	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 Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.220	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.419	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.267	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.383	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.489	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.830	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.154	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.55 in.) =	1.637	acre-feet	2.55 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.555	acre-feet	inches
Approximate 2-yr Detention Volume =	0.259	acre-feet	
Approximate 5-yr Detention Volume =	0.349	acre-feet	
Approximate 10-yr Detention Volume =	0.443	acre-feet	
Approximate 25-yr Detention Volume =	0.573	acre-feet	
Approximate 50-yr Detention Volume =	0.686	acre-feet	
Approximate 100-yr Detention Volume =	0.913	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.220	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.199	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.494	acre-feet
Total Detention Basin Volume =	0.913	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

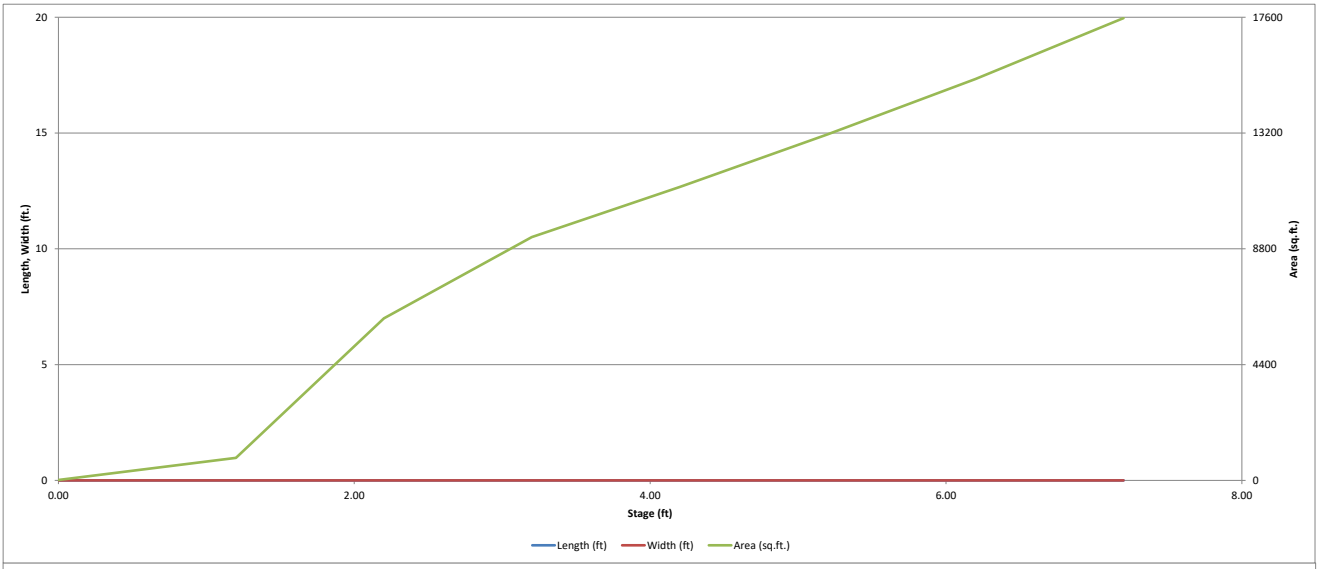
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

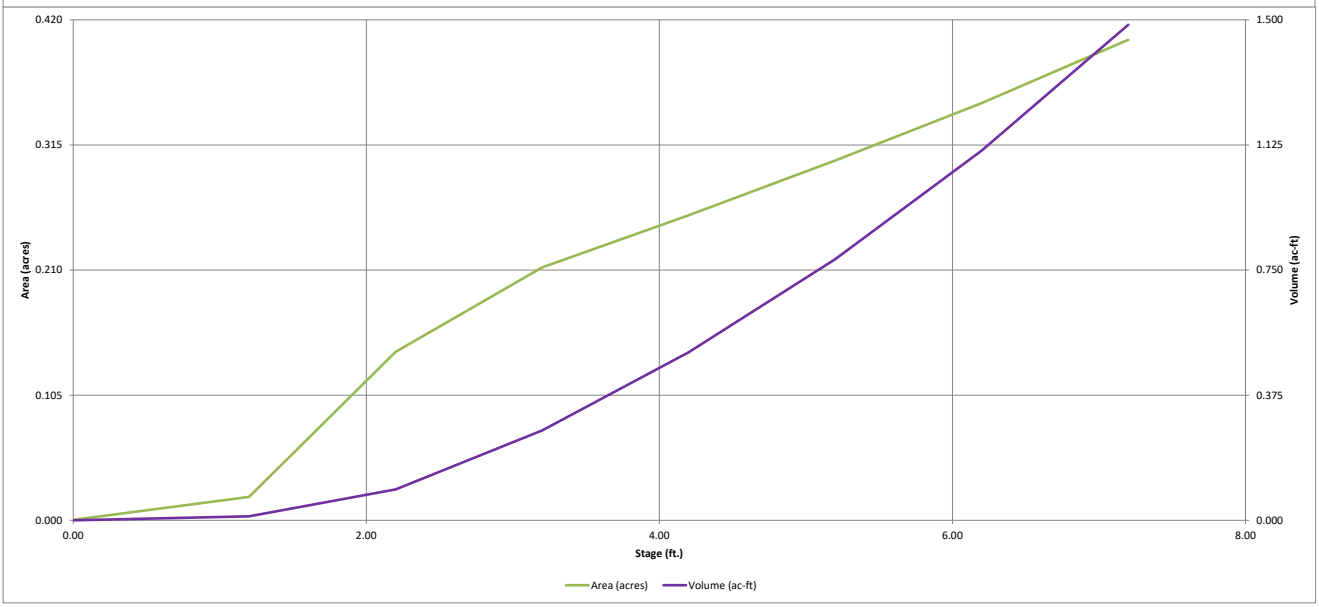
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	16	0.000		
5759	--	1.20	--	--	--	857	0.020	524	0.012
5760	--	2.20	--	--	--	6,158	0.141	4,031	0.093
5761	--	3.20	--	--	--	9,246	0.212	11,733	0.269
5762	--	4.20	--	--	--	11,150	0.256	21,931	0.503
5763	--	5.20	--	--	--	13,153	0.302	34,083	0.782
5764	--	6.20	--	--	--	15,255	0.350	48,287	1.109
5765	--	7.20	--	--	--	17,567	0.403	64,698	1.485

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



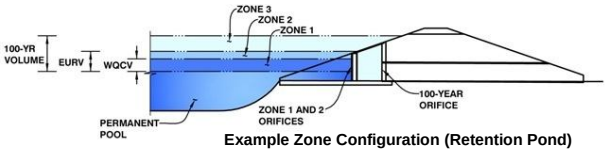


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Widefield Rec Center**

Basin ID: **South Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.96	0.220	Orifice Plate
Zone 2 (EURV)	3.86	0.199	Circular Orifice
Zone 3 (100-year)	5.62	0.494	Weir&Pipe (Restrict)
Total (all zones)		0.913	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.653E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.96	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.67	sq. inches (diameter = 15/16 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00					
Orifice Area (sq. inches)	0.67	0.67	0.67					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.96	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.02	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.86	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Diameter =	1.87	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.86	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.86	N/A	feet
Overflow Weir Front Edge Length =	4.00	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 =	8.17	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.48	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.74	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	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 =	1.40	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.53	N/A	feet
Restrictor Plate Height Above Pipe Invert =	11.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.49	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.20	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.79	feet
Spillway Crest Length =	9.00	feet	Stage at Top of Freeboard =	7.99	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.40	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.49	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.55	3.14
CUHP Runoff Volume (acre-ft) =	0.220	0.419	0.267	0.383	0.489	0.830	1.154	1.637	2.555
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.267	0.383	0.489	0.830	1.154	1.637	2.555
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.5	4.9	9.8	16.6	28.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.22	0.44	0.76	1.30
Peak Inflow Q (cfs) =	N/A	N/A	3.6	5.3	6.7	12.1	17.3	24.7	37.4
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.2	0.4	3.3	6.9	13.1	19.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.7	0.7	0.7	0.8	0.7
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.00	N/A	N/A	0.0	0.3	0.6	1.1	1.5
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) =	41	54	46	53	58	56	53	50	44
Time to Drain 99% of Inflow Volume (hours) =	**44**	58	49	57	62	61	60	58	56
Maximum Ponding Depth (ft) =	2.96	3.87	3.09	3.58	3.98	4.55	4.91	5.34	6.38
Area at Maximum Ponding Depth (acres) =	0.20	0.24	0.20	0.23	0.25	0.27	0.29	0.31	0.36
Maximum Volume Stored (acre-ft) =	0.220	0.421	0.246	0.353	0.446	0.596	0.694	0.822	1.172

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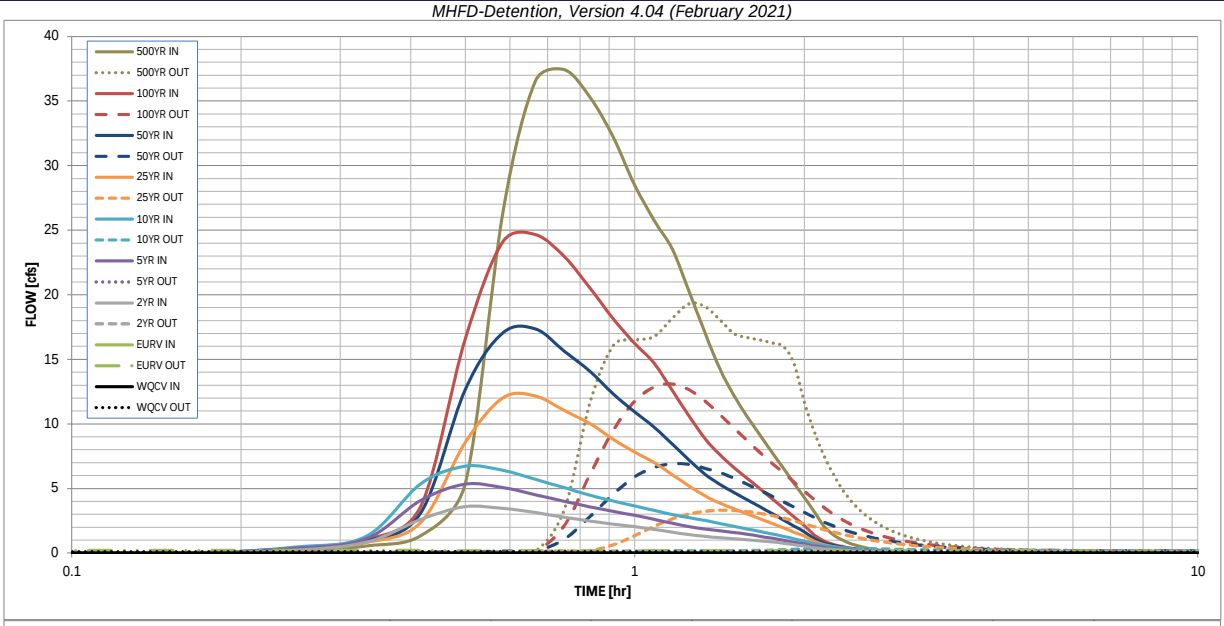
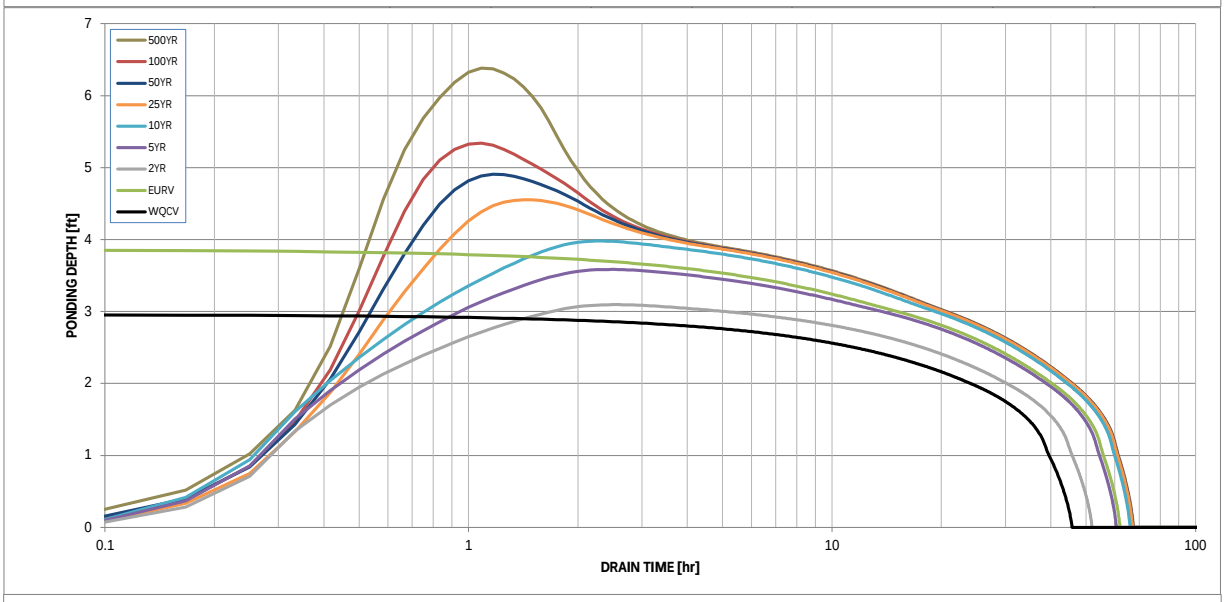
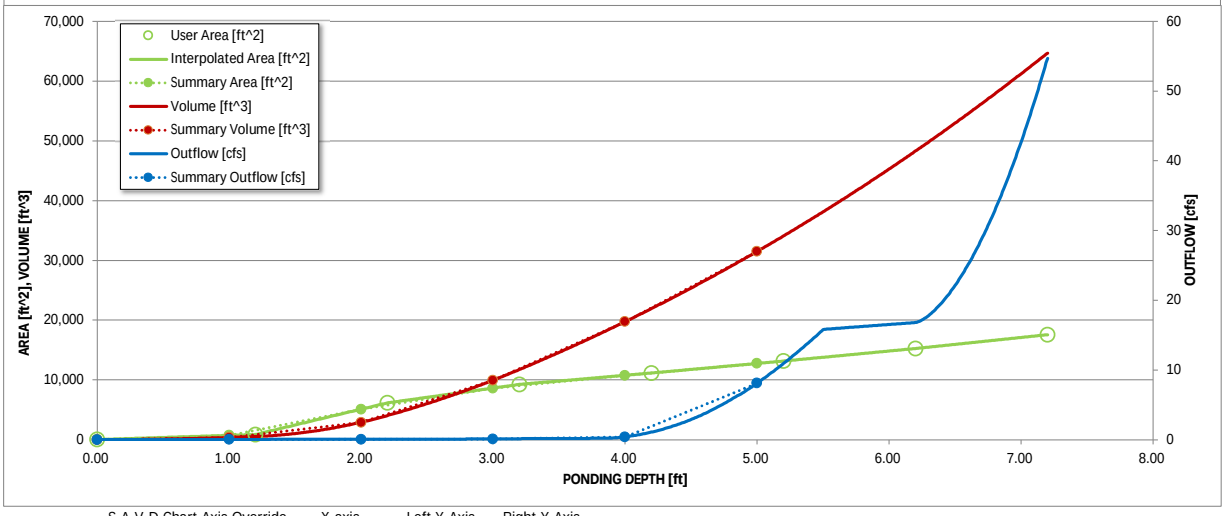
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

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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	0.03	0.01	0.08
	0:15:00	0.00	0.00	0.23	0.37	0.46	0.31	0.39	0.39	0.55
	0:20:00	0.00	0.00	0.83	1.09	1.29	0.82	0.96	1.04	1.34
	0:25:00	0.00	0.00	2.60	4.08	5.36	2.36	3.11	3.63	5.39
	0:30:00	0.00	0.00	3.60	5.33	6.72	8.56	12.67	16.60	26.41
	0:35:00	0.00	0.00	3.45	5.06	6.40	12.01	17.05	24.12	36.57
	0:40:00	0.00	0.00	3.13	4.52	5.70	12.15	17.34	24.65	37.42
	0:45:00	0.00	0.00	2.78	4.01	5.06	11.03	15.62	22.94	35.28
	0:50:00	0.00	0.00	2.48	3.58	4.47	10.02	14.06	20.50	32.15
	0:55:00	0.00	0.00	2.24	3.23	4.03	8.79	12.30	18.11	28.47
	1:00:00	0.00	0.00	2.04	2.91	3.65	7.81	10.92	16.24	25.72
	1:05:00	0.00	0.00	1.84	2.60	3.30	6.99	9.74	14.67	23.53
	1:10:00	0.00	0.00	1.61	2.31	2.98	6.07	8.43	12.58	20.21
	1:15:00	0.00	0.00	1.42	2.05	2.74	5.18	7.19	10.58	17.02
	1:20:00	0.00	0.00	1.29	1.86	2.51	4.41	6.09	8.84	14.24
	1:25:00	0.00	0.00	1.20	1.72	2.28	3.87	5.32	7.60	12.21
	1:30:00	0.00	0.00	1.11	1.59	2.07	3.43	4.69	6.63	10.58
	1:35:00	0.00	0.00	1.02	1.47	1.87	3.03	4.12	5.79	9.16
	1:40:00	0.00	0.00	0.94	1.31	1.67	2.66	3.59	5.00	7.86
	1:45:00	0.00	0.00	0.86	1.15	1.49	2.31	3.08	4.24	6.62
	1:50:00	0.00	0.00	0.77	1.00	1.30	1.96	2.59	3.51	5.43
	1:55:00	0.00	0.00	0.65	0.85	1.11	1.63	2.11	2.81	4.30
	2:00:00	0.00	0.00	0.54	0.71	0.92	1.31	1.65	2.13	3.22
	2:05:00	0.00	0.00	0.42	0.56	0.73	0.93	1.13	1.41	2.10
	2:10:00	0.00	0.00	0.34	0.45	0.59	0.66	0.79	0.95	1.43
	2:15:00	0.00	0.00	0.28	0.37	0.49	0.50	0.59	0.68	1.02
	2:20:00	0.00	0.00	0.23	0.30	0.40	0.39	0.46	0.51	0.74
	2:25:00	0.00	0.00	0.19	0.25	0.33	0.31	0.36	0.38	0.54
	2:30:00	0.00	0.00	0.15	0.20	0.27	0.24	0.28	0.29	0.40
	2:35:00	0.00	0.00	0.12	0.16	0.21	0.19	0.22	0.21	0.28
	2:40:00	0.00	0.00	0.10	0.13	0.17	0.15	0.17	0.16	0.20
	2:45:00	0.00	0.00	0.08	0.10	0.13	0.12	0.13	0.12	0.15
	2:50:00	0.00	0.00	0.06	0.08	0.10	0.09	0.10	0.10	0.12
	2:55:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.08	0.09
	3:00:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.07
	3:05:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.05	0.06
	3:10:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.04
	3:15:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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
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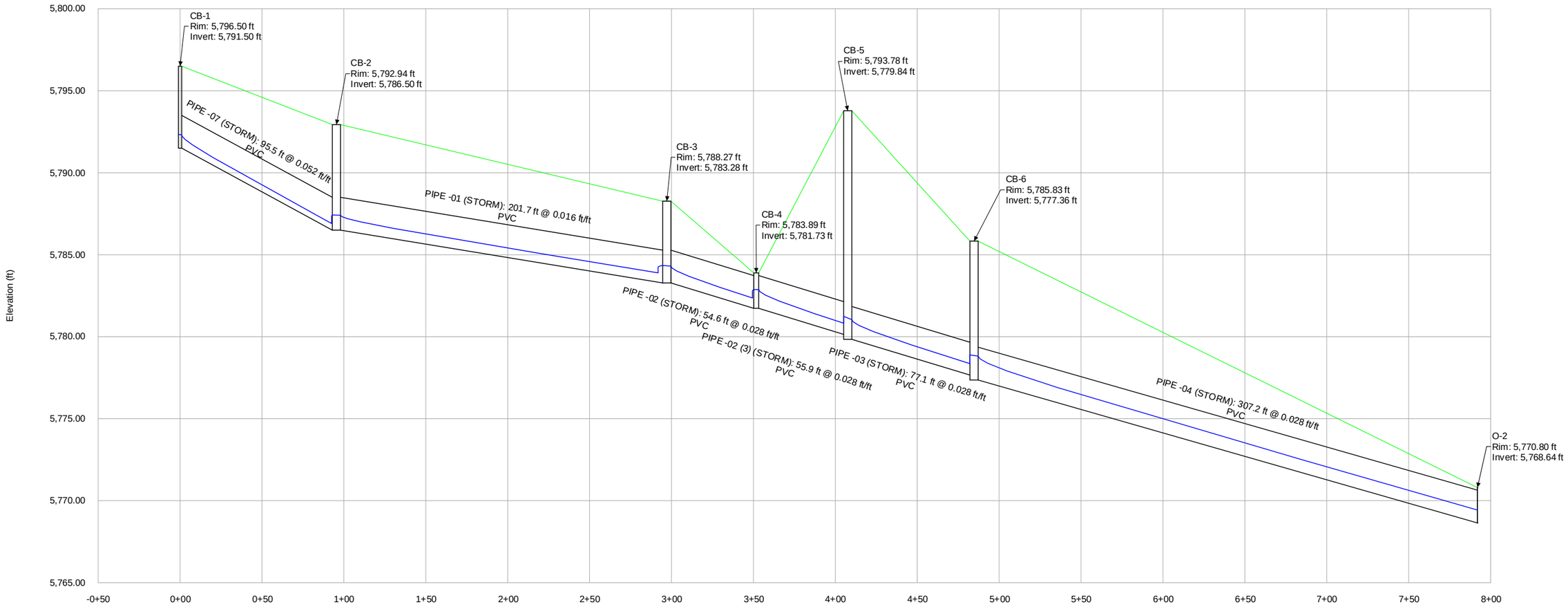
5-Year Calculations

Profile Report
Engineering Profile - STORM (Widefield Rec Center.stsw)



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FlexTable: Catch Basin Table

ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Inlet Type	Capture Efficiency (Calculated) (%)	Hydraulic Grade Line (In) (ft)	Headloss Coefficient (Standard)	Flow (Additional Subsurface) (cfs)
108	CB-1	5,796.50	5,796.50	5,791.50	Full Capture	100.0	5,792.33	0.050	5.35
109	CB-2	5,792.94	5,792.94	5,786.50	Full Capture	100.0	5,787.42	0.050	1.21
110	CB-3	5,788.27	5,788.27	5,783.28	Full Capture	100.0	5,784.34	0.100	1.70
111	CB-4	5,783.89	5,783.89	5,781.73	Full Capture	100.0	5,782.87	0.000	1.96
112	CB-5	5,793.78	5,793.78	5,779.84	Full Capture	100.0	5,781.24	0.400	0.98
113	CB-6	5,785.83	5,785.83	5,777.36	Full Capture	100.0	5,778.88	0.100	5.09

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FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
PIPE -07 (STORM)	CB-1	5,791.50	CB-2	5,786.50	95.3	0.052	24.0	0.010	5.35	12.81	67.30	7.9
PIPE -02 (3) (STORM)	CB-4	5,781.73	CB-5	5,780.14	55.8	0.028	24.0	0.010	10.22	12.44	49.62	20.6
PIPE -03 (STORM)	CB-5	5,779.84	CB-6	5,777.66	77.1	0.028	24.0	0.010	11.20	12.73	49.44	22.7
PIPE -01 (STORM)	CB-2	5,786.50	CB-3	5,783.28	201.6	0.016	24.0	0.010	6.56	8.91	37.16	17.7
PIPE -02 (STORM)	CB-3	5,783.28	CB-4	5,781.73	54.6	0.028	24.0	0.010	8.26	11.69	49.55	16.7
PIPE -04 (STORM)	CB-6	5,777.36	O-2	5,768.64	307.1	0.028	24.0	0.010	16.29	14.13	49.54	32.9

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FlexTable: Outfall Table

ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Boundary Element	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
114	O-2	5,770.80	True	5,768.64	Free Outfall	<None>		5,769.43	16.29	24" RCP FLARED END SECTION

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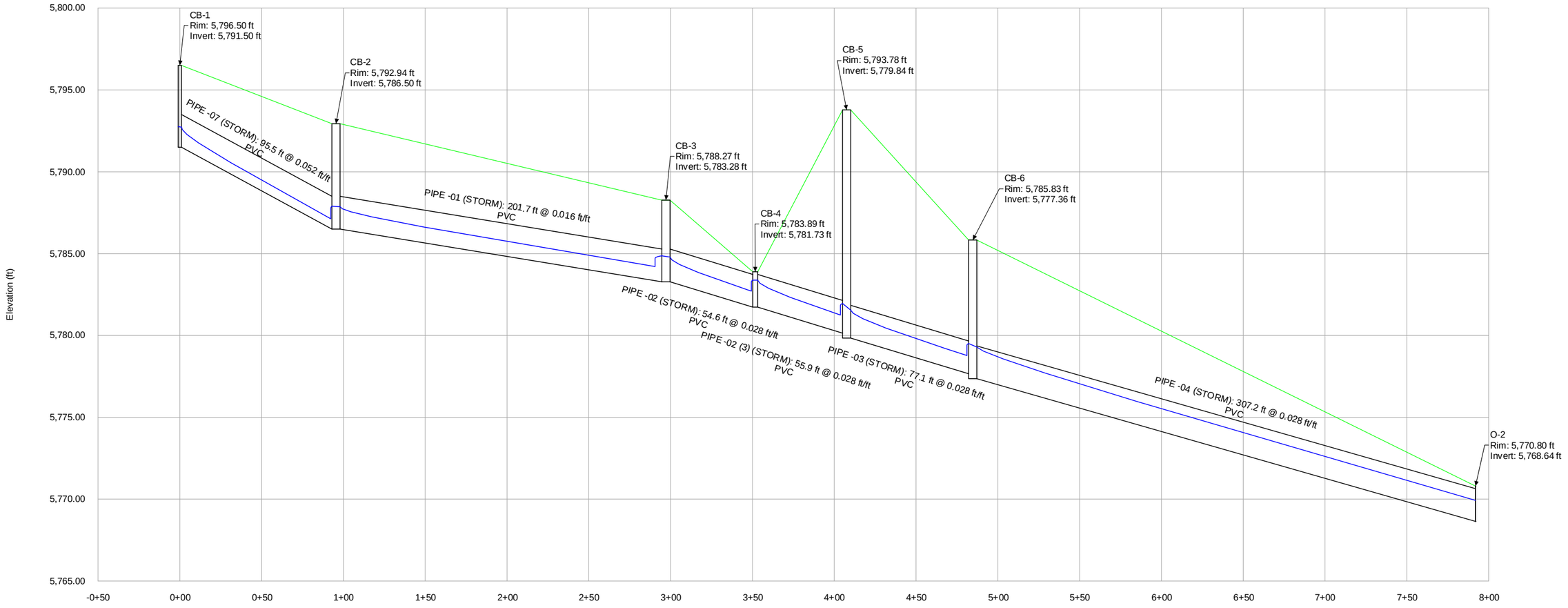
100-Year Calculations

Profile Report
Engineering Profile - STORM (Widefield Rec Center.stsw)



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FlexTable: Catch Basin Table

ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Inlet Type	Capture Efficiency (Calculated) (%)	Hydraulic Grade Line (In) (ft)	Headloss Coefficient (Standard)	Flow (Additional Subsurface) (cfs)
108	CB-1	5,796.50	5,796.50	5,791.50	Full Capture	100.0	5,792.76	0.050	11.73
109	CB-2	5,792.94	5,792.94	5,786.50	Full Capture	100.0	5,787.90	0.050	2.61
110	CB-3	5,788.27	5,788.27	5,783.28	Full Capture	100.0	5,784.86	0.100	3.21
111	CB-4	5,783.89	5,783.89	5,781.73	Full Capture	100.0	5,783.38	0.000	3.65
112	CB-5	5,793.78	5,793.78	5,779.84	Full Capture	100.0	5,781.95	0.400	1.83
113	CB-6	5,785.83	5,785.83	5,777.36	Full Capture	100.0	5,779.51	0.100	13.45

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FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
PIPE -07 (STORM)	CB-1	5,791.50	CB-2	5,786.50	95.3	0.052	24.0	0.010	11.73	16.09	67.30	17.4
PIPE -02 (3) (STORM)	CB-4	5,781.73	CB-5	5,780.14	55.8	0.028	24.0	0.010	21.20	15.17	49.62	42.7
PIPE -03 (STORM)	CB-5	5,779.84	CB-6	5,777.66	77.1	0.028	24.0	0.010	23.03	15.46	49.44	46.6
PIPE -01 (STORM)	CB-2	5,786.50	CB-3	5,783.28	201.6	0.016	24.0	0.010	14.34	11.06	37.16	38.6
PIPE -02 (STORM)	CB-3	5,783.28	CB-4	5,781.73	54.6	0.028	24.0	0.010	17.55	14.42	49.55	35.4
PIPE -04 (STORM)	CB-6	5,777.36	O-2	5,768.64	307.1	0.028	24.0	0.010	36.48	17.24	49.54	73.6

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FlexTable: Outfall Table

ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Boundary Element	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
114	O-2	5,770.80	True	5,768.64	Free Outfall	<None>		5,769.92	36.48	24" RCP FLARED END SECTION

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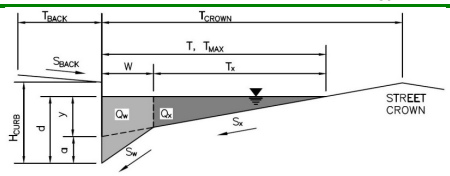
Version 4.06 Released August 2018

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

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

Project: Widefield Rec Center

Inlet ID: Inlet A1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	34.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.027	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	34.0	34.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

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INLET IN A SUMP OR SAG LOCATION

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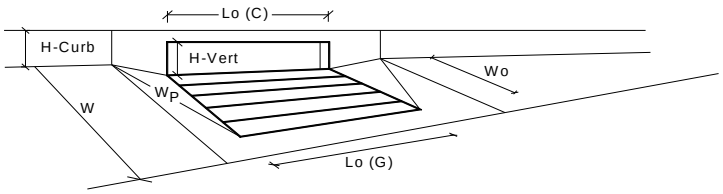

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.79	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**9.7**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	5.4	11.7	cfs

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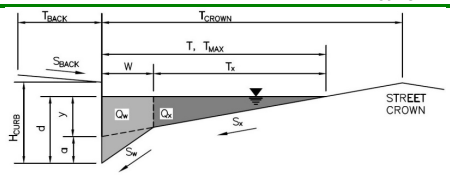
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Widefield Rec Center

Inlet ID: Inlet A8



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

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INLET IN A SUMP OR SAG LOCATION

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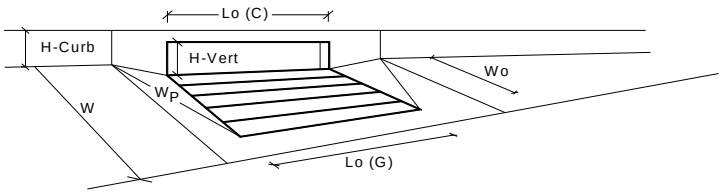

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	4.6	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.22	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.59	0.59	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.9**	**2.9**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	1.7	3.2	cfs

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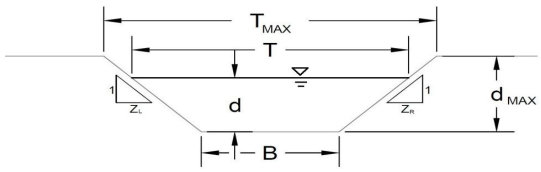
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A2



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.020	
Channel Invert Slope	S_O =	0.0150	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	15.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**12.00**	**12.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.50**	**0.50**	**feet**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**13.1**	**13.1**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**0.42**	**0.42**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**1.2**	**2.3**	**cfs**
Water Depth	d =	**0.12**	**0.17**	**feet**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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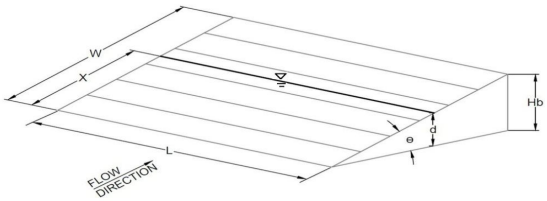
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A2

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.12	1.17	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**15.0**	**15.4**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

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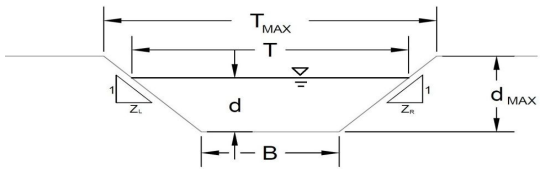
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A3



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030	
Channel Invert Slope	S_O =	0.0500	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	15.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	8.00	8.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.50	1.50	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	4.1	4.1	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.21	0.21	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.1	0.3	cfs
Water Depth	d =	0.02	0.05	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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AREA INLET IN A SWALE

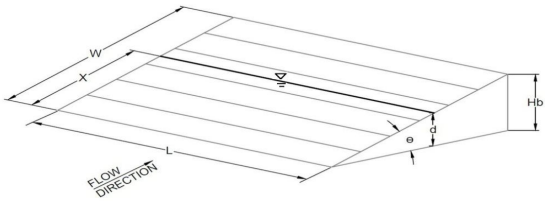
Widefield Rec Center

Inlet A3

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C

Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00 degrees
Width of Grate	W =	3.00 feet
Length of Grate	L =	3.00 feet
Open Area Ratio	A_{RATIO} =	0.70
Height of Inclined Grate	H_B =	0.00 feet
Clogging Factor	C_f =	0.50
Grate Discharge Coefficient	C_d =	0.96
Orifice Coefficient	C_o =	0.64
Weir Coefficient	C_w =	2.05



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.02	0.05	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.0**	**0.2**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.1**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**79**	**66**	**%**

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

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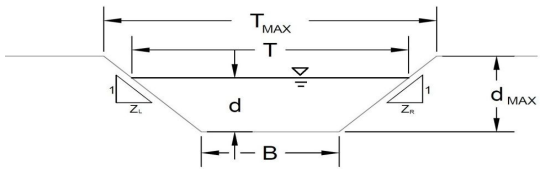
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A4



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030	
Channel Invert Slope	S_O =	0.0107	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	20.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	20.00	20.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.50	1.50	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	22.2	22.2	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.67	0.67	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.7	2.4	cfs
Water Depth	d =	0.12	0.23	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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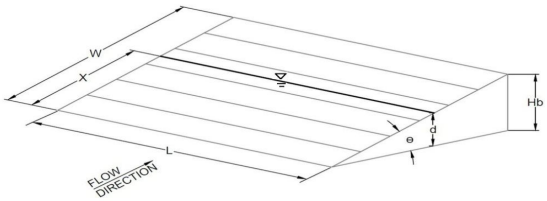
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A4

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C



Angle of Inclined Grade (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grade	W =	3.00	feet
Length of Grade	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grade	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grade Discharge Coefficient	C_d =	0.96	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.12	0.23	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.8**	**2.1**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.3**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**85**	**%**

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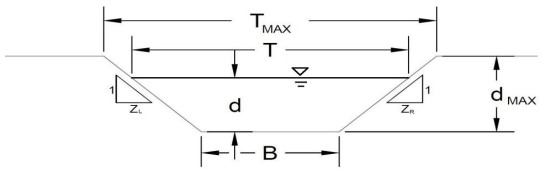
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A5



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030	
Channel Invert Slope	S_O =	0.0050	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	7.00	7.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.50	1.50	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	2.6	2.6	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.33	0.33	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.6	2.3	cfs
Water Depth	d =	0.14	0.31	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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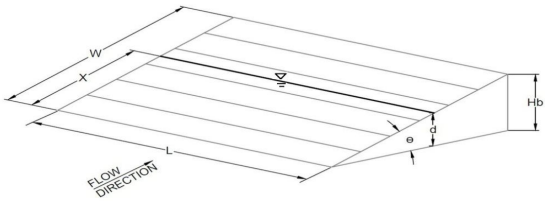
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A5

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C



Angle of Inclined Grade (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grade	W =	3.00	feet
Length of Grade	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grade	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grade Discharge Coefficient	C_d =	0.96	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.14	0.31	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.0**	**3.2**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

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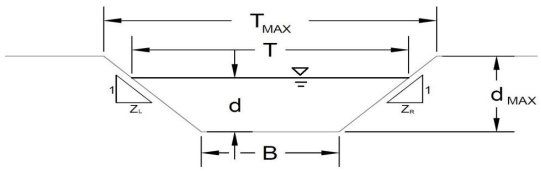
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A6



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030	
Channel Invert Slope	S_O =	0.0090	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	8.00	8.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.50	1.50	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	7.3	7.3	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.50	0.50	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.3	1.7	cfs
Water Depth	d =	0.08	0.22	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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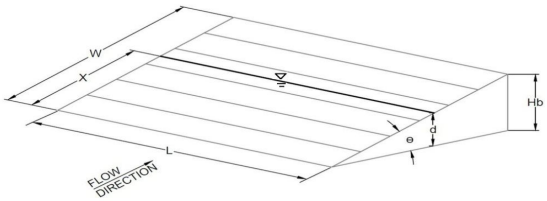
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A6

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C



Angle of Inclined Grade (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grade	W =	3.00	feet
Length of Grade	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grade	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grade Discharge Coefficient	C_d =	0.96	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.08	0.22	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**0.4**	**2.0**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

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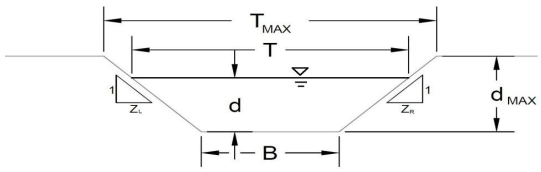
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A11



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.010	
Channel Invert Slope	S_O =	0.0150	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	12.00	ft/ft
Right Side Slope	Z2 =	12.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	12.00	12.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.00	1.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	17.8	17.8	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.33	0.33	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	2.6	5.3	cfs
Water Depth	d =	0.12	0.18	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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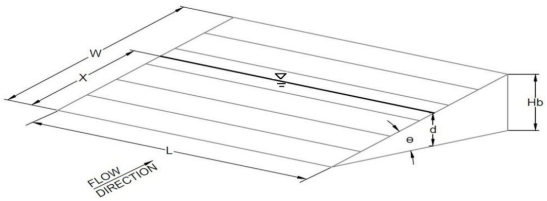
AREA INLET IN A SWALE

Widefield Rec Center

Inlet A11

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.12	1.18	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**15.1**	**15.5**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

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Worksheet for Grass-Lined Swale 1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.050	
Channel Slope	0.018	ft/ft
Left Side Slope	5.000	H:V
Right Side Slope	3.000	H:V
Discharge	11.36	cfs

Results		
Normal Depth	12.7	in
Flow Area	4.5	ft²
Wetted Perimeter	8.7	ft
Hydraulic Radius	6.1	in
Top Width	8.44	ft
Critical Depth	10.5	in
Critical Slope	0.050	ft/ft
Velocity	2.55	ft/s
Velocity Head	0.10	ft
Specific Energy	1.16	ft
Froude Number	0.619	
Flow Type	Subcritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	12.7	in
Critical Depth	10.5	in
Channel Slope	0.018	ft/ft
Critical Slope	0.050	ft/ft

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Worksheet for Concrete Swale 1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.015	ft/ft
Left Side Slope	12.000	H:V
Right Side Slope	12.000	H:V
Discharge	5.26	cfs

Results		
Normal Depth	3.9	in
Flow Area	1.3	ft²
Wetted Perimeter	7.8	ft
Hydraulic Radius	1.9	in
Top Width	7.79	ft
Critical Depth	5.0	in
Critical Slope	0.004	ft/ft
Velocity	4.16	ft/s
Velocity Head	0.27	ft
Specific Energy	0.59	ft
Froude Number	1.819	
Flow Type	Supercritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.9	in
Critical Depth	5.0	in
Channel Slope	0.015	ft/ft
Critical Slope	0.004	ft/ft

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Worksheet for Culvert 1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.010	
Channel Slope	0.032	ft/ft
Diameter	12.0	in
Discharge	7.66	cfs

Results		
Normal Depth	9.2	in
Flow Area	0.6	ft²
Wetted Perimeter	2.1	ft
Hydraulic Radius	3.6	in
Top Width	0.85	ft
Critical Depth	11.8	in
Percent Full	76.4	%
Critical Slope	0.025	ft/ft
Velocity	11.89	ft/s
Velocity Head	2.20	ft
Specific Energy	2.96	ft
Froude Number	2.406	
Maximum Discharge	8.84	cfs
Discharge Full	8.22	cfs
Slope Full	0.027	ft/ft
Flow Type	Supercritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	76.4	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	9.2	in
Critical Depth	11.8	in
Channel Slope	0.032	ft/ft
Critical Slope	0.025	ft/ft

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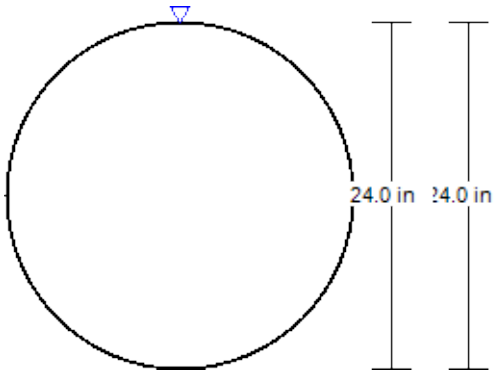
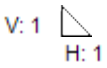
Existing 24" CMP Culvert Capacity

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.020 ft/ft
Normal Depth	24.0 in
Diameter	24.0 in
Discharge	41.59 cfs





Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:
Company:
Date: July 28, 2022
Project:
Location:

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 21.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.210

C) Contributing Watershed Area — Area = 22.040 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 6.00 in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- (•) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)
V_{DESIGN} = ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$)
$V_{DESIGN\ OTHER}$ = ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)
$V_{DESIGN\ USER}$ = 0.220 ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
$EURV_{DESIGN}$ = ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)
$EURV_{DESIGN\ USER}$ = ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)
L : W = 2.3 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)
Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV)
V_{FMIN} = 0.004 ac-ft

B) Actual Forebay Volume
V_F = 0.011 ac-ft

C) Forebay Depth (D_F = 18 inch maximum)
D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge
Q_{100} = 50.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)
Q_F = 1.00 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (•) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches)
Calculated D_P = in

G) Rectangular Notch Width
Calculated W_N = 5.6 in

WQCV is .220 ac-ft. 5% of that is .011 ac-ft. The forebay volume is 516.09 sq ft. this volume is .0118 ac-ft which is > 5%

Design Procedure Form: Extended Detention Basin (EDB)

Designer:
Company:
Date: June 3, 2022
Project:
Location:

6. Trickle Channel	
A) Type of Trickle Channel	Choose One: (•) Concrete ( ) Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 16 sq ft
C) Outlet Type	Choose One: (•) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 0.92 inches
E) Total Outlet Area	A_{ot} = 0.67 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 8.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 24 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.)	*S.S. Well Screen with 60% Open Area*
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)	A_{total} = 39 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 0.5 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 34 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches **VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.**

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Design Procedure Form: Extended Detention Basin (EDB)

Designer:
Company:
Date: June 3, 2022
Project:
Location:

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping: B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Ze = 4.00 ft / ft
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	

Notes:

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APPENDIX D: DRAINAGE MAPS

Kimley-Horn & Associates, Inc. **Opinion of Probable Construction Cost**

Client:	**Widefield School District 3**	**Date:**	**6/3/2022**
Project:	**Widefield Rec Center**	**Prepared By:**	**JAR**
KHA No.:	**096958002**	**Checked By:**	**EJG**

Sheet: **1 of 1**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Private PCM - Non-Reimbursable				
1	3/4" Fractured Face Granite Mixed w/ Class 5 Roadbase	1,406	CF	$12.00	$16,872
2	Concrete Trickle Channel	690	SF	$10.00	$6,900
3	24" PVC outlet pipe	2	LF	$67.00	$134
4	Outlet Structure	1	EA	$5,000.00	$5,000
5	Type L Riprap Emergency Overflow	9.8	Ton	$2,000.00	$19,600
6	Forebay	1.0	EA	$3,000.00	$3,000
			Subtotal:		$51,506
			Contingency (%,+/-)	40%	$20,602
			Project Total:		**$72,108**

Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

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LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR COMPOSITE RUNOFF COEFFICIENT
D = 100-YR DESIGN STORM RUNOFF (CFS)

- DESIGN POINT
- FLOW DIRECTION
- DRAINAGE BASIN BOUNDARY
- PROPERTY LINE
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MAJOR CONTOUR

NOTES

1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR COMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY EL PASO COUNTY IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. EL PASO COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. EL PASO COUNTY, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-1	3.07	8.19	17.22	8.19	17.22
2	EX-2	2.06	1.03	5.56	1.03	5.56
3	EX-3	4.38	5.79	14.55	5.79	14.55
4	EX-4	3.10	4.00	10.34	4.00	10.34
5	EX-5	3.97	1.91	8.93	1.91	8.93
6	EX-6	22.43	8.19	41.69	8.19	41.69
7	EX-7	0.79	2.04	4.07	2.04	4.07

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Widefield Parks and Recreation Facility Expansion

Widefield School District 3
1820 Main Street
Colorado Springs, CO. 80911

WIDEFIELD SCHOOL DISTRICT 3
PRIDE. TRADITION. INNOVATION.

Construction Documents

Drawn:	JAR
Checked:	EJG
Issued:	30 March 2022
Revised:	

Area Key Plan

NORTH

GRAPHIC SCALE IN FEET
0 40 80 160

Project No. 21-004
The LKA Partners Incorporated

PPR-2213

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR COMPOSITE RUNOFF COEFFICIENT
D = 100-YR DESIGN STORM RUNOFF (CFS)

- DESIGN POINT
- FLOW DIRECTION
- DRAINAGE BASIN BOUNDARY
- PROPERTY LINE
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MAJOR CONTOUR
- DISTURBED AREA EXCLUDED FROM POND

NOTES

1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR COMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY EL PASO COUNTY IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. EL PASO COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. EL PASO COUNTY, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.
3. PLEASE SEE THE FINAL DRAINAGE REPORT FOR THIS WIDEFIELD REC CENTER FOR PROPOSED 5 AND 100 YEAR FLOW VALUES.

BASINS TRIBUTARY TO POND		DISTURBED AREAS NOT TRIBUTARY TO POND	
A1	2.49 AC	AREA 1	0.49 AC
A2	0.35 AC	AREA 2	0.30 AC
A3	0.09 AC	AREA 3	0.14 AC
A4	0.83 AC	TOTAL	0.93 AC
A5	0.82 AC		
A6	0.73 AC		
A7	1.04 AC		
A8	0.43 AC		
A11	1.16 AC		
A12	14.10 AC		
TOTAL	22.04 AC		

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-1	3.07	8.19	17.22	8.19	17.22
2	EX-2	2.06	1.03	5.56	1.03	5.56
3	EX-3	4.38	5.79	14.55	5.79	14.55
4	EX-4	0.79	2.04	4.07	2.04	4.07
5	A1	2.49	5.35	11.73	5.35	11.73
6	A2	0.35	1.15	2.31	1.15	2.31
7	A3	0.09	0.06	0.30	0.06	0.30
8	A4	0.83	0.68	2.40	0.68	2.40
9	A5	0.82	0.56	2.26	0.56	2.26
10	A6	0.73	0.28	1.70	0.28	1.70
11	A7	1.04	3.92	7.30	3.92	7.30
12	A8	0.43	1.70	3.21	1.70	3.21
13	A9	3.41	4.42	11.61	4.42	11.61
14	A10	4.06	1.92	9.02	1.92	9.02
15	A11	1.16	2.51	5.41	2.51	5.41
16	A12	14.10	5.26	28.67	5.26	28.67

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Widefield Parks and Recreation Facility Expansion

Widefield School District 3
1820 Main Street
Colorado Springs, CO. 80911

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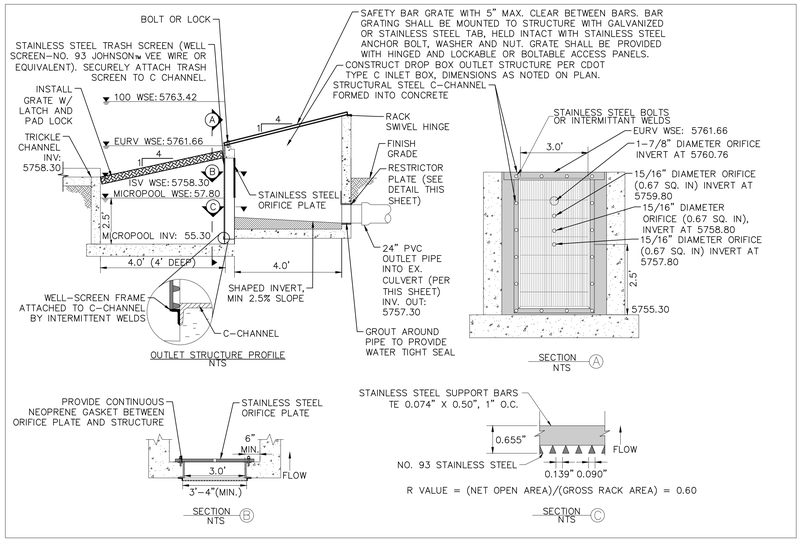
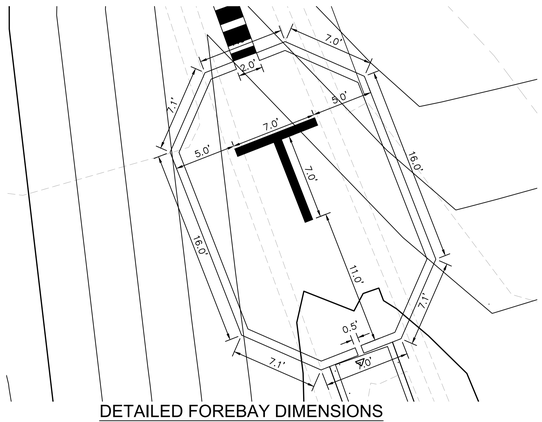
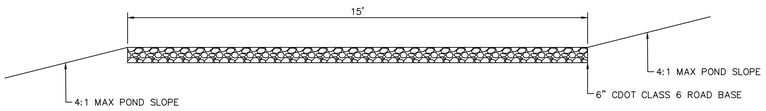


OUTLET STRUCTURE PROFILE DETAIL
N.T.S.



DETAILED FOREBAY DIMENSIONS
1" = 5'



MAINTENANCE ACCESS ROAD
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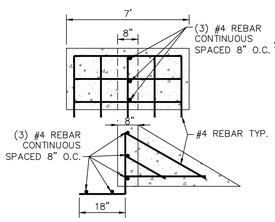

FOREBAY DISSIPATER DETAIL
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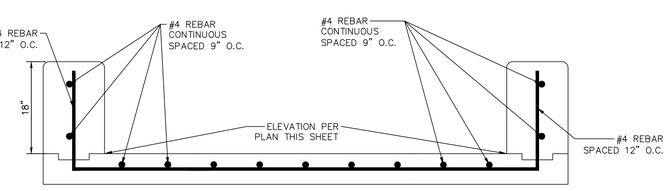
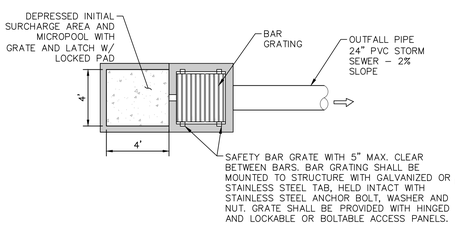
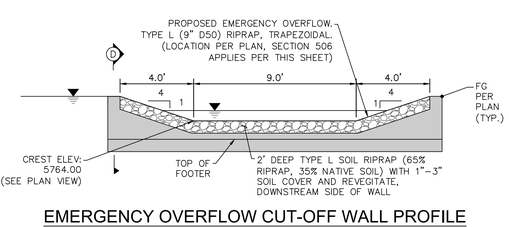


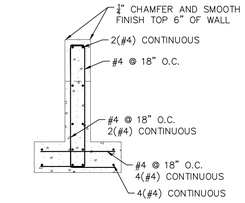
FOREBAY WALL SECTION E
N.T.S.



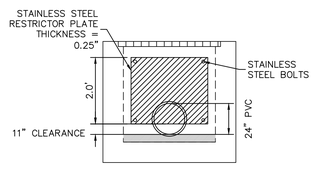
OUTLET STRUCTURE PLAN VIEW DETAIL
N.T.S.



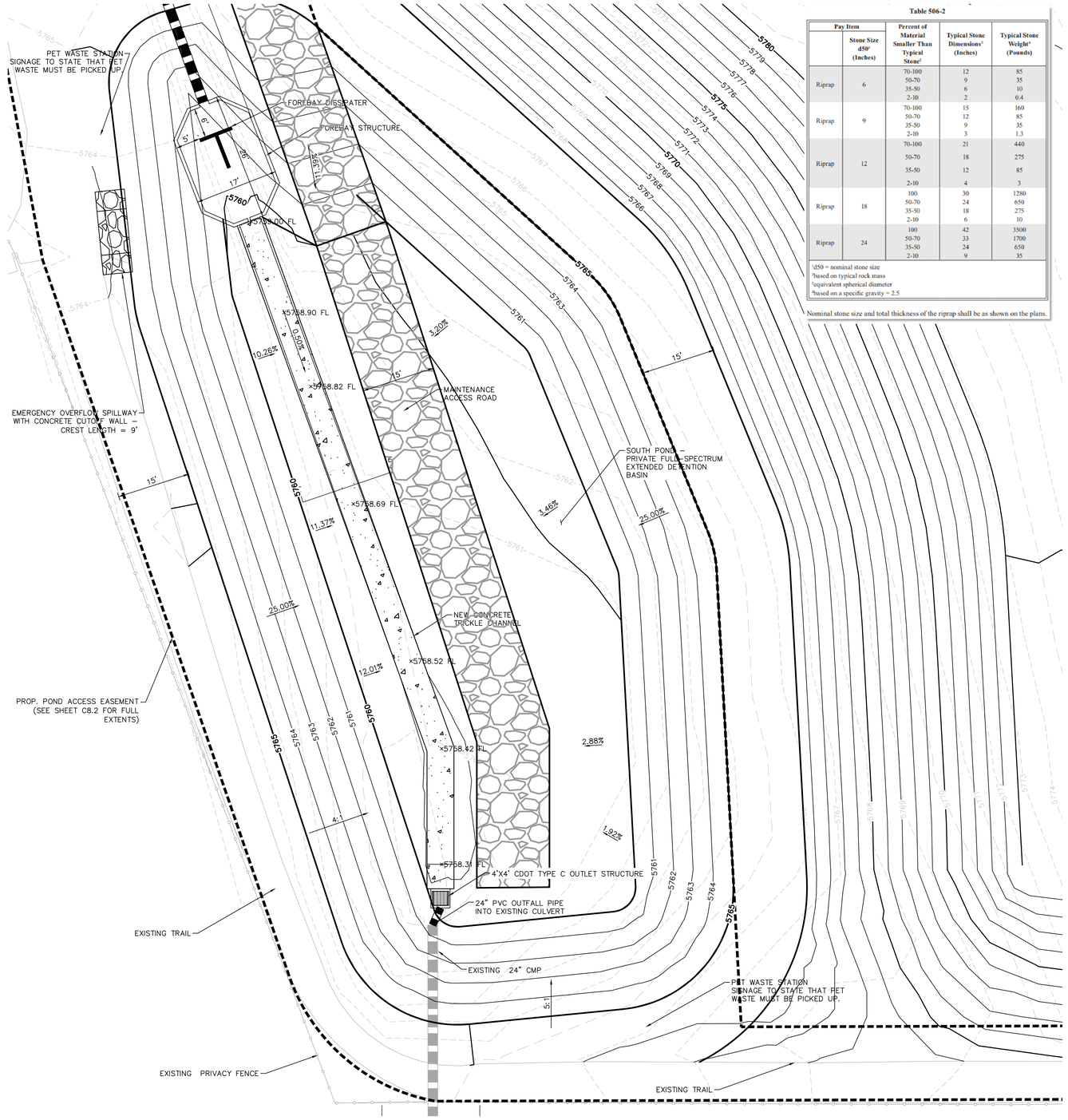
EMERGENCY OVERFLOW CUT-OFF WALL PROFILE
N.T.S.



EMERGENCY OVERFLOW CUT-OFF WALL SECTION D
N.T.S.

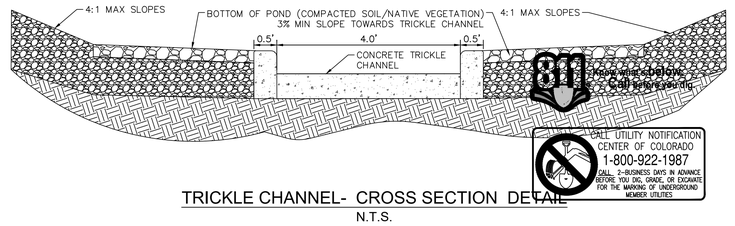


100-YEAR FLOW RESTRICTOR DETAIL
N.T.S.



GRAPHIC SCALE IN FEET
0 5 10 20
NORTH

DETENTION POND PLAN VIEW
SCALE: 1" = 20'



TRICKLE CHANNEL- CROSS SECTION DETAIL
N.T.S.

Table 506-2

Pay Item		Percent of Material Smaller Than Typical Stone[2]	Typical Stone Dimensions[3] (Inches)	Typical Stone Weight[4] (Pounds)
Stone Size d50[1] (Inches)				
Riprap	6	70-100	12	85
		50-70	9	35
		35-50	6	10
		2-10	2	0.4
Riprap	9	70-100	15	160
		50-70	12	85
		35-50	9	35
		2-10	3	1.3
Riprap	12	70-100	21	440
		50-70	18	275
		35-50	12	85
		2-10	4	3
Riprap	18	100	30	1280
		50-70	24	650
		35-50	18	275
		2-10	6	10
Riprap	24	100	42	3500
		50-70	33	1700
		35-50	24	650
		2-10	9	35

[1]d50 = nominal stone size
[2]based on typical rock mass
[3]equivalent spherical diameter
[4]based on a specific gravity = 2.5

Nominal stone size and total thickness of the riprap shall be as shown on the plans.

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POND DETAILS

C7.5

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