PRELIMINARY DRAINAGE REPORT
FOR
ESTATES AT CATHEDRAL PINES,
EL PASO COUNTY, COLORADO

PCD File No. ~~SF22-XXX~~
PUDSP2210

September 2022

Prepared For:

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Job No. 25260.00

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 El Paso County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Ryan Burns, Colorado P.E. # 0054412 Date
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: William Guman & Associates, LTD

By: Bill Guman

Title:

Address: 731 N. Weber Street
Colorado Springs CO 80903

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

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

Conditions:

CONTENTS

PURPOSE

This document is the Preliminary Drainage Report for Estates at Cathedral Pines. The purpose of this report is to identify on-site and off-site drainage patterns, culvert, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities.

GENERAL LOCATION AND DESCRIPTION

General Location

The proposed Estates at Cathedral Pines development is located within the southeast quarter of Section 2, Township 12 South, Range 66 West of the 6th Prime Meridian, El Paso County, Colorado. The proposed development is 35.09 acres containing approximately 8 – 2.7 to 4.1 acre single-family lots, 2.5 acres of open space, and associated infrastructure. The site is bounded on the east by Winslow Drive, by Cathedral Pines Subdivision Filing No. 1 to the east and north, and by Falcon Forest Subdivision Filing No. 2 to the south. The remainder of the site to the west is bound by multiple single-family residences on unplatted lots. A vicinity map of the area is presented in Appendix A.

Description of Property

The site is currently covered by an existing forested area with a large portion that has suffered damage from a fire. There is an existing grove of trees in the middle of the property that are healthy with little to no fire damage. The proposed development will save as many healthy trees as possible. Multiple natural drainage channels run through the site and range from poorly-defined to well-defined. The existing ground cover is sparse vegetation and open space with slopes that range from 3% to 30% generally draining from east to west.

Soils located within the site as shown on the USDA Natural Resources Conservation Service Soil Survey Map are kettle gravelly loamy. A soils map is included in Appendix A of this report. These soils are characterized as Hydrologic Soil Group B, which have a moderate infiltration rate when thoroughly wet and have a moderate rate of water transmission.

There are no major drainageways or known irrigation facilities located on the project site. There are no known utilities located within the project boundary. There is an existing trail that borders the property to the east.

Floodplain Statement

The FEMA Flood Insurance Rate Map (FIRM) Panel No. 08041C0315G, dated December 7, 2018 is the best representation of the project site. The site is located within Zone X which is defined as areas determined to be outside the 0.2% annual chance floodplain, and therefore there is little threat of a flood. See the FIRM map in Appendix A.

State whether or not the DBPS identified drainage improvements within the project site.

EXISTING DRAINAGE CONDITIONS

Major Basin Descriptions

The site lies within the Black Squirrel Creek Drainage Basin. The DPBS for this basin was prepared by URS Corporation and dated January 1989. See references in Appendix D for more information. The Black Squirrel Creek DBPS modeled the site assuming residential development 5-acre single-family lots. The proposed development is composed of 2.7 to 4.1 acre single-family lots, which is denser than was originally assumed. This site will detain runoff to historic rates to prevent any negative impacts to the existing downstream drainage.

Existing Sub-basin Drainage

Engineer must confirm in the Drainage Report that the existing pond is functioning as intended.

Existing basin drainage patterns are generally from east to west by way of sheet flow overland and then concentrated flow within natural channels. Off-site flows enter the property at DPP1 from an existing pond that is part of the Cathedral Pines Subdivision Filing No.1 development. These flow transverse the site via an existing natural channel. Off-site flows also enter the site along the southern property line and are routed through the site via an existing natural channel. Existing flows on the site are routed to the western and northern property lines via overland flow and existing natural channels.

engineer must confirm in the DR that the existing natural channels are functioning properly and do not require stabilization.

The existing basin delineation as shown in the existing drainage map in Appendix E is as follows:

Basin OS-1 is approximately 2.44 acres and in its existing condition is comprised of part of a single-family lot with a house, asphalt drive, and a portion of Winslow Drive. The basin is off-site and therefore no work is proposed within this basin. Runoff flows will follow the historic path east to west overland to the existing natural channel at DPO1(Q_5= 1.78 cfs, Q_{100}=6.7 cfs) where it will enter Basin EX-8 and follow the drainage patterns of the basin as described below. Flows will combine with DP8 at DP8.1.

Basin EX-1 is approximately 0.84 acres and in its existing conditions is undeveloped land. Runoff (Q_5= 0.3 cfs, Q_{100}=1.8 cfs) flows overland towards DP1 and onto the adjacent property to the north known as Cathedral Pines Subdivision Filing No. 1. For applicable excerpt from Drainage Report and Plan for Cathedral Pines Subdivision Filing No. 1 referrer to Appendix D.

Basin EX-2 is approximately 3.16 acres and in its existing conditions is undeveloped land. Runoff (Q_5= 0.8 cfs, Q_{100}=5.6 cfs) flows overland towards DP2 and onto the adjacent property to the north known as Cathedral Pines Subdivision Filing No. 1. For applicable excerpt from Drainage Report and Plan for Cathedral Pines Subdivision Filing No. 1 referrer to Appendix D.

Basin EX-3 is approximately 4.89 acres and in its existing conditions is undeveloped land, and existing drainageways (both poorly and well-defined). Runoff flows will follow the historic path east

to west overland and in swales towards DP3 (Q_5= 1.1 cfs, Q_{100}=7.5 cfs). Flows continue onto the unplatted property to the west at DP3.

Basin EX-4 is approximately 2.67 acres and in its existing conditions is undeveloped land, and existing drainageways (both poorly and well-defined). Runoff flows will follow the historic path east to west overland towards DP4 (Q_5= 0.7 cfs, Q_{100}=4.6 cfs). Flows continue onto the unplatted property to the west at DP4.

Basin EX-5 is approximately 8.29 acres and in its existing conditions is undeveloped land, existing drainageways (both poorly and well-defined), and a portion of Winslow Drive. Runoff flows will follow the historic path east to west overland towards DP5 (Q_5= 2.3 cfs, Q_{100}=14.4 cfs). Flows continue onto the unplatted property to the west at DP5.

Basin EX-6 is approximately 4.74 acres and in its existing conditions is undeveloped land, existing drainageways (both poorly and well-defined), and a portion of Winslow Drive. Runoff flows will follow the historic path east to west overland towards DP6 (Q_5= 1.5 cfs, Q_{100}=9.6 cfs). Flows continue onto the unplatted property to the west at DP6.

Basin EX-7 is approximately 8.06 acres and in its existing conditions is undeveloped land, existing drainageways (both poorly and well-defined), and a portion of Winslow Drive. Runoff flows will follow the historic path east to west overland towards DP7 (Q_5= 2.3 cfs, Q_{100}=14.0 cfs). Off –site flows enter the basin at DPP1 (Q_5= 3.7 cfs, Q_{100}=10.9cfs) from an existing pond that is part of the Cathedral Pines subdivision Filing No. 1 development. Flows form DPP1 and DP7 continue onto the unplatted property to the west at DP7.1 (Q_5= 6.0 cfs, Q_{100}=24.9 cfs).

Basin EX-8 is approximately 3.64 acres and in its existing conditions is undeveloped land, existing drainageways (both poorly and well-defined), and a portion of Winslow Drive. Runoff flows will follow the historic path east to west overland towards DP8 (Q_5= 1.1 cfs, Q_{100}=6.5 cfs). Off –site flows enter the basin at DPO1 (Q_5= 3.7 cfs, Q_{100}=10.9cfs) from the adjacent property to the south known as the Falcon Forest Subdivision Filing No. 2 development. Flows form DPO1 and DP8 continue onto the unplatted property to the west at DP8.1 (Q_5= 2.3 cfs, Q_{100}=11.5 cfs).

Proposed Conveyance

Developed flows are collected in proposed roadside ditches, natural and engineered swales, and proposed culverts, which convey water to the proposed detention areas on the south and north ends of the site. As previously noted, there are large portions of the site that have experience fire damage with a grove of trees that are consider healthy in the middle of the site that have little to no fire damage. Therefore, the design goal of the proposed drainage conveyance was to limit the disturbance to the healthy trees and natural aesthetics of the site.

Roadside swales will be designed per the typical county rural roadside ditch section. Proposed swale sections will be designed to ensure they are stable and have required capacity to satisfy criteria. A swale is considered stable with a velocity of 5 ft/s or less. To ensure capacity, swales will have a minimum of 1-ft. of freeboard over the water surface for flows anticipated in a 100-year storm event. Natural drainage ways will be used wherever the sections are deemed stable and have sufficient capacity for the proposed flows. Detailed swale calculations and sections will be provided in the Final Drainage report.

In addition to the swales, proposed culverts also convey flows under roadways. Culverts under proposed local paved roadways will be sized to ensure that flows will not over-top the roadway. The outlets of the proposed culverts will be protected with riprap to limit potential erosion.

Proposed Sub-basin Drainage

In the proposed condition, the site will be developed into 8, 2.5-acre minimum, single-family lots, proposed roadways, proposed swales, proposed roadside swales, undeveloped land, existing drainageways (both well and poorly defined), culverts, and two proposed full-spectrum extended detention basins (EDBs). The drainage design is intended to limit the impacts of development and impact to the natural landscape and the healthy tree grove by utilizing the existing well-vegetated natural drainage paths as much as possible. In general, the proposed drainage conditions follow the historic path from east to west utilizing pervious surfaces and the existing natural channels. The proposed full-spectrum EDBs will treat developed flows from Basins N and S. Flows will then follow the historic paths in proposed or existing natural channels onto the unplatted properties to the west.

Proposed hydrologic analysis was performed utilizing the Rational Method calculations for the on-site drainage basins. For the contributing areas within the proposed 2.5-acre (minimum) single-family lots, a percent imperviousness of 10% was assumed in the hydrologic analysis. The off-site basins are large lot residential single-family homes and predominantly are composed of undeveloped land. Large portions of these basins are heavily wooded.

The proposed basin delineation as shown in proposed drainage map in Appendix E is as follows;

Basin OS-1 is approximately 2.44 acres and in its existing condition is comprised of part of a single-family lot with a house, asphalt drive, and a portion of Winslow Drive. The basin is off-site and therefore no work is proposed within this basin. Runoff flows will follow the historic path east to west overland to the existing natural channel at DPO1(Q_5= 1.78 cfs, Q_{100}=6.7 cfs) where it will enter Basin K and follow the drainage patterns of the basin as described below. Flows will combine with DP12 at DP12.1.

Basin N is approximately 5.62 acres and in its proposed condition is comprised of a portion of existing Winslow Drive, a portion of the proposed roadways, parts of 2.5-acre developed Lots 6-8, proposed roadside swales, existing undeveloped landscaping areas, and proposed North Pond and

associated infrastructure. Runoff generated by this basin (Q_5= 4.8 cfs, Q_{100}= 16.9 cfs) sheets flows into the roadside swales and flows north to the proposed full-spectrum extended detention basin known as North Pond. Flows exits the pond at DPNP (Q_5= 1.9 cfs, Q_{100}= 8.0 cfs) and are route through Basin D to DP6.1 (Q_5= 2.7 cfs, Q_{100}= 11.4 cfs) where flows for DPNP and DP6 combine.

Basin S is approximately 3.36 acres and in its proposed condition is comprised of a portion of existing Winslow Drive, a portion of the proposed roadways, parts of 2.5-acre developed Lots 1-2, proposed roadside swales, existing undeveloped landscaping areas, and proposed South Pond and associated infrastructure. Runoff generated by this basin (Q_5= 4.0 cfs, Q_{100}= 11.8 cfs) sheets flows into the roadside swales and flows south to the proposed full-spectrum extended detention basin known as South Pond. Off –site flows enter the basin at DPP1 (Q_5= 3.7 cfs, Q_{100}=10.9cfs) from an existing pond that is part of the Cathedral Pines subdivision Filing No. 1 development. Flows form DPP1 and DP2 combine in South Pond at DP2.1 (Q_5= 5.9 cfs, Q_{100}= 19.7 cfs). Flows exits the pond at DPSP (Q_5= 4.6 cfs, Q_{100}= 14.8 cfs) and are route through Basin J to DP11.1 (Q_5= 7.2 cfs, Q_{100}= 26.2 cfs) where flows for DPSP and DP11 combine.

Basin A is approximately 0.84 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lot 8. Runoff generated by this basin (Q_5= 0.5 cfs, Q_{100}= 2.1 cfs) sheets flows generally northwest to DP3 and onto the adjacent property to the north known as Cathedral Pines Subdivision Filing No. 1. For applicable excerpt from Drainage Report and Plan for Cathedral Pines Subdivision Filing No. 1 referrer to Appendix D.

Basin B is approximately 2.18 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lots 7 and 8. Runoff generated by this basin (Q_5= 1.1 cfs, Q_{100}= 4.5 cfs) sheets flows generally northwest to DP4 and onto the adjacent property to the north known as Cathedral Pines Subdivision Filing No. 1. For applicable excerpt from Drainage Report and Plan for Cathedral Pines Subdivision Filing No. 1 referrer to Appendix D.

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Basin C is approximately 1.96 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lot 7 and existing drainageways (both poorly and well-defined). Runoff generated by this basin (Q_5= 1.0 cfs, Q_{100}= 4.5 cfs) sheets flows generally northwest to DP5 and onto the unplatted adjacent property to the west.

Basin D is approximately 1.69 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lots 6 and 7 and a proposed swale. Runoff generated by this basin (Q_5= 0.8 cfs, Q_{100}= 3.4 cfs) sheets flows to the proposed swale that flows to the west to DP6. Flows from North Pond's outlet structure outfall to this basin at DPNP (Q_5= 1.9 cfs, Q_{100}= 8.0 cfs). Flows from DPNP and DP6 combine at DP6.1 (Q_5= 2.7 cfs, Q_{100}= 11.8 cfs) and continue onto the unplatted adjacent property to the west.

Basin F is approximately 2.37 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lots 5 and 6. Runoff generated by this basin (Q_5= 1.1 cfs, Q_{100}= 4.8 cfs) sheet flows generally follows the historic drainage pattern of east to west to DP7 and onto the unplatted adjacent property to the west.

Basin G is approximately 5.08 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lots 4-6 and existing drainageways (both poorly and well-defined). Runoff generated by this basin (Q_5= 2.7 cfs, Q_{100}= 11.4 cfs) sheets flows to an existing natural channel and generally follows the historic drainage pattern from east to west to DP8 and onto the unplatted adjacent property to the west.

Basin H is approximately 3.51 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lots 3 and 4 and existing drainageways (both poorly and well-defined). Runoff generated by this basin (Q_5= 2.0 cfs, Q_{100}= 8.6 cfs) sheet flows to an existing natural channel and generally follows the historic drainage pattern from east to west to DP9. Flow from basin I enter the basin at DP10 (Q_5= 0.5 cfs, Q_{100}= 2.4 cfs) via the proposed culvert. Flows from DP9 and DP10 combine at DP9.1 (Q_5= 2.4 cfs, Q_{100}= 10.7 cfs) and continue onto the unplatted adjacent property to the west.

Basin I is approximately 0.89 acres and in its proposed condition is comprised of part of proposed landscaping and undeveloped land. Runoff generated by this basin (Q_5= 0.5 cfs, Q_{100}= 2.4 cfs) sheets flows to the existing natural channel and generally follows the historic drainage pattern of east to west to DP10 where it enters a proposed culvert and into Basin H. Flows from DP10 and DP9 (Q_5= 2.0 cfs, Q_{100}= 8.6 cfs) combine at DP9.1 (Q_5= 2.4 cfs, Q_{100}= 10.7 cfs) before continuing onto the unplatted adjacent property to the west.

Basin J is approximately 5.14 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lots 2-4 and existing drainageways (both poorly and well-defined). Runoff generated by this basin (Q_5= 2.6 cfs, Q_{100}= 11.4 cfs) sheets flows to the existing natural channel that flows to the west to DP11. Flows from South Pond's outlet structure outfall to this basin at DPSP (Q_5= 4.6 cfs, Q_{100}= 14.8 cfs). Flows from DPSP and DP11 combine at DP11.1 (Q_5= 7.2 cfs, Q_{100}= 26.2 cfs) and continue onto the unplatted adjacent property to the west.

Basin K is approximately 3.64 acres and in its proposed condition is comprised of part of proposed 2.5-acre developed Lots 1 and 2 and existing drainageways (both poorly and well-defined). Runoff generated by this basin (Q_5= 1.8 cfs, Q_{100}= 7.5 cfs) sheet flows to an existing natural channel and generally follows the historic drainage pattern from east to west to DP12. Flow from off-site basin OS-1 enter the basin at DPO1 (Q_5= 1.7 cfs, Q_{100}= 6.7 cfs). Flows from DP12 and DPO1 combine at DP12.1 (Q_5= 3.1 cfs, Q_{100}= 6.7 cfs) and continue onto the unplatted adjacent property to the west.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the "City of Colorado Spring/El Paso County Drainage Criteria Manual" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "Urban Storm Drainage Criteria Manual" Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "Colorado Springs Drainage Criteria Manual (CCSDCM)", dated May 2014, as adopted by El Paso County, as well as the July 2019 El Paso County Engineering Criteria Manual update.

Discuss how the flows were developed for DPP1. This design point provides off-site flows. Discuss combination of DPP1 flows with the existing and proposed basin flows.

Hydrologic Criteria

All hydrologic data was obtained from the "City of Colorado Springs Drainage Criteria Manual" Volumes 1 and 2, and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from Table 6-2 of the Colorado Springs Criteria. One hour point rainfall data for the storm events is identified in the chart below. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the DCM. Time of concentrations were developed using equations from the DCM. All runoff calculations and applicable charts and graphs are included in Appendix B. Urban Drainage and Flood Control District's UD-Detention, Version 4.06 workbook was used for pond sizing. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets are presented in Appendix C.

Table 1 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.50
100-year	2.52

Revise. Rainfall Intensities for the Rational Method shall be based on Figure 6-5 Intensity Duration Frequency Curve from the City DCM.

Hydraulic Criteria

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site. The Federal Highway Administration's HY-8 program (Volume 7.50) will be used to analyze the proposed culverts within the Estates at Cathedral Pines development. Per Section 6.4.1 of the EPCDCM, culverts were sized as to not overtop the road in the 100-year storm. UDFCD Volume 2 Chapter 9 Figure 9-35 will be used to size the riprap protection around the proposed culverts.

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) will be used for design of roadside ditches and swale design. Swale cross sections will be designed to so that 100-year velocities are less than 5ft/s, to limit erosive potential.

Provide a statement in the hydraulic Criteria and Drainage Facility Design section of the report that hydraulic design will be finalized with the Final Drainage Report.

DRAINAGE FACILITY DESIGN

General Concept

The combination of the proposed and existing stormwater conveyance system was designed to convey the developed Estates at Cathedral Pines flows to one of two full-spectrum EDB via roadside ditches and swales. The drainage design is intended to utilize the existing well-vegetated natural drainage paths on-site and reduce the impacts of development. The proposed full-spectrum EDBs will be located at the northern and southern ends of the proposed main roadway. The North Pond will outfall to a proposed swale that will route flow to follow the historic drainage path of east to west between lots 6 and 7. The South Pond will utilize an existing natural channel to outfall flows on the adjacent unplatted property. Development of the 2.5 acre (min.) single-family lots in basins A-K will be limited to 10% or less for areas that do not have a water quality feature downstream in order to satisfy Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure. Impacts to adjacent properties will be limited as proposed developed flows will be released at below existing rates of flow.

All proposed drainage items in this report will be designed to accept both 5-year and 100-year flows. All culverts will have a flared end section (FES) on both sides of the pipe. All culverts will have riprap protection downstream as a method of erosion protection prior to the stormwater entering the proposed swales. The proposed forebays will have a concrete bottom leading to the soil riprap berm. The proposed pond forebays and weir contain 3% of the required Water Quality Capture Volume (WQCV). The forebays weir will release 2% of the undetained peak 100-year inflow into the full-spectrum EDB via a notch in the berm and onto the proposed concrete trickle channel. The trickle channel will direct flows into the proposed full-spectrum EDB outlet structure, which will detain water per times specified by criteria.

Specific Details

Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual, Volume 2 this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes; stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Reducing Runoff Volumes: The development of the project site is proposed as single-family residential (2.5 acre min.) with lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roadways will utilize roadside ditches to further disconnect impervious areas. Proposed flow is in general following the historic path over pervious surfaces into existing drainage paths. These practices will also allow for increased infiltration and reduce runoff volume.

Step 2, Stabilize Drainageways: This site will utilize roadside ditches with culvert crossings throughout the site. These roadside ditches will then direct the applicable on-site and off-site development flows to a proposed full-spectrum EDB within the project. The proposed full-spectrum EDB's will be designed to release flows at or below historic rates. Roadside ditches will be stabilized by keeping velocities below 5 ft/s. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream drainageways is anticipated.

Step 3, Provide WQCV: Runoff from this development will be treated through capture and slow release of the WQCV in the two onsite proposed permanent full-spectrum EDB that will be designed per current El Paso County drainage criteria.

Step 4, Consider the need for Industrial and Commercial BMP's: No industrial or commercial uses are proposed within this development. Site specific temporary source control BMPs as well as permanent BMP's will be detailed in this plan and narrative to protect receiving waters.

for Basins G, H, and J

Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention will be provided for all of the development site not meeting exclusions present in the ECM - Stormwater Quality Policy and Procedures Section I.7.1.B. As previously stated, the applicable exclusions fall under Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure for areas with large single-family lots (2.5-acre min.). Outlet structure release rates will be limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities.

State that the proposed roadway will be treated as it does not fall under the aforementioned exclusion.

Proposed Full-spectrum EDBs

Water quality is provided for the site by two private full-spectrum detention and water quality extended detention basins. The proposed North Pond is sized to provide water quality and detention for a total of 5.65 acres at 17.4% impervious. Table 2 below shows the basin parameters. The proposed South Pond is sized to provide water quality and detention for a total of 3.36 acres at 25.4% impervious. Table 3 below shows the basin parameters. Refer to Appendix C for the UD-Detention design sheets that include the tributary basin parameters as well as the stage-storage table and outlet structure design. The outlet structure will include an orifice plate, overflow grate, and restrictor plate to release stormwater at the appropriate rates. The WQCV will be released within 40 hours, the EURV will be released within 72 hours, and the 100-year will be released at or below the pre-development flow rate. Tables 4 and 5 below gives the design storm results for the North and South Ponds respectively. A broad-crested weir will be provided as an emergency spillway along the western embankment of both ponds to convey emergency overflows to the unplatted properties to the west per historic drainage patterns of east to west.

Table 2 - Watershed Design Parameters North Pond

Watershed Area	5.65 AC
Percent Impervious	17.4%
Watershed Slope	0.040 ft/ft

Table 3 - Watershed Design Parameters South Pond

Watershed Area	3.36 AC
Percent Impervious	25.7%
Watershed Slope	0.045 ft/ft

ge 11 notes Developer is responsible for ainage structures within easement or cts. This should be revised to the veloper, HOA or District (based on how e comment on page 11 is addressed).

e 4- Design Storm Results North Pond

ign Storm Period	Volume (AC-FT)	Depth (FT)	Q_{out} (CFS)
VQCV	0.049	1.38	0.0
EURV	0.097	2.08	0.0
100-YR	0.169	2.93	7.4

Table 5- Design Storm Results South Pond

Design Storm Period	Volume (AC-FT)	Depth (FT)	Q_{out} (CFS)
WQCV	0.038	1.90	0.0
EURV	0.088	3.0	0.0
100-YR	0.143	3.85	3.7

Show more significance (hundredths). The pond should not be retaining and infiltrating the WQCV and EURV.

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. The property owner shall be responsible for the inspection, maintenance, rehabilitation and repair of stormwater and erosion control facilities located on the property unless another party accepts such responsibility in writing and responsibility is properly assigned through legal documentation. Access is provided from onsite facilities.

Calculations and pond design parameters are presented in Appendix C.

Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated Cost Estimate must be submitted with each Final Drainage Report. The Erosion Control Plan and Cost Estimate shall be submitted prior to obtaining a grading permit.

Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within any platted County ROW (roadside ditches and local road culverts) will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts (full spectrum water quality ponds, drainageway culverts and

Verify with the developer, This is typically not seen. On going maintenance is typically with the property owner, an HOA, or a Metro District. Additionally pond maintenance should be with the HOA or the Metro District if available.

Correct to 2023 drainage/bridge fee $10478/imp ac and $660/imp ac. Large lot deduction only applies to drainage fee not bridge fee

Preliminar …es

drainagew … d by the developer. Inspection access for El Paso Coun … ment.

Drainage and Bridge Fees

The proposed site lies within the ~~Bennett Ranch~~ Drainage Basin. The drainage fee associated with the ~~Bennett Ranch~~ Drainage Basin is ~~$9,595~~ per impervious acre and the bridge fee is ~~$604~~ per impervious acre. Final calculation of drainage fees, as well as determination of potential reimbursements, will be determined at the time of the Final Plat recordation.

Construction Cost Opinion

A construction cost opinion will be provided at the time of final design.

Black Squirrel basin

SUMMARY

The Preliminary Drainage Report for Estates at Cathedral Pines identifies on-site and off-site drainage patterns, storm sewer, culvert locations, areas tributary to the site, and safely routes developed storm water to adequate outfall facilities. The proposed Estates at Cathedral Pines development will not adversely affect the off-site major drainageways or surrounding development. This report meets the latest El Paso County Drainage Criteria requirements for this site.

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

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Trib to Pond A (ac)	Disturbed Area Treated via Runoff Reduction (ac)	Area Excluded from WQ per ECM App I.7.1.C.1 (ac)	Area Excluded from WQ per ECM App I.7.1.B.# (ac)	Applicable WQ Exclusions (App I.7.1.B.#)
A	4.50	4.50	4.50	-	-	-	
B	1.25	1.25	-	1.00	0.25	-	
C	6.00	4.00	-	-	-	4.00	ECM App I.7.1.B.5
D	2.50	2.50	1.00	-	0.50	1.00	ECM App I.7.1.B.7
E	3.00	-	3.00	-	-	-	
F	8.25	-	-	-	-	-	
Total	25.50	12.25	8.50	1.00	0.75	5.00	
Comments		*[For each row, the sum of the values in Columns 4-7 must be greater than or equal to the value in Column 3 above.]*	*[Values in this column can be more than Column 3 if over-treating non-disturbed areas.]*	See RR calc spreadsheet.	*[Total must be <20% of site and <1ac.]*		

REFERENCES:

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. FEMA Flood Insurance Rate Map (F.I.R.M.) Panel No. 08041C0535G, effective date December 7, 2018.

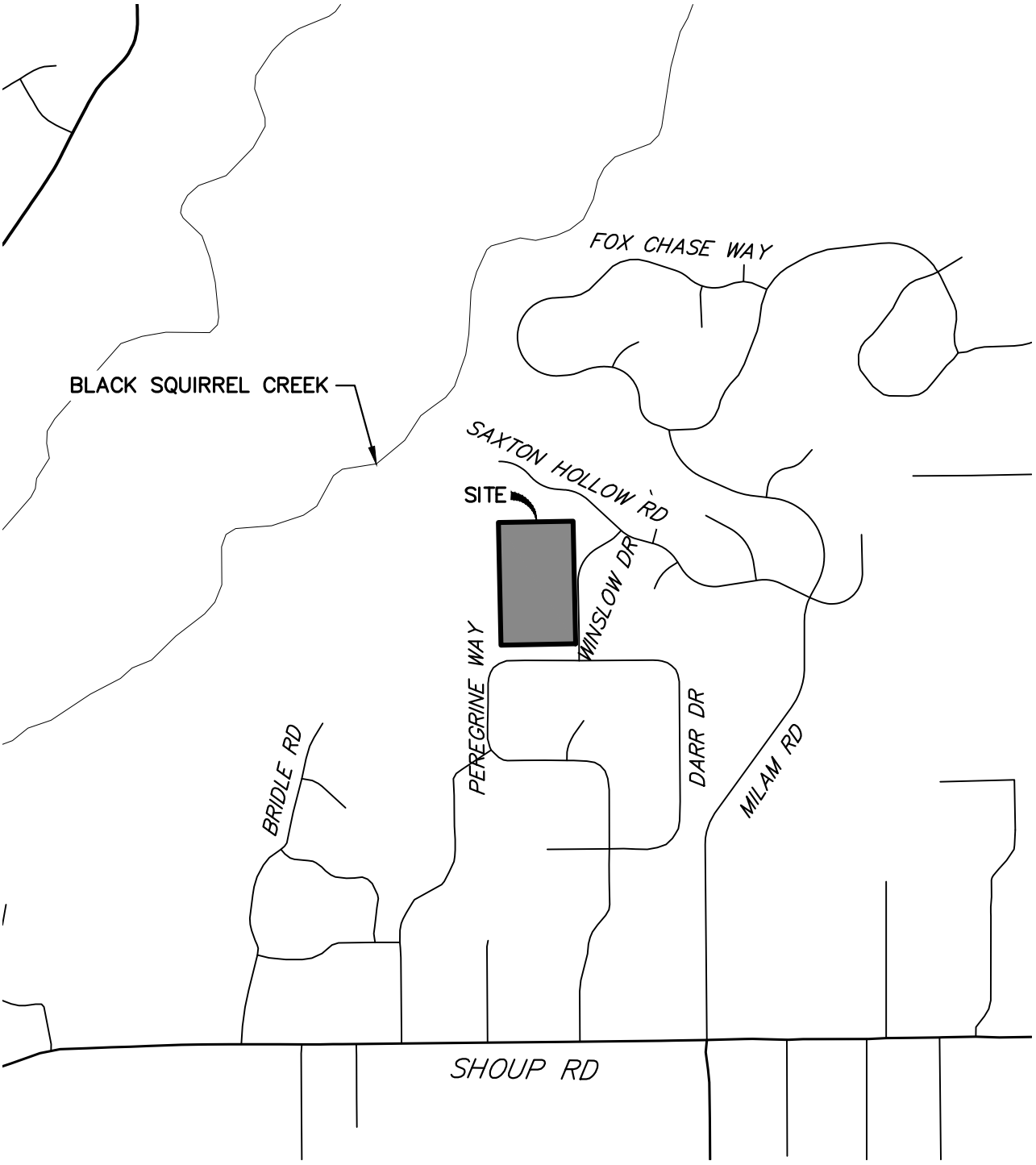
4. "Soil Survey of El Paso County Area, Colorado," by the USDA Natural Resources Conservation Service.

5. Final Drainage Report and Plan for Cathedral Pines Subdivision Filing No. 1, prepared by Leigh Whitehead & Associates, Inc. and dated January 2005.

6. Black Squirrel Creek Drainage Basin Planning Study, prepared by URS Corporation and dated January, 1989.

APPENDIX A

FIGURES AND EXHIBITS



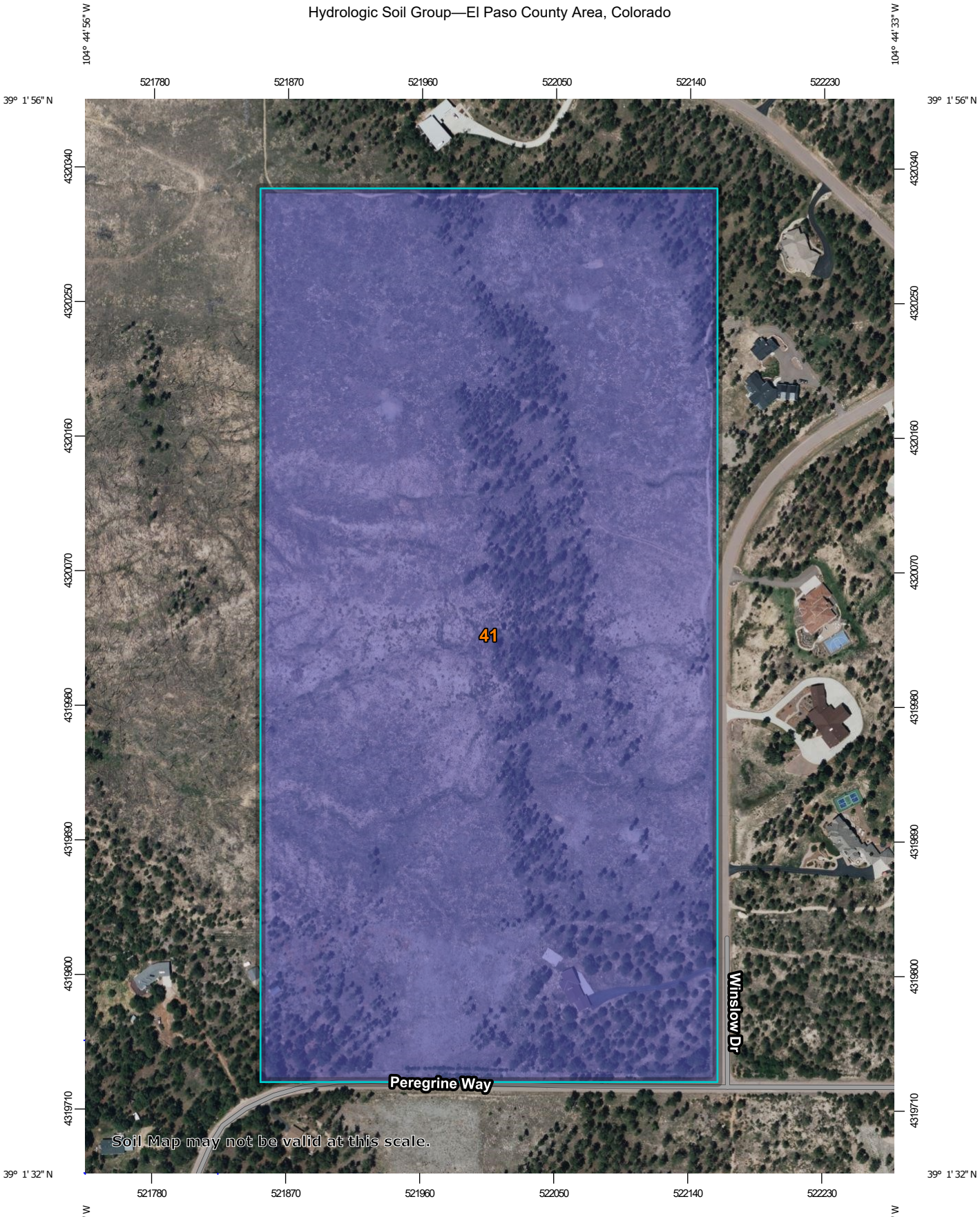
2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

CATHEDRAL PINES
VICINITY MAP
2000-5260.00
08-17-2022
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com



Map Scale: 1:3,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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: Jun 9, 2021—Jun 12, 2021

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	45.5	100.0%
Totals for Area of Interest			**45.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

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

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

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

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

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

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

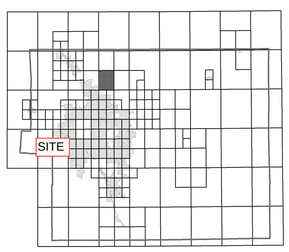
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

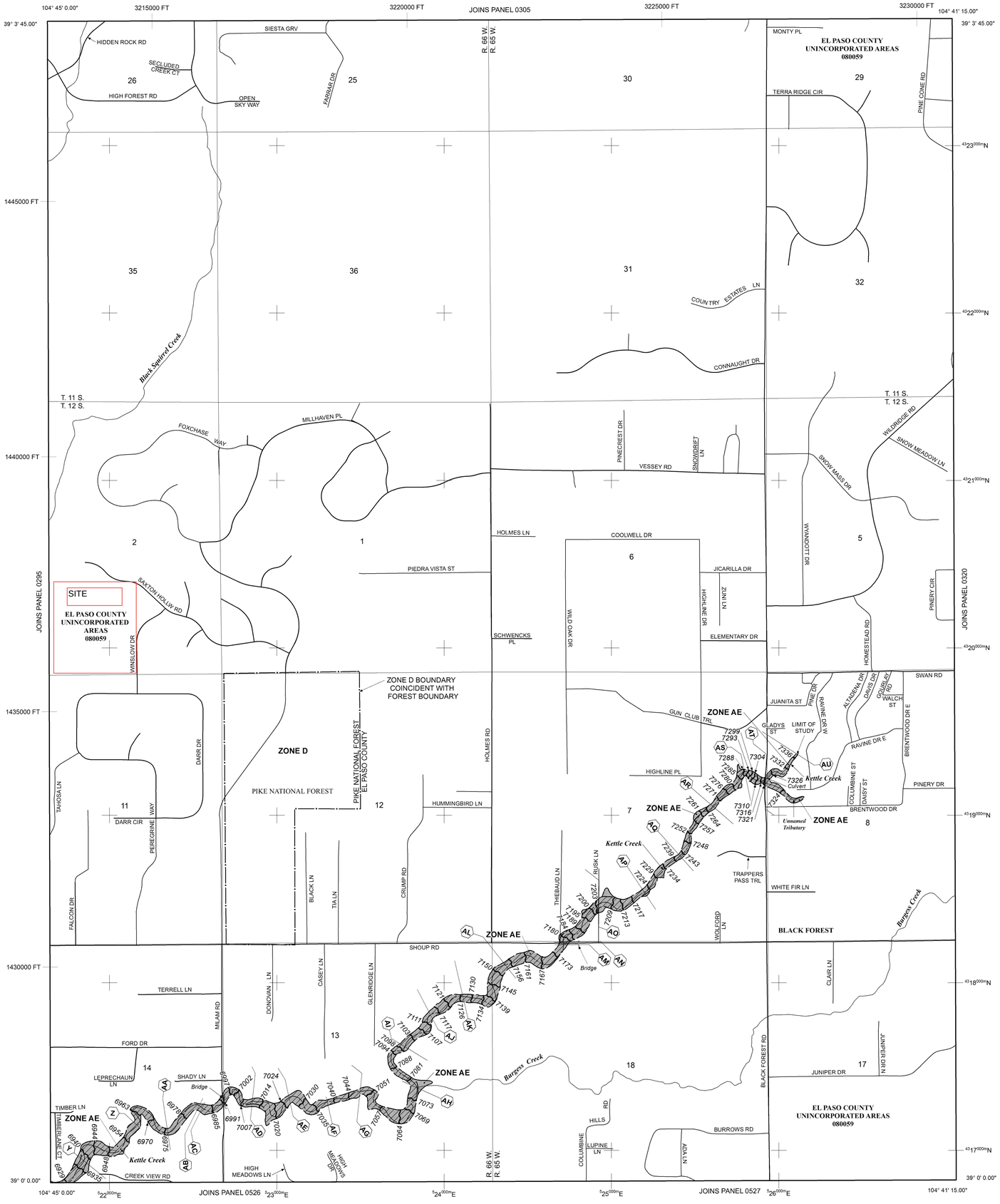
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



LEGEND

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

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

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

A — A — Cross section line
23 — 23 — Transect line
97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

PANEL 0315G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 315 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0315	G

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

MAP NUMBER
08041C0315G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

APPENDIX B

HYDROLOGIC CALCULATIONS

EXISTING COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Cathedral Pines
Location: El Paso County

Project Name: Cathedral Pines Existing
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/19/22

Basin ID	Total Area (ac)	Hardscape/Water (100% Impervious)				2.5 Acre Lots (10% Impervious)				Lawns (2% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
EX-1	0.84	0.90	0.96	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	0.84	2.0%	0.09	0.36	2.0%
EX-2	3.16	0.90	0.96	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	3.16	2.0%	0.09	0.36	2.0%
EX-3	4.89	0.90	0.96	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	4.89	2.0%	0.09	0.36	2.0%
EX-4	2.67	0.90	0.96	0.00	0.0%	0.16	0.41	0.00	0.0%	0.09	0.36	2.67	2.0%	0.09	0.36	2.0%
EX-5	8.29	0.90	0.96	0.07	0.9%	0.16	0.41	0.00	0.0%	0.09	0.36	8.22	2.0%	0.10	0.37	2.9%
EX-6	4.74	0.90	0.96	0.05	1.0%	0.16	0.41	0.00	0.0%	0.09	0.36	4.69	2.0%	0.10	0.37	3.0%
EX-7	8.06	0.90	0.96	0.10	1.2%	0.16	0.41	0.00	0.0%	0.09	0.36	7.96	2.0%	0.10	0.37	3.2%
EX-8	3.64	0.90	0.96	0.05	1.4%	0.16	0.41	0.00	0.0%	0.09	0.36	3.59	2.0%	0.10	0.37	3.4%
OS-1	2.44	0.90	0.96	0.05	2.0%	0.16	0.41	2.39	9.8%	0.09	0.36	0.00	0.0%	0.17	0.42	11.8%
TOTAL ON-SITE	38.73															2.6%
TOTAL OFF-SITE	2.44															11.8%

EXISTING STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Cathedral Pines
Location: El Paso County

Project Name: Cathedral Pines Existing
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/19/22

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EX-1	0.84	B	2%	0.09	0.36	254	7.3%	15.1	0	0.0%	7.0	0.0	0.0	15.1	254.0	25.7	15.1
EX-2	3.16	B	2%	0.09	0.36	300	5.6%	17.9	400	5.3%	7.0	1.6	4.1	22.0	700.0	28.8	22.0
EX-3	4.89	B	2%	0.09	0.36	300	4.4%	19.4	849	4.6%	7.0	1.5	9.4	28.8	1149.0	32.8	28.8
EX-4	2.67	B	2%	0.09	0.36	300	4.3%	19.5	368	4.9%	7.0	1.5	4.0	23.5	668.0	28.7	23.5
EX-5	8.29	B	3%	0.10	0.37	300	7.4%	16.2	777	5.9%	7.0	1.7	7.6	23.8	1077.0	31.2	23.8
EX-6	4.74	B	3%	0.10	0.37	108	12.0%	8.3	973	6.4%	7.0	1.8	9.2	17.5	1081.0	32.3	17.5
EX-7	8.06	B	3%	0.10	0.37	220	9.4%	12.8	1,032	4.9%	7.0	1.5	11.1	23.9	1252.0	33.7	23.9
EX-8	3.64	B	3%	0.10	0.37	150	6.2%	12.1	1,019	5.0%	7.0	1.6	10.9	23.0	1169.0	33.5	23.0
OS-1	2.44	B	12%	0.17	0.42	181	6.9%	11.9	0	0.0%	7.0	0.0	0.0	11.9	181.0	24.0	11.9

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

Equation 6-2

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

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Equation 6-4

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

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Equation 6-3

Equation 6-5

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

EXISTING STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cathedral Pines
Location: El Paso County
Design Storm: 5-Year

Project Name: Cathedral Pines Existing
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/19/22

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	EX-1	0.84	0.09	15.1	0.08	3.51	0.3															Flows overland towards DP1 and onto adjacent proporerty.
	2	EX-2	3.16	0.09	22.0	0.28	2.94	0.8															Flows overland towards DP2 and onto adjacent proporerty.
	3	EX-3	4.89	0.09	28.8	0.44	2.54	1.1															Flows overland towards existing natural swale and then to DP3. Flows onto adjecent property.
	4	EX-4	2.67	0.09	23.5	0.24	2.85	0.7															Flows overland towards DP4 and onto adjacent proporerty.
	5	EX-5	8.29	0.10	23.8	0.81	2.83	2.3															Flows overland towards existing natural swale and then to DP5. Flows onto adjecent property.
	6	EX-6	4.74	0.10	17.5	0.46	3.29	1.5															Flows overland towards existing natural swale and then to DP6 Flows onto adjecent property.
	7	EX-7	8.06	0.10	23.9	0.80	2.82	2.3															Flows overland towards existing natural swale and then to DP7 Flows onto adjecent property.
	7.1								23.9	2.11	2.82	6.0											Flows from DP7 and DPP1 combine in the natural swale and exit the site at DP7.1
	8	EX-8	3.64	0.10	23.0	0.37	2.88	1.1															Flows overland towards existing natural swale and then to DP8 Flows onto adjecent property.
	8.1								23.0	0.80	2.88	2.3											Flows from Basins EX-8 & OS-1 combine in the natural swale and exit the site at DP8.1
	O1	OS-1	2.44	0.17	11.9	0.43	3.87	1.7															Flows overland towards DPO1 and onto the site via exting natural swale
	P1		15.50			1.31		3.7															Flows from an off-site pond enter the site via an existing 18" RCP culvert

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
Values in blue indicate that they are from "Cathedral Pines Subdivision Filing No. 1 Drainage Report & Plan"

EXISTING STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cathedral Pines
Location: El Paso County
Design Storm: 100-Year

Project Name: Cathedral Pines Existing
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/19/22

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	EX-1	0.84	0.36	15.1	0.30	5.90	1.8															Flows overland towards DP1 and onto adjacent proporerty.
	2	EX-2	3.16	0.36	22.0	1.14	4.94	5.6															Flows overland towards DP2 and onto adjacent proporerty.
	3	EX-3	4.89	0.36	28.8	1.76	4.27	7.5															Flows overland towards existing natural swale and then to DP3. Flows onto adjecent property.
	4	EX-4	2.67	0.36	23.5	0.96	4.78	4.6															Flows overland towards DP4 and onto adjacent proporerty.
	5	EX-5	8.29	0.37	23.8	3.03	4.75	14.4															Flows overland towards existing natural swale and then to DP5. Flows onto adjecent property.
	6	EX-6	4.74	0.37	17.5	1.73	5.53	9.6															Flows overland towards existing natural swale and then to DP6 Flows onto adjecent property.
	7	EX-7	8.06	0.37	23.9	2.96	4.74	14.0															Flows overland towards existing natural swale and then to DP7 Flows onto adjecent property.
	7.1								23.9	5.26	4.74	24.9											Flows from DP7 and DPP1 combine in the natural swale and exit the site at DP7.1
	8	EX-8	3.64	0.37	23.0	1.34	4.84	6.5															Flows overland towards existing natural swale and then to DP8 Flows onto adjecent property.
	8.1								23.0	2.37	4.84	11.5											Flows from Basins EX-8 & OS-1 combine in the natural swale and exit the site at DP8.1
	O1	OS-1	2.44	0.42	11.9	1.03	6.50	6.7															Flows overland towards DPO1 and onto the site via exting natural swale
	P1		15.50			2.30		10.9															Flows from an off-site pond enter the site via an existing 18" RCP culvert

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
Values in blue indicate that they are from "Cathedral Pines Subdivision Filing No. 1 Drainage Report & Plan"

PROPOSED COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Cathedral Pines
Location: El Paso County

Project Name: Cathedral Pines-Proposed
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/21/22

Basin ID	Total Area (ac)	Hardscape/Water (100% Impervious)				Gravel Hardscape (80% Impervious)				2.5 Acre Lots (10% Impervious)				Lawns (2% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
N	5.65	0.90	0.96	0.64	11.4%	0.59	0.70	0.09	1.3%	0.16	0.41	2.14	3.8%	0.09	0.36	2.78	1.0%	0.22	0.45	17.4%
S	3.36	0.90	0.96	0.59	17.4%	0.59	0.70	0.07	1.7%	0.16	0.41	2.09	6.2%	0.09	0.36	0.61	0.4%	0.29	0.50	25.7%
A	0.84	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	0.84	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
B	2.18	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	2.18	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
C	1.96	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	1.96	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
D	1.69	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	1.69	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
F	2.37	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	2.37	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
G	5.08	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	5.08	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
H	3.51	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	3.51	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
I	0.89	0.90	0.96	0.04	4.5%	0.59	0.70	0.00	0.0%	0.16	0.41	0.06	0.6%	0.09	0.36	0.79	1.8%	0.13	0.39	6.9%
J	5.14	0.90	0.96	0.00	0.0%	0.59	0.70	0.00	0.0%	0.16	0.41	5.14	10.0%	0.09	0.36	0.00	0.0%	0.16	0.41	10.0%
K	3.64	0.90	0.96	0.05	1.4%	0.59	0.70	0.00	0.0%	0.16	0.41	3.59	9.9%	0.09	0.36	0.00	0.0%	0.17	0.42	11.2%
OS-1	2.44	0.90	0.96	0.05	2.0%	0.59	0.70	0.00	0.0%	0.16	0.41	2.39	9.8%	0.09	0.36	0.00	0.0%	0.17	0.42	11.8%
TOTAL ON-SITE	**36.31**																			**12.7%**
TOTAL OFF-SITE	**2.44**																			**11.8%**

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Cathedral Pines
Location: El Paso County

Project Name: Cathedral Pines-Proposed
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/21/22

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
N	5.65	B	17%	0.22	0.45	20	2.0%	5.7	972	3.8%	15.0	2.9	5.6	11.2	992.0	30.3	11.2
S	3.36	B	26%	0.29	0.50	20	2.0%	5.2	783	3.8%	15.0	2.9	4.5	9.7	803.0	27.0	9.7
A	0.84	B	10%	0.16	0.41	254	7.3%	14.0	0	0.0%	7.0	0.0	0.0	14.0	254.0	24.3	14.0
B	2.18	B	10%	0.16	0.41	300	5.6%	16.6	400	5.3%	7.0	1.6	4.1	20.8	700.0	27.1	20.8
C	1.96	B	10%	0.16	0.41	153	5.7%	11.8	461	4.2%	7.0	1.4	5.4	17.2	614.0	27.9	17.2
D	1.69	B	10%	0.16	0.41	300	4.7%	17.7	392	4.3%	7.0	1.5	4.5	22.2	692.0	27.3	22.2
F	2.37	B	10%	0.16	0.41	300	4.3%	18.2	368	4.9%	7.0	1.5	4.0	22.1	668.0	27.0	22.1
G	5.08	B	10%	0.16	0.41	154	6.5%	11.4	561	6.9%	7.0	1.8	5.1	16.5	715.0	27.7	16.5
H	3.51	B	10%	0.16	0.41	141	13.3%	8.6	598	5.8%	7.0	1.7	5.9	14.5	739.0	28.3	14.5
I	0.89	B	7%	0.13	0.39	101	8.4%	8.7	145	6.7%	7.0	1.8	1.3	10.0	246.0	25.8	10.0
J	5.14	B	10%	0.16	0.41	235	11.9%	11.5	643	4.8%	7.0	1.5	7.0	18.5	878.0	29.0	18.5
K	3.64	B	11%	0.17	0.42	150	6.2%	11.3	1019	5.0%	7.0	1.6	10.9	22.1	1169.0	31.3	22.1
OS-1	2.44	B	12%	0.17	0.42	181	6.9%	11.9	0	0.0%	7.0	0.0	0.0	11.9	181.0	24.0	11.9

$$t_c = t_i + t_t$$

Equation 6-2

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

Equation 6-3

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

Equation 6-4

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

Equation 6-5

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cathedral Pines
Location: El Paso County
Design Storm: 5-Year

Project Name: Cathedral Pines-Proposed
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/21/22

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	NP					0.65		1.9															
	1	N	5.65	0.22	11.2	1.22	3.96	4.8															Flows overland to road side swale and then to DP1 into North Pond. Flows leave North Pond at DPNP & flow to DP6.1
	SP					1.43		4.6															
	2	S	3.36	0.29	9.7	0.96	4.18	4.0															Offsite flows enter at DPP1.Flows overland to road side swale to DP2 into South Pond. Flows leave South Pond at DPSP & flow to DP11.1
	2.1								18.5	1.85	3.21	5.9											Flows from DP2 and DP P1 combine in Proposed South Pond at DP2.1
	3	A	0.84	0.16	14.0	0.13	3.62	0.5															Flows overland north to DP3 and onto Cathedral Pines Sub. Filing No. 1 Tract 1
	4	B	2.18	0.16	20.8	0.35	3.03	1.1															Flows overland north to DP4 and onto Cathedral Pines Sub. Filing No. 1 Tract 1
	5	C	1.96	0.16	17.2	0.31	3.32	1.0															Flows overland west to DP5 and onto an unplatted property to the west
	6	D	1.69	0.16	22.2	0.27	2.93	0.8															Flows overland west to DP6 and onto an unplatted property to the west
	6.1								22.2	0.92	2.93	2.7											Flows from DP NP & DP6 combine in the proposed swale to DP6.1 and onto an unplatted property to the west
	7	F	2.37	0.16	22.1	0.38	2.94	1.1															Flows overland west to DP7 and onto an unplatted property to the west
	8	G	5.08	0.16	16.5	0.81	3.38	2.7															Flows overland to an existing natural channel to DP8 and onto an unplatted property to the west

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cathedral Pines
Location: El Paso County
Design Storm: 5-Year

Project Name: Cathedral Pines-Proposed
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/21/22

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	9	H	3.51	0.16	14.5	0.56	3.57	2.0															Flows overland to an existing natural channel to DP9 and onto an unplatted property to the west at DP9.1
	9.1								14.5	0.68	3.57	2.4											Flows from DP9 & DP10 combine in the existing natural channel at 9.1 and onto an unplatted property to the west
	10	I	0.89	0.13	10.0	0.12	4.12	0.5															Flows overland to an existing natural channel to DP10 and contuies to Basin H via proposed culvert
	11	J	5.14	0.16	18.5	0.82	3.21	2.6															Flows overland to an existing natural channel to DP11 and onto an unplatted property to the west
	11.1								18.5	2.25	3.21	7.2											Flows from DP11 & DPSP combine in the existing natural channel at 11.1 and onto an unplatted property to the west
	12	K	3.64	0.17	22.1	0.62	2.94	1.8															Flows overland to an existing natural channel to DP12 and onto an unplatted property to the west
	12.1								22.1	1.05	2.94	3.1											Flows from DP11 & DPO1 combine in the existing natural channel at 12.1 and onto an unplatted property to the west
	O1	OS-1	2.44	0.17	11.9	0.43	3.87	1.7															Flows overland towards DPO1 and onto the site via exting natural swale
	P1		15.50			0.89		3.7															Flows from an off-site pond enter the site via an existing 18" RCP culvert

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
Values in blue indicate that they are from "Cathedral Pines Subdivision Filing No. 1 Drainage Report & Plan"

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cathedral Pines
Location: El Paso County
Design Storm: 100-Year

Project Name: Cathedral Pines-Proposed
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/21/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	NP					1.62		8.0															
	1	N	5.65	0.45	11.2	2.56	6.64	17.0															Flows overland to road side swale and then to DP1 into North Pond. Flows leave North Pond at DPNP & flow to DP6.1
	SP					2.75		14.8															
	2	S	3.36	0.50	9.7	1.69	7.01	11.8															Offsite flows enter at DPP1.Flows overland to road side swale to DP2 into South Pond. Flows leave South Pond at DPSP & flow to DP11.1
	2.1								18.5	3.66	5.38	19.7											Flows from DP2 and DP P1 combine in Proposed South Pond at DP2.1
	3	A	0.84	0.41	14.0	0.34	6.08	2.1															Flows overland north to DP3 and onto Cathedral Pines Sub. Filing No. 1 Tract 1
	4	B	2.18	0.41	20.8	0.89	5.09	4.5															Flows overland north to DP4 and onto Cathedral Pines Sub. Filing No. 1 Tract 1
	5	C	1.96	0.41	17.2	0.80	5.57	4.5															Flows overland west to DP5 and onto an unplatted property to the west
	6	D	1.69	0.41	22.2	0.69	4.92	3.4															Flows overland west to DP6 and onto an unplatted property to the west
	6.1								22.2	2.31	4.92	11.4											Flows from DP NP & DP6 combine in the proposed swale to DP6.1 and onto an unplatted property to the west
	7	F	2.37	0.41	22.1	0.97	4.93	4.8															Flows overland west to DP7 and onto an unplatted property to the west
	8	G	5.08	0.41	16.5	2.08	5.67	11.8															Flows overland to an existing natural channel to DP8 and onto an unplatted property to the west

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cathedral Pines
Location: El Paso County
Design Storm: 100-Year

Project Name: Cathedral Pines-Proposed
Project No.: 25260.00
Calculated By: APL
Checked By:
Date: 9/21/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	9	H	3.51	0.41	14.5	1.44	5.99	8.6															Flows overland to an existing natural channel to DP9 and onto an unplatted property to the west at DP9.1
	9.1								14.5	1.79	5.99	10.7											Flows from DP9 & DP10 combine in the existing natural channel at 9.1 and onto an unplatted property to the west
	10	I	0.89	0.39	10.0	0.35	6.92	2.4															Flows overland to an existing natural channel to DP10 and contuies to Basin H via proposed culvert
	11	J	5.14	0.41	18.5	2.11	5.38	11.4															Flows overland to an existing natural channel to DP11 and onto an unplatted property to the west
	11.1								18.5	4.86	5.38	26.2											Flows from DP11 & DPSP combine in the existing natural channel at 11.1 and onto an unplatted property to the west
	12	K	3.64	0.42	22.1	1.52	4.93	7.5															Flows overland to an existing natural channel to DP12 and onto an unplatted property to the west
	12.1								22.1	2.55	4.93	12.6											Flows from DP11 & DPO1 combine in the existing natural channel at 12.1 and onto an unplatted property to the west
	O1	OS-1	2.44	0.42	11.9	1.03	6.50	6.7															Flows overland towards DPO1 and onto the site via exting natural swale
	P1		15.50			1.55		10.9															Flows from an off-site pond enter the site via an existing 18" RCP culvert

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
Values in blue indicate that they are from "Cathedral Pines Subdivision Filing No. 1 Drainage Report & Plan"

Provide forebay, trickle channel, culvert, ditch, and riprap hydraulic calculations with the final drainage report.

APPENDIX C

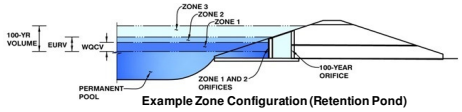
HYDRAULIC CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Cathedral Pines

Basin ID: North Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	5.65	acres
Watershed Length =	795	ft
Watershed Length to Centroid =	350	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	17.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.049	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.097	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.109	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.206	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.300	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.456	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.567	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.721	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 4 in.) =	1.418	acre-feet	4.00 inches
Approximate 2-yr Detention Volume =	0.065	acre-feet	
Approximate 5-yr Detention Volume =	0.098	acre-feet	
Approximate 10-yr Detention Volume =	0.165	acre-feet	
Approximate 25-yr Detention Volume =	0.209	acre-feet	
Approximate 50-yr Detention Volume =	0.221	acre-feet	
Approximate 100-yr Detention Volume =	0.275	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.049	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.047	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.178	acre-feet
Total Detention Basin Volume =	0.275	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

Pond worksheet will be reviewed further once pond details are provided.

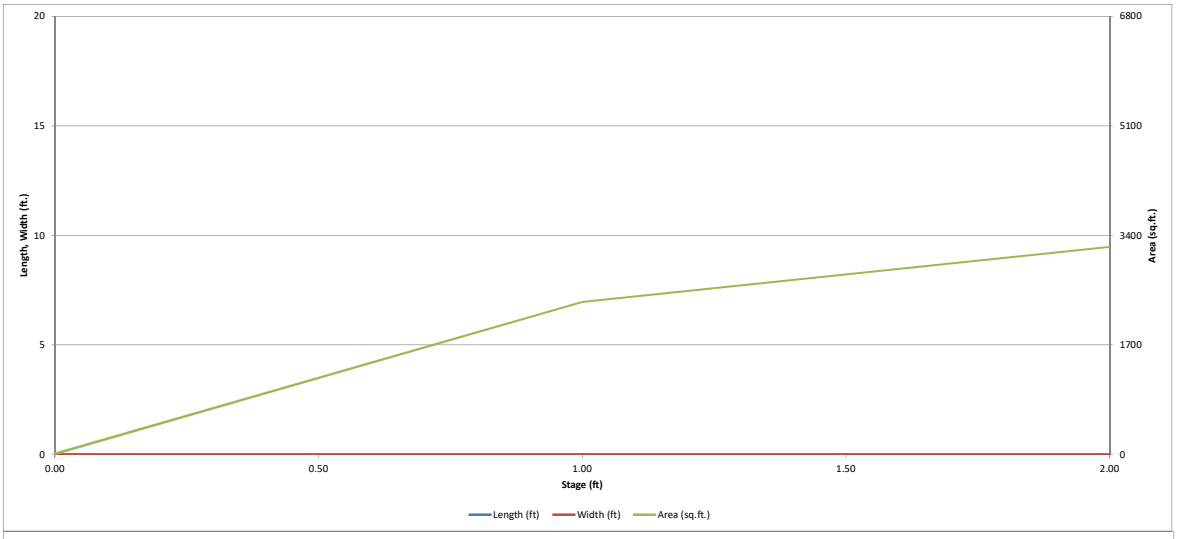
Please provide forebay design calculations (MHFD-BMP spreadsheet). The minimum forebay volumes are shown on MHFD T-5 Table EDB-4. The forebay outlet should be sized to release 2% of the undetained peak 100-year discharge.

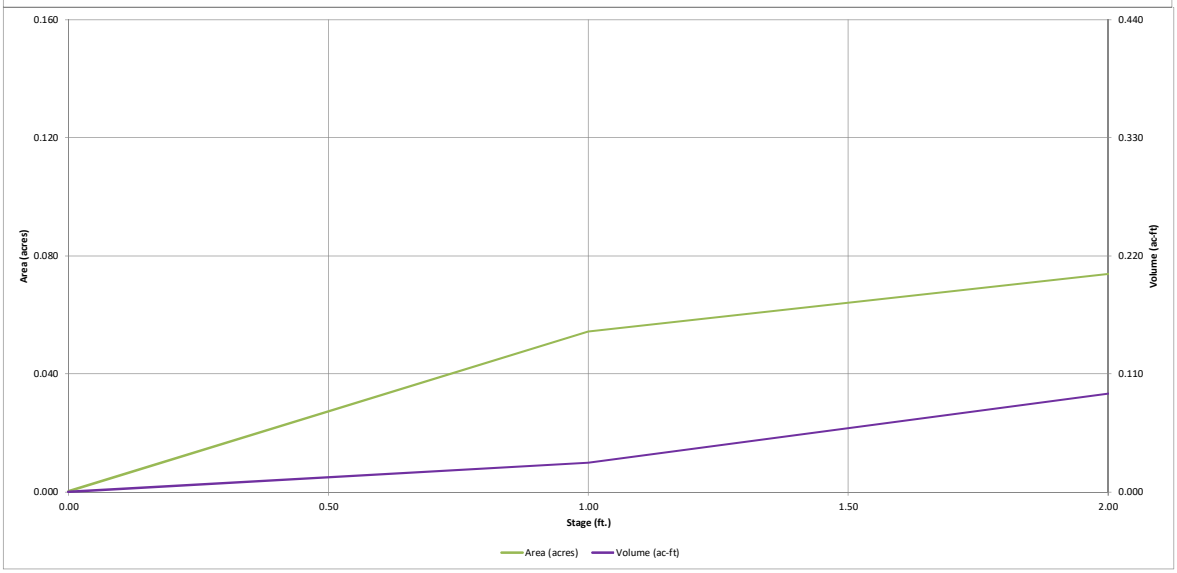
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
	--	1.00	--	--	--	2,370	0.054	1,190	0.027
	--	2.00	--	--	--	3,219	0.074	3,984	0.091
	--	3.00	--	--	--	4,196	0.096	7,692	0.177
	--	4.00	--	--	--	5,301	0.122	12,440	0.286
	--	5.00	--	--	--	6,534	0.150	18,358	0.421

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



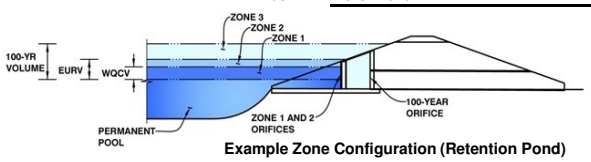


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Cathedral Pines**

Basin ID: **North Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.38	0.049	Orifice Plate
Zone 2 (EURV)	2.07	0.047	Orifice Plate
Zone 3 (100-year)	3.91	0.178	Weir&Pipe (Restrict)
Total (all zones)		0.275	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.292E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.07	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 =	0.33	sq. inches (diameter = 5/8 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	1.00					
Orifice Area (sq. inches)	0.33	0.33	0.33					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	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 =	2.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.25	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.37	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.26	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	6.26	N/A	ft^2
Debris Clogging % =	0%	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 =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.98	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.47	N/A	feet
Restrictor Plate Height Above Pipe Invert =	9.80		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.66	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.21	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	4.21	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.13	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.31	acre-ft

Calculated Parameters for Spillway

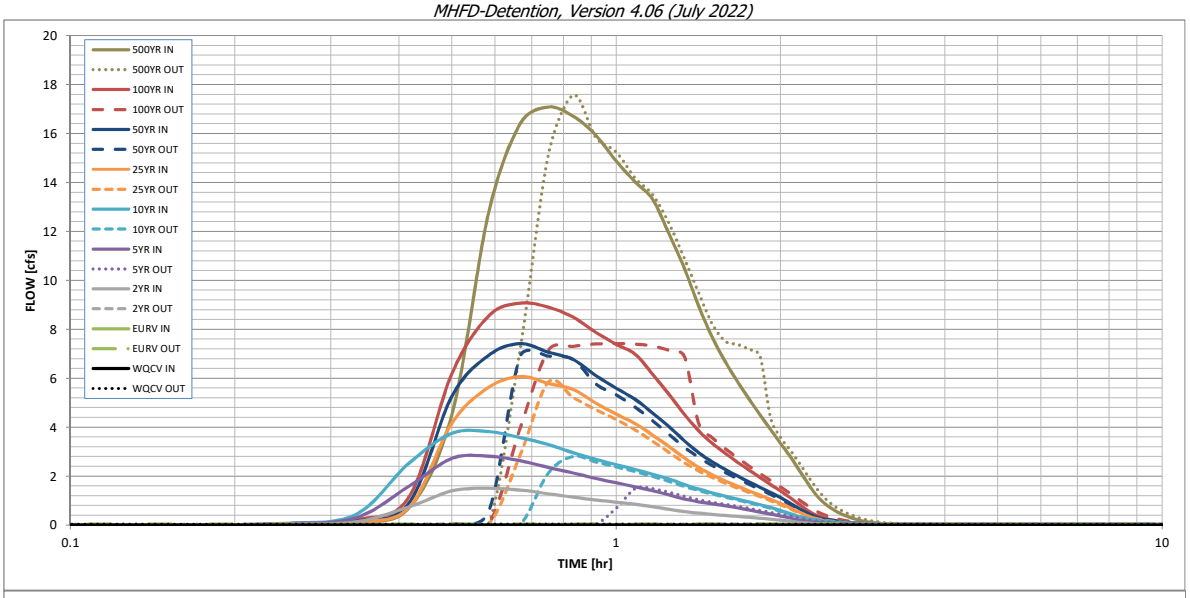
Routed Hydrograph Results

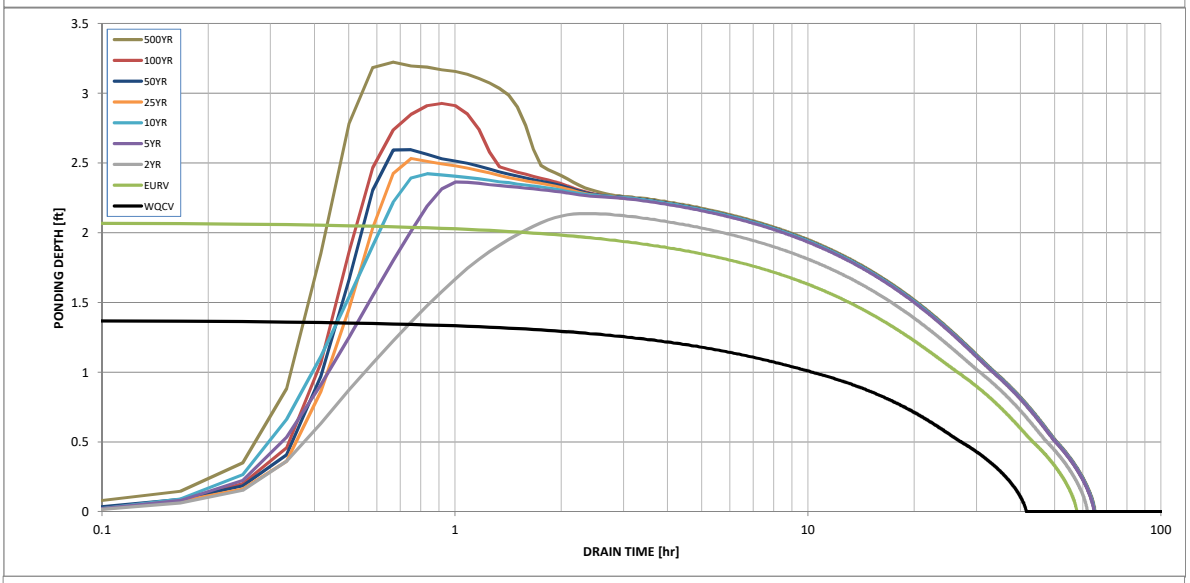
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

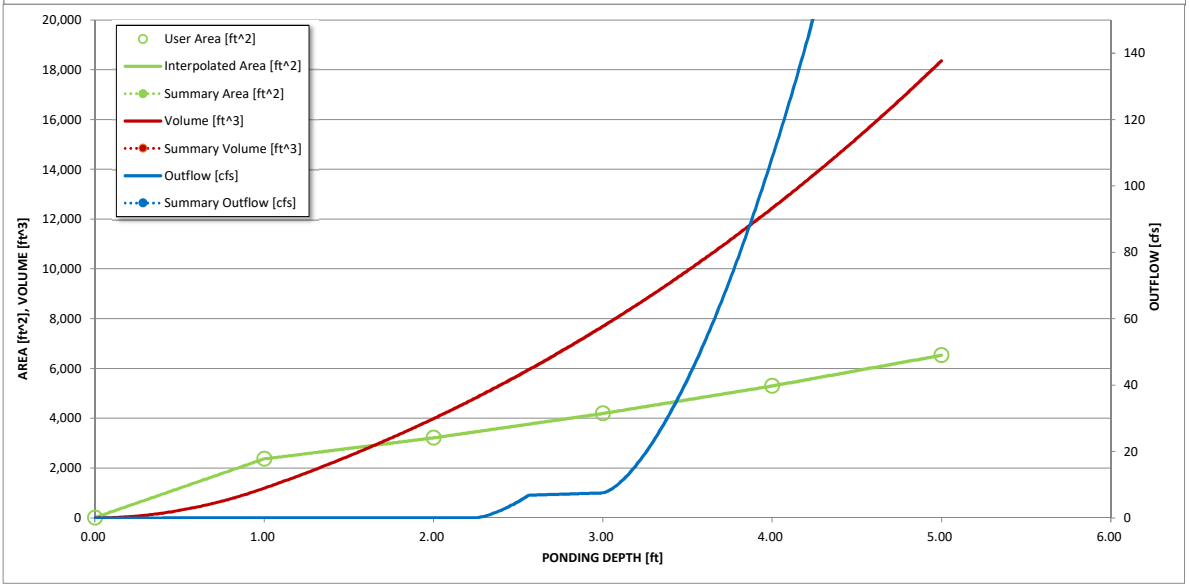
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	4.00
CUHP Runoff Volume (acre-ft) =	0.049	0.097	0.109	0.206	0.300	0.456	0.567	0.721	1.418
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.109	0.206	0.300	0.456	0.567	0.721	1.418
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.7	1.9	2.9	5.1	6.4	8.0	15.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.12	0.34	0.51	0.91	1.14	1.42	2.79
Peak Inflow Q (cfs) =	N/A	N/A	1.5	2.8	3.8	6.1	7.4	9.1	17.1
Peak Outflow Q (cfs) =	0.0	0.0	0.0	1.5	2.8	5.8	6.9	7.4	17.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.0	1.1	1.1	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.4	0.9	1.1	1.2	1.2
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) =	37	50	54	51	48	43	41	37	26
Time to Drain 99% of Inflow Volume (hours) =	**40**	54	58	59	57	54	52	50	43
Maximum Ponding Depth (ft) =	1.38	2.08	2.14	2.36	2.42	2.53	2.59	2.93	3.22
Area at Maximum Ponding Depth (acres) =	0.06	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.10
Maximum Volume Stored (acre-ft) =	0.049	0.097	0.101	0.120	0.124	0.134	0.139	0.169	0.198

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	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	0.00	0.00	0.03
	0:15:00	0.00	0.00	0.04	0.06	0.07	0.05	0.06	0.06	0.13
	0:20:00	0.00	0.00	0.13	0.30	0.43	0.13	0.17	0.22	0.70
	0:25:00	0.00	0.00	0.74	1.59	2.53	0.72	0.89	1.14	4.54
	0:30:00	0.00	0.00	1.40	2.73	3.75	4.18	5.28	6.21	12.76
	0:35:00	0.00	0.00	1.51	2.82	3.82	5.63	6.94	8.55	16.41
	0:40:00	0.00	0.00	1.44	2.63	3.58	6.07	7.42	9.07	17.09
	0:45:00	0.00	0.00	1.28	2.36	3.30	5.79	7.07	8.91	16.72
	0:50:00	0.00	0.00	1.14	2.13	2.96	5.55	6.77	8.50	15.94
	0:55:00	0.00	0.00	1.03	1.91	2.69	4.99	6.12	7.88	14.87
	1:00:00	0.00	0.00	0.94	1.73	2.47	4.53	5.59	7.39	14.02
	1:05:00	0.00	0.00	0.86	1.57	2.28	4.15	5.14	6.98	13.30
	1:10:00	0.00	0.00	0.75	1.41	2.08	3.67	4.57	6.15	11.88
	1:15:00	0.00	0.00	0.65	1.23	1.89	3.21	4.02	5.34	10.48
	1:20:00	0.00	0.00	0.55	1.07	1.66	2.74	3.44	4.52	8.93
	1:25:00	0.00	0.00	0.49	0.95	1.47	2.35	2.95	3.85	7.66
	1:30:00	0.00	0.00	0.44	0.87	1.32	2.05	2.58	3.34	6.68
	1:35:00	0.00	0.00	0.40	0.80	1.18	1.81	2.28	2.93	5.87
	1:40:00	0.00	0.00	0.36	0.71	1.06	1.60	2.01	2.57	5.16
	1:45:00	0.00	0.00	0.32	0.62	0.95	1.40	1.77	2.25	4.51
	1:50:00	0.00	0.00	0.29	0.53	0.84	1.22	1.55	1.95	3.90
	1:55:00	0.00	0.00	0.24	0.45	0.72	1.05	1.33	1.66	3.34
	2:00:00	0.00	0.00	0.20	0.37	0.60	0.89	1.12	1.40	2.80
	2:05:00	0.00	0.00	0.16	0.29	0.46	0.71	0.89	1.11	2.22
	2:10:00	0.00	0.00	0.12	0.21	0.34	0.53	0.67	0.84	1.67
	2:15:00	0.00	0.00	0.08	0.14	0.25	0.36	0.46	0.58	1.19
	2:20:00	0.00	0.00	0.06	0.11	0.20	0.24	0.32	0.40	0.86
	2:25:00	0.00	0.00	0.04	0.08	0.16	0.17	0.23	0.28	0.63
	2:30:00	0.00	0.00	0.04	0.07	0.13	0.12	0.17	0.20	0.46
	2:35:00	0.00	0.00	0.03	0.05	0.10	0.09	0.12	0.14	0.34
	2:40:00	0.00	0.00	0.02	0.04	0.08	0.07	0.09	0.09	0.24
	2:45:00	0.00	0.00	0.02	0.03	0.06	0.05	0.07	0.06	0.16
	2:50:00	0.00	0.00	0.01	0.03	0.05	0.04	0.05	0.04	0.11
	2:55:00	0.00	0.00	0.01	0.02	0.04	0.03	0.04	0.03	0.08
	3:00:00	0.00	0.00	0.01	0.02	0.03	0.02	0.03	0.02	0.06
	3:05:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.05
	3:10:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.04
	3:15:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.03
	3:20:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	3:25:00	0.00	0.00	0.00	0.00	0.01	0.00	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	0.01
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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

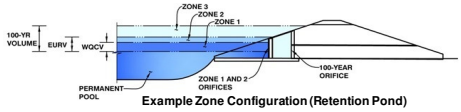
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Estates at Cathedral Pines**

Basin ID: **South Pond**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	3.36	acres
Watershed Length =	820	ft
Watershed Length to Centroid =	405	ft
Watershed Slope =	0.045	ft/ft
Watershed Imperviousness =	25.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.038	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.088	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.090	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.152	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.211	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.302	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.369	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.460	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 4 in.) =	0.879	acre-feet	4.00	inches
Approximate 2-yr Detention Volume =	0.062	acre-feet		
Approximate 5-yr Detention Volume =	0.089	acre-feet		
Approximate 10-yr Detention Volume =	0.135	acre-feet		
Approximate 25-yr Detention Volume =	0.160	acre-feet		
Approximate 50-yr Detention Volume =	0.169	acre-feet		
Approximate 100-yr Detention Volume =	0.203	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.038	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.049	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.116	acre-feet
Total Detention Basin Volume =	0.203	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

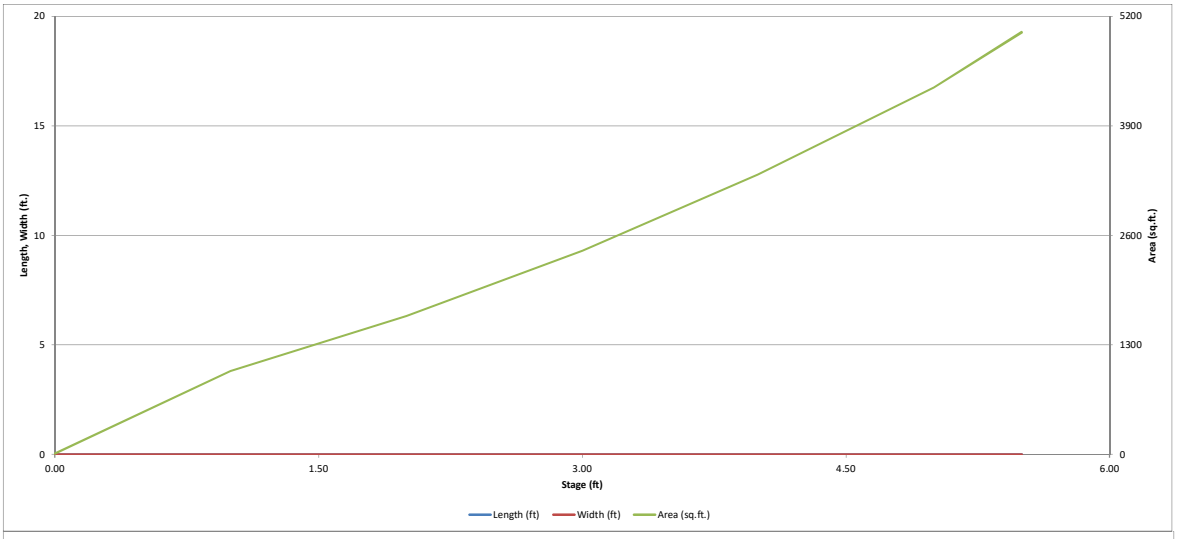
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

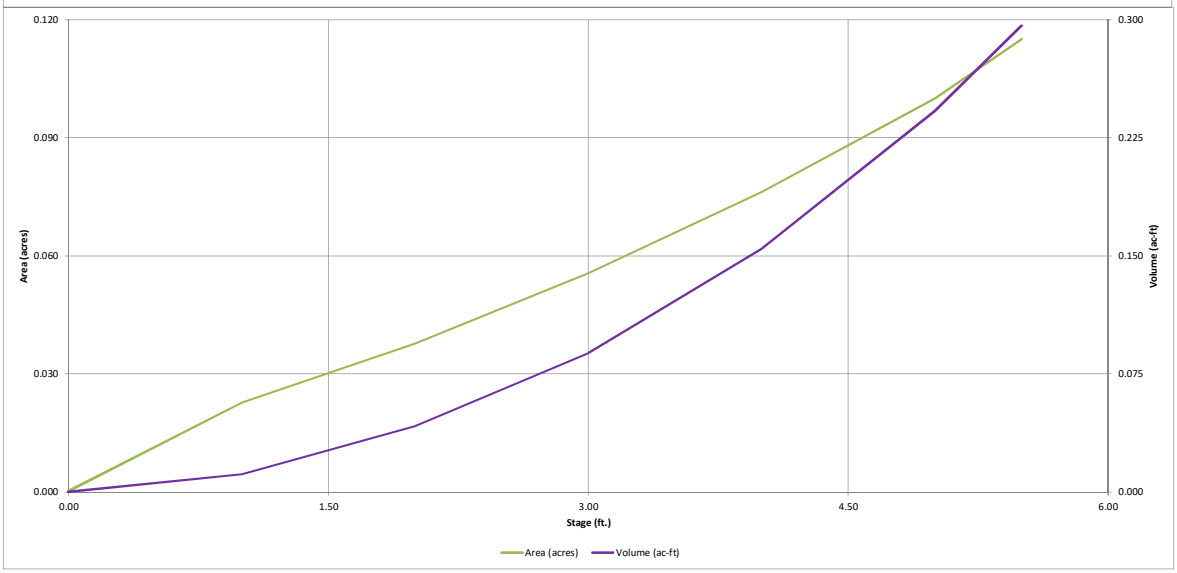
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
	--	1.00	--	--	--	992	0.023	501	0.012
	--	2.00	--	--	--	1,641	0.038	1,817	0.042
	--	3.00	--	--	--	2,418	0.056	3,847	0.088
	--	4.00	--	--	--	3,323	0.076	6,717	0.154
	--	5.00	--	--	--	4,356	0.100	10,557	0.242
	--	5.50	--	--	--	5,013	0.115	12,899	0.296

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



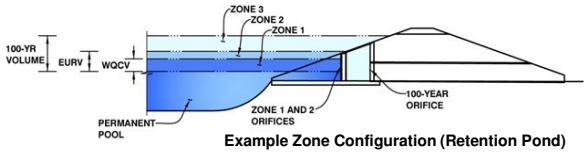


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Estates at Cathedral Pines**

Basin ID: **South Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.92	0.038	Orifice Plate
Zone 2 (EURV)	2.99	0.049	Orifice Plate
Zone 3 (100-year)	4.59	0.116	Weir&Pipe (Restrict)
Total (all zones)		0.203	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.250E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.99	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 =	0.18	sq. inches (diameter = 1/2 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	1.00	1.50				
Orifice Area (sq. inches)	0.18	0.18	0.18	0.18				

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	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 =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.25	N/A	feet
Overflow Weir Front Edge Length =	2.00	N/A	feet	Overflow Weir Slope Length =	2.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.95	N/A	
Horiz. Length of Weir Sides =	2.00	N/A	feet	Overflow Grate Open Area w/o Debris =	2.78	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	2.78	N/A	ft^2
Debris Clogging % =	0%	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 =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.40	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.25	N/A	feet
Restrictor Plate Height Above Pipe Invert =	5.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.11	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.90	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.14	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	5.04	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.10	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.25	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

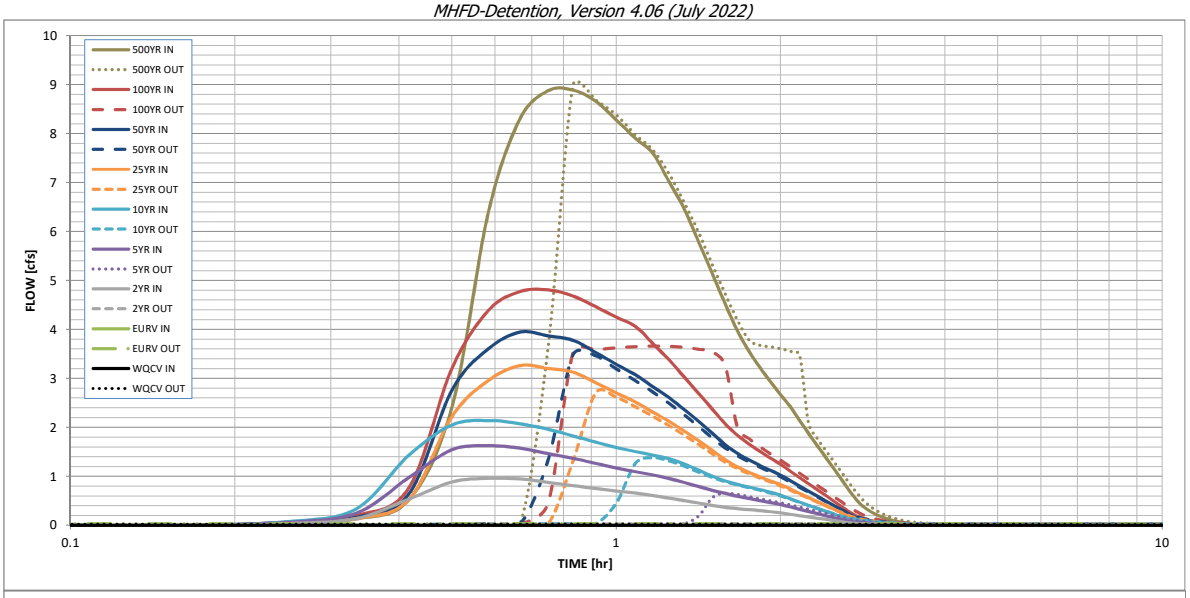
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

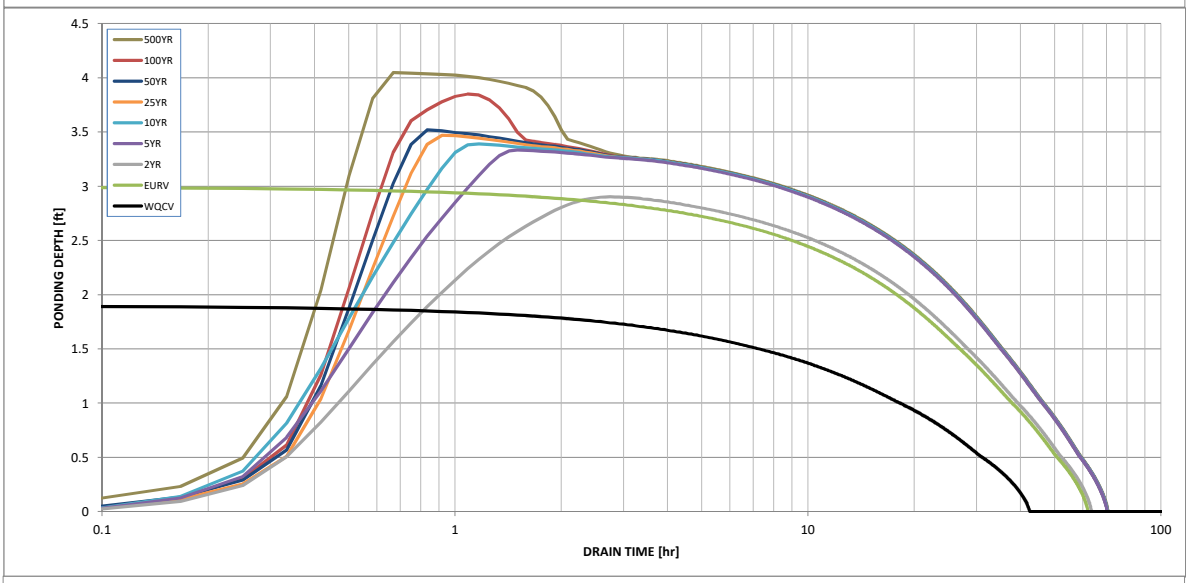
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	4.00
CUHP Runoff Volume (acre-ft) =	0.038	0.088	0.090	0.152	0.211	0.302	0.369	0.460	0.879
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.090	0.152	0.211	0.302	0.369	0.460	0.879
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.9	1.3	2.4	3.0	3.9	7.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.09	0.26	0.40	0.72	0.90	1.15	2.27
Peak Inflow Q (cfs) =	N/A	N/A	1.0	1.6	2.1	3.3	3.9	4.8	8.9
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.7	1.4	2.7	3.5	3.7	9.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	1.0	1.1	1.2	0.9	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.5	1.0	1.2	1.3	1.3
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) =	37	52	53	56	53	49	47	44	35
Time to Drain 99% of Inflow Volume (hours) =	**40**	58	59	63	62	59	58	56	50
Maximum Ponding Depth (ft) =	1.90	3.00	2.90	3.33	3.39	3.47	3.52	3.85	4.05
Area at Maximum Ponding Depth (acres) =	0.04	0.06	0.05	0.06	0.06	0.07	0.07	0.07	0.08
Maximum Volume Stored (acre-ft) =	0.038	0.088	0.083	0.108	0.111	0.117	0.119	0.143	0.157

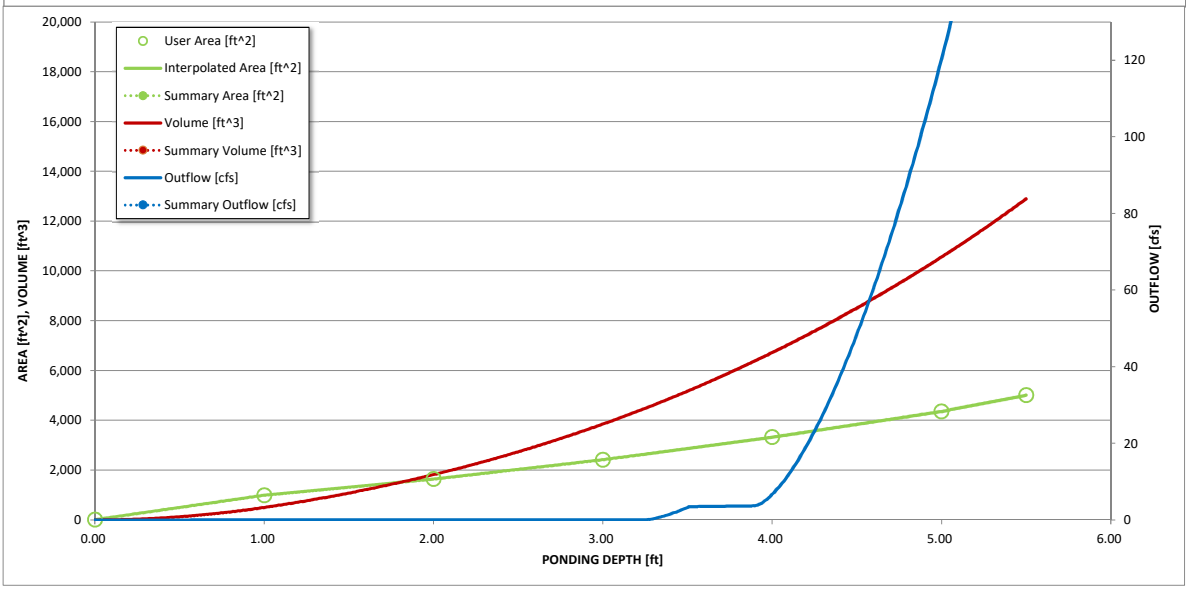
These ratios will need to be adjust to 1.0 or less with the final drainage report for the 2-yr through 100-yr design storms.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	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	0.00	0.00	0.03
	0:15:00	0.00	0.00	0.04	0.06	0.08	0.05	0.07	0.06	0.13
	0:20:00	0.00	0.00	0.14	0.25	0.34	0.14	0.17	0.20	0.52
	0:25:00	0.00	0.00	0.54	0.98	1.43	0.53	0.64	0.77	2.42
	0:30:00	0.00	0.00	0.89	1.55	2.05	2.23	2.76	3.21	6.41
	0:35:00	0.00	0.00	0.96	1.63	2.14	2.96	3.61	4.39	8.31
	0:40:00	0.00	0.00	0.95	1.58	2.07	3.26	3.95	4.78	8.88
	0:45:00	0.00	0.00	0.88	1.47	1.96	3.20	3.87	4.81	8.89
	0:50:00	0.00	0.00	0.81	1.37	1.83	3.13	3.78	4.68	8.66
	0:55:00	0.00	0.00	0.75	1.27	1.70	2.91	3.53	4.47	8.28
	1:00:00	0.00	0.00	0.70	1.17	1.59	2.71	3.29	4.25	7.91
	1:05:00	0.00	0.00	0.66	1.10	1.51	2.52	3.08	4.07	7.60
	1:10:00	0.00	0.00	0.61	1.03	1.44	2.31	2.83	3.71	7.01
	1:15:00	0.00	0.00	0.56	0.96	1.36	2.12	2.61	3.38	6.45
	1:20:00	0.00	0.00	0.51	0.87	1.25	1.92	2.36	3.02	5.78
	1:25:00	0.00	0.00	0.46	0.79	1.13	1.73	2.12	2.69	5.13
	1:30:00	0.00	0.00	0.41	0.72	1.00	1.53	1.88	2.37	4.52
	1:35:00	0.00	0.00	0.37	0.65	0.91	1.34	1.65	2.07	3.98
	1:40:00	0.00	0.00	0.34	0.60	0.84	1.20	1.47	1.84	3.56
	1:45:00	0.00	0.00	0.32	0.55	0.78	1.08	1.34	1.66	3.22
	1:50:00	0.00	0.00	0.30	0.51	0.73	0.99	1.22	1.51	2.93
	1:55:00	0.00	0.00	0.28	0.47	0.68	0.91	1.12	1.37	2.67
	2:00:00	0.00	0.00	0.26	0.43	0.62	0.83	1.03	1.25	2.42
	2:05:00	0.00	0.00	0.23	0.38	0.54	0.74	0.91	1.11	2.14
	2:10:00	0.00	0.00	0.20	0.33	0.48	0.65	0.80	0.97	1.88
	2:15:00	0.00	0.00	0.17	0.29	0.41	0.57	0.70	0.85	1.63
	2:20:00	0.00	0.00	0.15	0.24	0.35	0.49	0.60	0.73	1.39
	2:25:00	0.00	0.00	0.12	0.20	0.29	0.41	0.50	0.61	1.17
	2:30:00	0.00	0.00	0.10	0.16	0.23	0.33	0.41	0.50	0.94
	2:35:00	0.00	0.00	0.08	0.12	0.18	0.26	0.32	0.39	0.73
	2:40:00	0.00	0.00	0.06	0.09	0.14	0.19	0.23	0.28	0.53
	2:45:00	0.00	0.00	0.04	0.07	0.11	0.13	0.16	0.20	0.39
	2:50:00	0.00	0.00	0.03	0.06	0.09	0.10	0.12	0.14	0.29
	2:55:00	0.00	0.00	0.03	0.05	0.07	0.07	0.09	0.10	0.22
	3:00:00	0.00	0.00	0.02	0.04	0.06	0.05	0.07	0.08	0.16
	3:05:00	0.00	0.00	0.02	0.03	0.05	0.04	0.05	0.05	0.12
	3:10:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.09
	3:15:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.06
	3:20:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.02	0.05
	3:25:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.04
	3:30:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.03
	3:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:40:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	3:45:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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

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

APPENDIX D

REFERENCE MATERIALS

FINAL
DRAINAGE REPORT AND PLAN
FOR
CATHEDRAL PINES SUBDIVISION FILING NO. 1

January, 2005

Leigh
& Whitehead
Associates, Inc.

CONSULTING CIVIL ENGINEERS & SURVEYORS
2906 BEACON STREET
COLORADO SPRINGS, CO 80907-6192

LWA Project No. 04040.62

TABLE 1

BASIN ID		AREA		Q5 cfs		Q100 cfs	
Exist.	Prop.	Exist.	Prop.	Exist.	Prop.	Exist.	Prop.
DP-1	DP-1	0.22 sm.	0.36 sm.	40.0	57.0	175.0	189.0
DP-2	DP-2	1.02 sm.	0.87 sm.	68.0	141.0	335.0	465.0
DP-3	DP-3	1.24 sm.	1.43 sm.	76.0	218.0	385.0	733.0
D	D	8.61 Ac.	5.06 Ac.	1.8	5.0	4.9	12.3
E	E	20.20 Ac.	15.50 Ac.	4.2	13.4	11.3	32.8
F	F	2.79 Ac.	2.79 Ac.	0.9	0.9	2.5	2.5

TABLE 1

sm = Square Miles Ac. = Acres

Culverts have been sized in accordance with the requirements of the Bureau of Public Roads, nomographs, and the City of Colorado Springs/El Paso County Drainage Criteria Manual. The computer program "Culvert Master for Windows", Culvert Design and Analysis Software, Version 1.0, developed by Haestad Methods, was used in the computations for sizing of culverts. This software program is in accordance with the Bureau of Public Road's standards for developing culvert sizes. The culverts have been sized as R.C.P., using a Manning's roughness coefficient of 0.013. The culvert design data computations are in the back of this report. The rip-rap at the outlet of the culverts, have been designed in accordance with CDOT Std. M-601-12, and a copy of this standard is located in the back of this report. These rip-rap pads are shown on the detailed street plan and profiles and the calculations are in the back of this report. These rip-rap pads have been sized in accordance with the appropriate requirements.

There are plans to construct 2-detention facilities. One is located at design point 3 (DP-3) in basin B, and the other one is located at Winslow Drive in basin E. These detention facilities release runoff at or below historic rates.

The detention pond at DP-3 has been sized to accept runoff from Filing No. 1, which contributes 381.67 acres. This does include basins B21 and D. The remaining 413.6 undeveloped acres from the adjacent portion will sheet flow westerly to Black Squirrel Creek, and will not be intercepted by this detention facility. Developed peak flow at DP-3 for the 381.67 acres is 142.0 cfs for the 5 year event, and 444.0 cfs for the 100 year event.

Historic flows at this location are 44.0 cfs for the 5 year event and 219.0 cfs for the 100 year event. This detention facility will release flows of 41.8 cfs for the 5 year event and 192.6 cfs for the 100 year event. These flows are below historic runoff. This detention pond will detain 5.84 acre feet (100.2 cfs) for the 5 year event and 17.26 acre (251.4 cfs) for the 100 year event When the remaining portion of this basin is developed, detailed evaluation will be required to determine the best solution to reduce developed runoff from exiting the property.

The detention pond at Basin E has been sized to accept runoff from 15.50 acres, which generates a peak developed flow of 13.4 cfs for the 5 year event and 32.8 cfs for the 100 year event. Historic flows at this location are 4.2 cfs for the 5 year event and 11.3 cfs for the 100 year event. This detention facility will release runoff of 3.7 cfs for the 5 year event and 10.9 cfs for the 100 year event. These flows are below historic runoff. This detention pond will detain 0.25 acre feet (9.7 cfs) for the 5 year event and0.56 acre feet (21.9 cfs) for the 100 year event

Detention facilities were analyzed using Haestad methods "Pond Pack-Detention Pond Design and Analysis" computer program for both the 5 year and 100 year events. Pond volumes were determined by conic method. The detention ponds are private drainage facilities and will be maintained by the homeowners association. Calculations for the two detention ponds are included in the back of this report. These ponds will have adequate maintenance access.

The proposed detention facilities include outlet structures that will control both the minor and major storms. The are dual-stage outlet facilities. The calculations for the emergency spillway are shown on the construction documents. Any seeding that is developed in the detention pond areas will be in accordance with the NRCS specifications that are shown on sheet 2 of the construction documents.

Located throughout the property are small stock or ranch ponds that are currently in existence. These ponds will be removed and regraded, and will not be part of the storm drainage system. All runoff calculations for this development did not take into account these stock ponds. Grades for the proposed roads may cause high storm water flow velocities and create the need for roadside ditch protection. The roadside ditches generate

RUNOFF COMPUTATIONS
RATIONAL METHOD

CATHEDRAL PINES SUBDIVISION FILING NO. 1
HOLMES ROAD, Sec.'s 1 & 2, T12S, R66W
EL PASO COUNTY, COLORADO

TABLE A: LWA # 04040.62
PROPOSED CONDITIONS

04040_62.xls

LEIGH WHITEHEAD & ASSOCIATES,INC.
Engineers, Surveyors & Planners
2906 BEACON STREET
COLORADO SPRINGS, COLORADO
(719) 636-5179

16-Nov-04

BASIN	AREA	SOIL TYPE	C 5 / C 100	GEOMETRY LENGTH / SLOPE	GEOMETRY HEIGHT	Tt 5 / Tt 100	V / Tt	tc 5 / tc 100	i 5 / i 100	Q5	Q100	COMMENTS
B29	7.60	B	0.30	300	42.0	10.85	3.95	14.31	3.45	7.9		
		26/40	0.40		14.00	9.49	3.46	12.95	6.32		19.2	
B30	8.85	B	0.30	300	48.0	10.38	3.37	14.29	3.45	9.2		
		26	0.40		16.00	9.08	3.91	12.99	6.31		22.3	
B31	15.46	B	0.30	300	38.0	11.21	3.60	18.38	3.05	14.1		
		26/40	0.40		12.67	9.81	7.17	16.98	5.54		34.3	
B32	37.25	B	0.30	300	12.0	16.40	4.01	29.68	2.33	26.1		
		26/40/71	0.40		4.00	14.35	13.28	27.63	4.25		63.3	
B32	69.16	B	0.30	300	42.0	10.85	Varies	26.87	2.47	51.3		B29 through B32
(cum.)		26/40/71	0.40		14.00	9.49	16.02	25.51	4.45		123.1	
DP-3	916.42	B	0.29	300	15.0	15.43	Varies	66.25	1.39	370.2		Rational; OS-B1 -- B32
		26/40/41/71	0.39		5.00	13.52	50.82	64.34	2.48		887.2	
DP-3	1.4319	B	CN							218		HEC-1; OS-B1 -- B32
		26/40/41/71	64.51								733	(Ultimate Condition)
DP-3	381.67	B	0.29	300	15.0	15.43	Varies	46.05	1.78	196.6		Rational Analysis
		26/40/41/71	0.39		5.00	13.52	30.62	44.14	3.19		474.7	
DP-3	0.5964	B	CN							142		HEC-1; OS-B1 -- B32
		26/40/41/71	64.51								444	(For Detention Purposes)
D	5.06	B	0.30	300	23.0	13.23	3.81	15.77	3.29	5.0		
		41	0.40		7.67	11.58	2.54	14.12	6.07		12.3	
E	15.50	B	0.30	300	17.0	14.62	3.54	20.37	2.89	13.4		
		41	0.40		5.67	12.79	5.75	18.54	5.30		32.8	
F	2.79	B	0.10	350	40.0	15.66		15.66	3.30	0.9		Undisturbed
		41	0.15		11.43	14.88		14.88	5.92		2.5	
Milam Cir.	1.22	B	0.40	200	9.0	11.27		11.27	3.85	1.9		
		41	0.50		4.50	9.66		9.66	7.18		4.4	

Culvert Designer/Analyzer Report
Winslow Drive - 2

Peak Discharge Method: User-Specified			
Design Discharge	4.7 cfs	Check Discharge	11.7 cfs
Grades Model: Inverts			
Invert Upstream	7,365.00 ft	Invert Downstream	7,364.00 ft
Length	70.00 ft	Slope	0.014286 ft/ft
Drop	1.00 ft		
Headwater Model: Maximum Allowable HW			
Headwater Elevation	7,368.00 ft		
Tailwater properties: Triangular Channel			
Slope	0.020000 ft/ft	Mannings Coefficient	0.035
Depth	0.78 ft	Left Side Slope	6 H : V
Right Side Slope	6 H : V		
Tailwater conditions for Design Storm.			
Discharge	4.7 cfs	Bottom Elevation	7,364.00 ft
Depth	0.56 ft	Velocity	2.53 ft/s
Tailwater conditions for Check Storm.			
Discharge	11.7 cfs	Bottom Elevation	7,364.00 ft
Depth	0.78 ft	Velocity	3.18 ft/s

	Name	Desc	Discharge	HW Elev	Velocity
	Trial-1	1-18 inch Circular	4.7 cfs	7,366.34 ft	6.59 ft/s
x	Trial-2	1-18 inch Circular	11.7 cfs	7,367.74 ft	8.06 ft/s

Len Beasley
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Culvert Designer/Analyzer Report
Winslow Drive - 2

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	7,368.00 ft	Storm Event	Design
Computed Headwater Elevation	7,366.34 ft	Discharge	4.7 cfs
Headwater Depth/ Height	0.89	Tailwater Elevation	7,364.56 ft
Inlet Control HW Elev	7,366.23 ft	Control Type	Outlet Control
Outlet Control HW Elev	7,366.34 ft		

Grades			
Upstream Invert	7,365.00 ft	Downstream Invert	7,364.00 ft
Length	70.00 ft	Constructed Slope	0.014286 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.64 ft
Slope Type	Steep	Normal Depth	0.64 ft
Flow Regime	Supercritical	Critical Depth	0.83 ft
Velocity Downstream	6.59 ft/s	Critical Slope	0.005655 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	7,366.34 ft	Upstream Velocity Head	0.34 ft
Ke	0.50	Entrance Loss	0.17 ft

Inlet Control Properties			
Inlet Control HW Elev	7,366.23 ft	Flow Control	Unsubmerged
Inlet Type	End-Section Conforming to fill slope	Area Full	1.8 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Len Beasley
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Culvert Designer/Analyzer Report
Winslow Drive - 2

Design:Trial-2

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	7,368.00 ft	Storm Event	Check
Computed Headwater Elevation	7,367.74 ft	Discharge	11.7 cfs
Headwater Depth/ Height	1.83	Tailwater Elevation	7,364.78 ft
Inlet Control HW Elev	7,367.74 ft	Control Type	Inlet Control
Outlet Control HW Elev	7,367.50 ft		

Grades			
Upstream Invert	7,365.00 ft	Downstream Invert	7,364.00 ft
Length	70.00 ft	Constructed Slope	0.014286 ft/ft

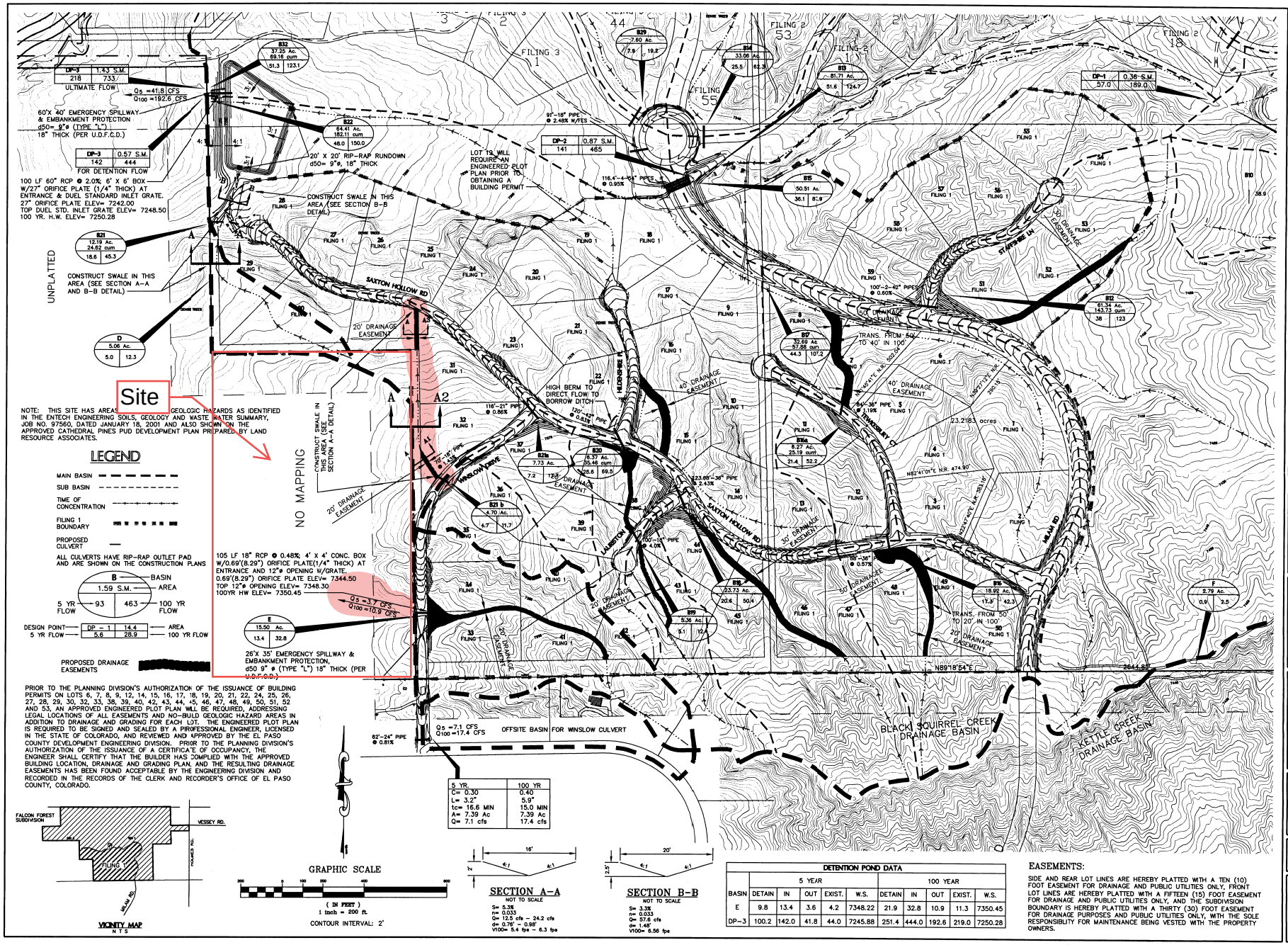
Hydraulic Profile			
Profile	S2	Depth, Downstream	1.15 ft
Slope Type	Steep	Normal Depth	1.15 ft
Flow Regime	Supercritical	Critical Depth	1.30 ft
Velocity Downstream	8.06 ft/s	Critical Slope	0.011352 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	7,367.50 ft	Upstream Velocity Head	0.80 ft
Ke	0.50	Entrance Loss	0.40 ft

Inlet Control Properties			
Inlet Control HW Elev	7,367.74 ft	Flow Control	Submerged
Inlet Type	End-Section Conforming to fill slope	Area Full	1.8 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Len Beasley
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666



5 YR.	100 YR
C= 0.30	0.40
L= 3.2"	5.9"
tc= 16.6 MIN	15.0 MIN
A= 7.39 Ac	7.39 Ac
Q= 7.1 cfs	17.4 cfs

DETENTION POND DATA

	5 YEAR					100 YEAR				
BASIN	DETAIN	IN	OUT	EXIST.	W.S.	DETAIN	IN	OUT	EXIST.	W.S.
E	9.8	13.4	3.6	4.2	7348.22	21.9	32.8	10.9	11.3	7350.45
DP-3	100.2	142.0	41.8	44.0	7245.88	251.4	444.0	192.6	219.0	7250.28

ENGINEERS PLANNERS SURVEYORS
LEIGH WHITEHEAD & ASSOCIATES
2720 EAST YAMPA STREET, SUITE 1
COLORADO SPRINGS, CO 80909
PHONE (719) 636-0170 * FAX (719) 636-0190

SHEET TITLE: FINAL DRAINAGE PLAN PROPOSED CONDITIONS
PROJECT NAME: CATHEDRAL PINES SUBDIVISION FILING NO. 1

BENCHMARK:
TOP OF 5/8" DIA. REBAR 23' NORTH AND 20' EAST OF THE SOUTHWEST COR. OF SECTION 1
ELEV= 7436.65 - NAVD '88

REVISIONS:

SCALE: 1" = 200'
DATE: 1/18/05
DRAWN BY: CLH
CHECKED BY: LAB

SHEET NO: 2 OF 2

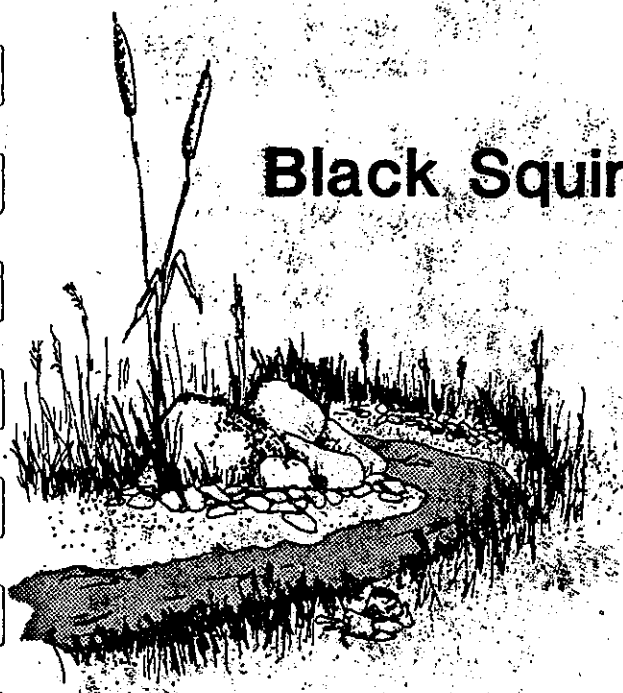
PROJECT NO: 04040
DRAWING NAME: Final Drainage
VIEW: PROPOSED

Approved
El Paso County
Planning Commission
This 17th day of Jan. 1989

Chairman

Elaine Rebex, Secretary

URS
CONSULTANTS
MAKING
TECHNOLOGY
WORK™



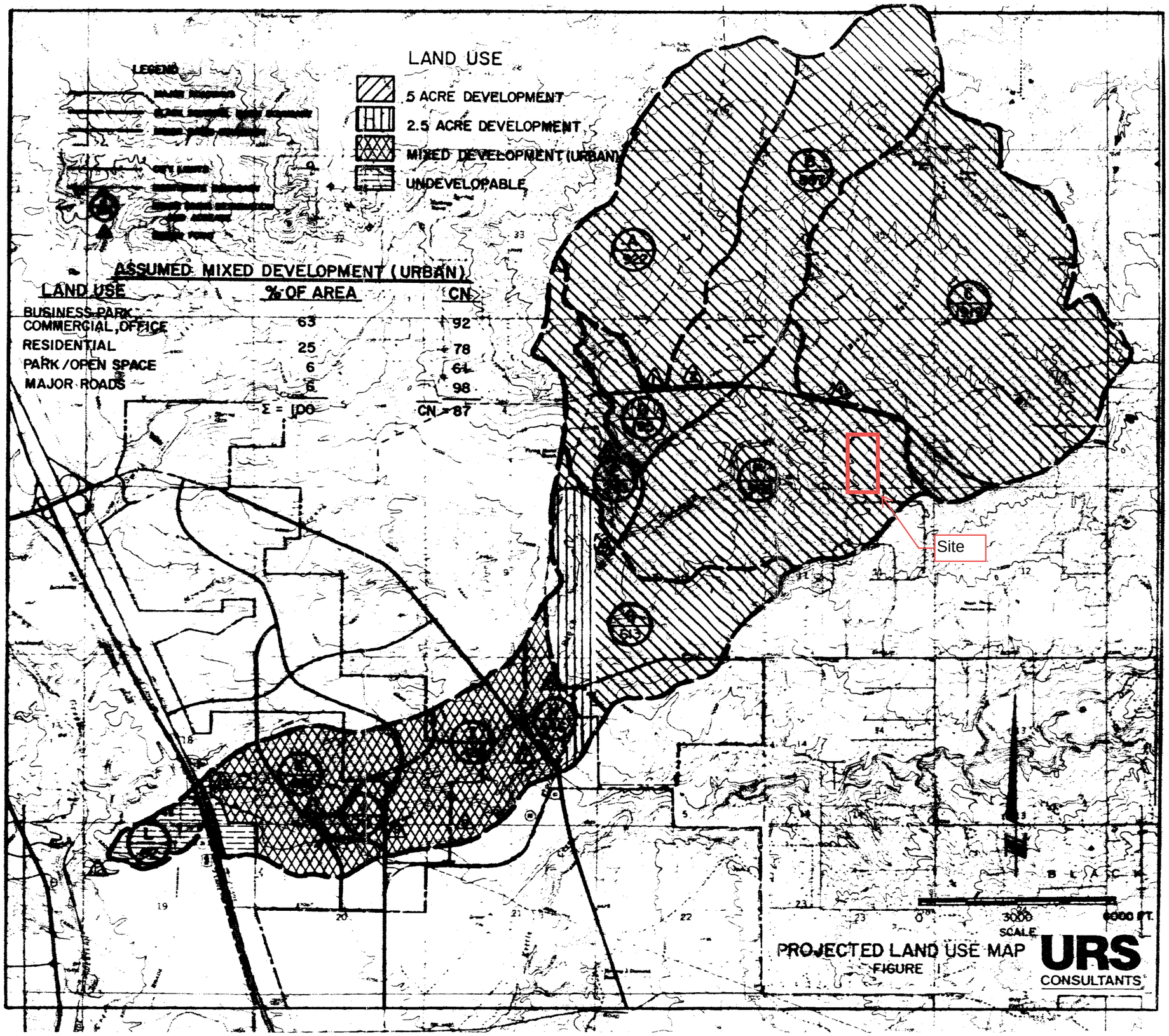
Black Squirrel Creek Drainage Basin Planning Study

City of Colorado Springs

and El Paso County

January, 1989

Department, the City Public Works Department, the City Planning Department, along with the aid of the Black Forest Preservation Study, the Urban Planning Area Map, and the Northgate Master Plan. The area between Interstate 25 and State Highway 83 (Downstream of D.P. #6)was assumed to be developed as if it was an urban type development. A buffer area was also assumed along State Highway 83 consisting of 2.5 acre development. This buffer area was assumed to be included within the urban development. The remaining area was assumed to be developed in a rural type development with an average lot size of 5 acres per current zoning and presently platted subdivisions within the basin. This was assumed to be appropriate due to the limiting density where City services are anticipated to be available and the desirability of maintaining the forest area in a more rural type setting. The Air Force Academy land was assumed to remain undeveloped and was not included in the drainage and bridge fee calculations. Future changes in land use beyond this concept would require a revision to this study. Land use assumptions for the basin are depicted on Figure 1.


LAND USE
.5 ACRE DEVELOPMENT
2.5 ACRE DEVELOPMENT
MIXED DEVELOPMENT (URBAN)
UNDEVELOPABLE
ASSUMED MIXED DEVELOPMENT (URBAN)
LAND USE | % OF AREA | CN
BUSINESS PARK, COMMERCIAL, OFFICE | 63 | 92
RESIDENTIAL | 25 | 78
PARK / OPEN SPACE | 6 | 61
MAJOR ROADS | 6 | 98
Σ = 100 | CN = 87
Site
SCALE
3000
6000 FT.
PROJECTED LAND USE MAP
FIGURE 1
URS
CONSULTANTS

LEGEND

- MAJOR ROADWAYS
- BLACK SQUIRREL BASIN BOUNDARY
- MAJOR BASIN BOUNDARY
- MINOR SUB-BASIN BOUNDARY
- CITY LIMITS
- NORTHGATE BOUNDARY
- FOREST AREA
- A 922 — MAJOR BASIN ACREAGE
- A1 — MINOR SUB-BASIN DESIGNATION
- 100-ACRE LIMIT & STABILIZED CHANNEL
- 2 — DESIGN POINT
- 3 — DETENTION POND
- PARTIALLY LINED CHANNEL
- FULLY LINED CHANNEL

BLACK SQUIRREL CREEK DRAINAGE BASIN
PROPOSED MAJOR DRAINAGE FACILITIES

DESIGN POINT	REACH	FACILITY	DESIGN FLOW (cfs) (1)
	1	RURAL MAJOR DRAINAGEWAY	563
1A		3 x 8' x 120' CBC *	563
	2	RURAL MAJOR DRAINAGEWAY	848
1B		(10'x 10') x 220' CBC *	848
	3	RURAL MAJOR DRAINAGEWAY	1205
		DETENTION FACILITY #1	(see table 7)
1		(10' x 10') x 120' CBC	906
	4	RURAL MAJOR DRAINAGEWAY	564
		(7'x 7') x 150' CBC *	564
	16	RURAL MAJOR DRAINAGEWAY	906
	5	RURAL MAJOR DRAINAGEWAY	685-985
		DETENTION FACILITY #2	(see table 7)
2		(10'x 8') x 120' CBC	740
	7	RURAL MAJOR DRAINAGEWAY	740
		6' x 4' x 120' CBC (NORTHGATE FORD)	142
	8	RURAL MAJOR DRAINAGEWAY	251
	9	6' x 7' x 120' CBC (S.N. 83)	251
	10	RURAL MAJOR DRAINAGEWAY	1478
	11	RURAL MAJOR DRAINAGEWAY	1450
	12	RURAL MAJOR DRAINAGEWAY	497
		RURAL MAJOR DRAINAGEWAY	497
	12	8' x 8' x 120' CBC (MILAM ROAD)	497
	13	RURAL MAJOR DRAINAGEWAY	350-1421
		DETENTION FACILITY #3	(see table 7)
	14	RURAL MAJOR DRAINAGEWAY	574
	14	5' x 8' x 120' CBC (MILAM ROAD)	574
		RURAL MAJOR DRAINAGEWAY	362
	15	(7' x 120' CBC (MILAM ROAD)	823
	16	RURAL MAJOR DRAINAGEWAY	1052
4		(10'-10') x 10' x 150' CBC	1841
	17	RURAL MAJOR DRAINAGEWAY	1719
	18	RURAL MAJOR DRAINAGEWAY	608
		DETENTION FACILITY #4	(see table 7)
	19	RURAL MAJOR DRAINAGEWAY	2207
		8'x 8&0& FULLY LINED CHANNEL	2658
20		(14'-14'-11') x 10' K 2(0 CBC	3850
	21	RURAL MAJOR DRAINAGEWAY	3588
		(11'-14'-11') x (10.x 2(3 CBC *	3588
	22	25' x 8'-6" 2350' FULLY LINED CHANNEL	3577
		(14'-14'-11')0'x(10'x 2(3 CBC	3577
23		25.x 8' x 2256' FULLY LINED CHANNEL	3957
		DETENTION FACILITY #5	(see table 7)
24		PARTIALLY LINED CHANNEL	3974
		DETENTION FACILITY #6	(see table 7)
25		8'x 3 x 3600' FULLY LINED CHANNEL	3968
		DETENTION FACILITY #7	(see table 7)
		DETENTION FACILITY #8	(see table 7)
		EXISTING (14' - 11') x 10' K 2(0 CBC	9774
26		50' x 8'-6" 3900' FULLY LINED CHANNEL	3803
10		(11'-14'-11') x 10' K 120 CBC	3803
27		25'x 8'-6" 2500' FULLY LINED CHANNEL	3960
28		13' x 8' x 1640' FULLY LINED CHANNEL	7745
		22'x 8'x 120' CBC *	7745
		DETENTION FACILITY #9	(see table 7)
11		CITY/COUNTY BOUNDARY	9953
12		CONFLUENCE w/ MONUMENT CREEK	3931

NOTE: Design flows shown are for the ultimate buildout conditions as represented in the Black Squirrel Creek hydrologic model. Interim flows may be higher at certain locations along the main channel. (See hydrographs for example). Where facilities are to be constructed along the main channel, the design flow must be analyzed and accepted by the City or County at the preliminary and final drainage report level.

* Replacement Facilities

ARKANSAS RIVER BASIN

SOUTH PLATTE RIVER BASIN

SMITH CREEK DRAINAGE BASIN

MONUMENT BRANCH DRAINAGE BASIN

MIDDLE TRIB. DRAINAGE BASIN

KETTLE CREEK DRAINAGE BASIN

ELKHORN DRAINAGE BASIN

GLENEAGLE

NORTHGATE

FORD

BRIARGATE

BLACK FOREST

ASSUMED URBAN/RURAL LIMITS
SEE FIG. 1 FOR LAND USE DETAIL

SEE SECTIONS IV AND VI FOR DISCUSSION ON ROBINSON POND.

Site

BLACK SQUIRREL CREEK DRAINAGE BASIN
SUMMARY OF DETENTION FACILITIES

POND NO.	LOCATION	TYPE	PEAK INFLOW (cfs)	PEAK OUTFLOW (cfs)	DETENTION VOLUME HISTORIC (ac)	DETENTION VOLUME ABSA (ac)	OBTAINED BY ABSA (ac-ft) (basin)
1	D,E	ONSTREAM	1205	906	3.9	4.4	A1,A5
2	D,E	ONSTREAM	985	740	4.1	4.1	B1,B3
3	D,E,F	ONSTREAM	1481	1205	4.8	4.8	C1,C5,C10
4	D,E,F	OFFSTREAM	606	564	2.7	2.7	E1
5	D,E,F	OFFSTREAM	1280	906	5.2	5.2	F1
6	D,E,F,G	OFFSTREAM	970	185	15	15	G1
7	G,H,I,J	OFFSTREAM	968	968	29	29	I1,I2
8	G,H,I,J	OFFSTREAM	983	249	11.2	11.2	J4
9	G,H,I,J,K,L	OFFSTREAM	1339	176	15	15	K1

NOTE: Subbasins C4, D1, D3, E1, E2, F1, F3, F4, G1, G2, H, I2, J3, K, L2 and L3 under developed conditions will be maintained to historic flows due to a undetained peak from upstream ponds. Temporary detention is required as development occurs until the permanent detention facilities are constructed.

BLACK SQUIRREL CREEK DRAINAGE BASIN

DEVELOPED CONDITIONS MAJOR FACILITIES

FIGURE 4

URS CONSULTANTS
MAKING TECHNOLOGY WORK™
COLORADO SPRINGS, COLORADO

LEGEND

- MAJOR ROADWAYS
- BLACK SQUIRREL BASIN BOUNDARY
- CITY LIMITS
- NORTHGATE BOUNDARY
- FOREST AREA
- (1) DETENTION PONDS (MAJOR SYSTEM)
- 100 ACRE LIMIT
- 2 DESIGN POINT
- INLET
- EXISTING INITIAL SYSTEM
- 24" RCP
- 30" RCP
- 36" RCP
- 42" RCP
- 48" RCP
- RURAL INITIAL SYSTEM
- (10) RURAL INITIAL SYSTEM DESIGNATION (SEE TABLE 9)

ARKANSAS RIVER BASIN

SOUTH PLATTE RIVER BASIN

GLENEAGLE

NORTHGATE

BLACK FOREST

BRIARGATE

USAFA

FORD

ASSUMED URBAN/RURAL LIMITS
SEE FIG. 1 FOR DETAIL

Site

BLACK SQUIRREL CREEK DRAINAGE BASIN

DEVELOPED CONDITIONS INITIAL DRAINAGE SYSTEM

FIGURE 5

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APPENDIX E

DRAINAGE MAPS

CATHEDRAL PINES
EXISTING DRAINAGE MAP

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX-1	0.84	2%	0.09	0.36	15.1	0.3	1.8
EX-2	3.16	2%	0.09	0.36	22.0	0.8	5.6
EX-3	4.89	2%	0.09	0.36	28.8	1.1	7.5
EX-4	2.67	2%	0.09	0.36	23.5	0.7	4.6
EX-5	8.29	3%	0.10	0.37	23.8	2.3	14.4
EX-6	4.74	3%	0.10	0.37	17.5	1.5	9.6
EX-7	8.06	3%	0.10	0.37	23.9	2.3	14.0
EX-8	3.64	3%	0.10	0.37	23.0	1.1	6.5
OS-1	2.44	12%	0.17	0.42	11.9	1.7	6.7

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	0.3	1.8
2	0.8	5.6
3	1.1	7.5
4	0.7	4.6
5	2.3	14.4
6	1.5	9.6
7	2.3	14.0
7.1	6.0	24.9
8	1.1	6.5
8.1	2.3	11.5
O1	1.7	6.7
P1	3.7	10.9

LEGEND:

- —6000— EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- DRAINAGE BASIN
- A / B = A = BASIN DESIGNATION, B = AREA IN ACRES
- 1 = DESIGN POINT
- EXISTING DRAINAGE ARROW

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

EXISTING DRAINAGE MAP
CATHEDRAL PINES
JOB NO. 25260.00
09/19/2022
SHEET 1 OF 1

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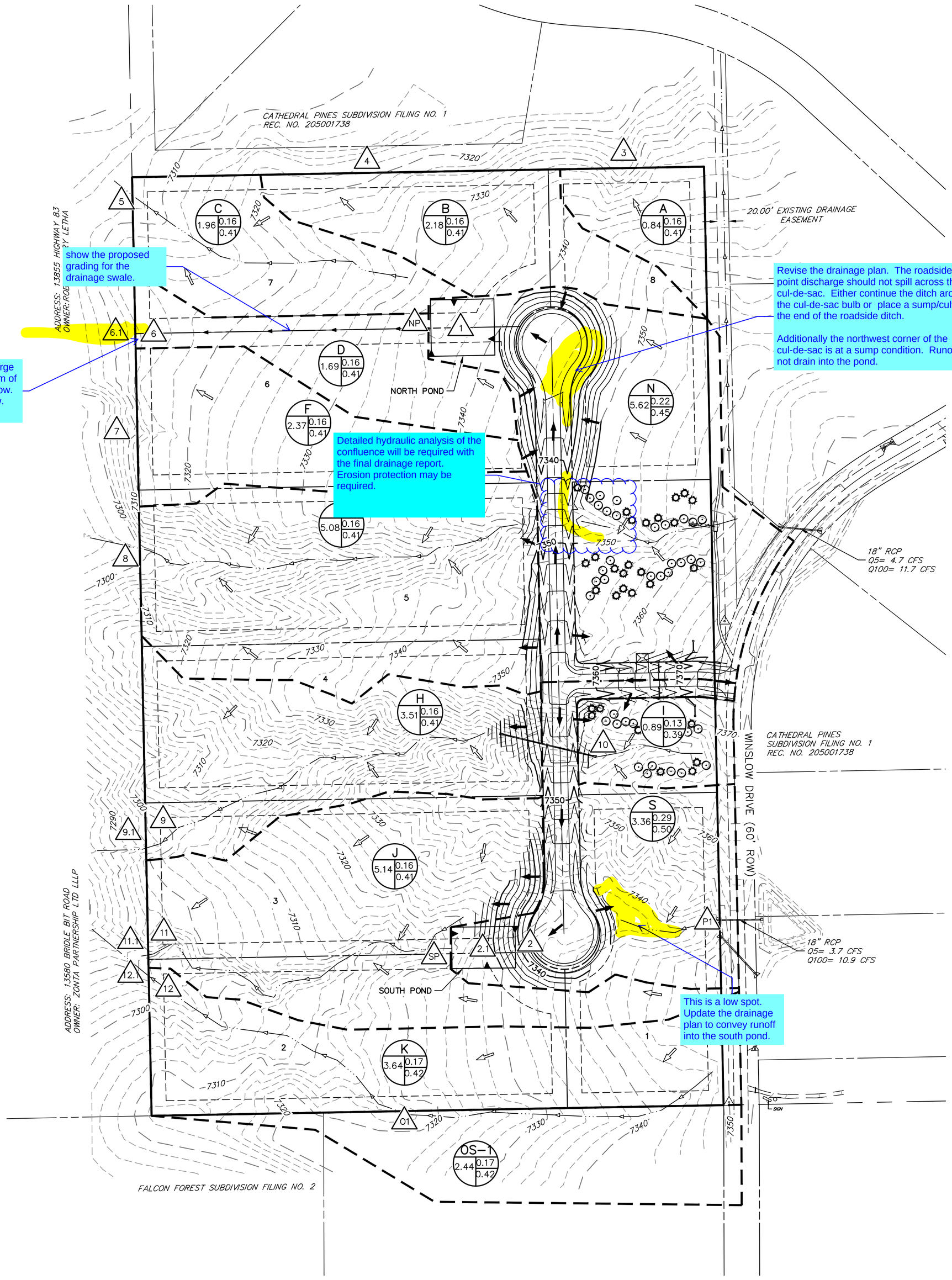
ESTATES AT CATHEDRAL PINES

PROPOSED DRAINAGE MAP



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
SECTION LINE		
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
ELECTRIC	E	E
FIBER OPTIC	FO	FO
GAS MAIN	G	G
IRRIGATION MAIN	IRR	IRR
OVERHEAD UTILITY	OHU	OHU
SANITARY SEWER	S	
STORM SEWER		
TELEPHONE	T	T
WATER MAIN	W	W
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
DEPRESSION CONT. (INDEX)	6100	6100
DEPRESSION CONT. (INTER)		
CURB & GUTTER		
WALL		

BASIN ID: ID / AC / C5 / C100

DESIGN POINT DESIGNATION: 4

FLOW DIRECTION (PROPOSED)

FLOW DIRECTION (EXISTING)

SUB-BASIN DRAINAGE AREA

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
N	5.62	18%	0.22	0.45	11.2	4.8	16.9
S	3.36	26%	0.29	0.50	9.7	4.0	11.8
A	0.84	10%	0.16	0.41	14.0	0.5	2.1
B	2.18	10%	0.16	0.41	20.8	1.1	4.5
C	1.96	10%	0.16	0.41	17.2	1.0	4.5
D	1.69	10%	0.16	0.41	22.2	0.8	3.4
F	2.37	10%	0.16	0.41	22.1	1.1	4.8
G	5.08	10%	0.16	0.41	16.5	2.7	11.8
H	3.51	10%	0.16	0.41	14.5	2.0	8.6
I	0.89	7%	0.13	0.39	10.0	0.5	2.4
J	5.14	10%	0.16	0.41	18.5	2.6	11.4
K	3.64	11%	0.17	0.42	22.1	1.8	7.5
OS-1	2.44	12%	0.17	0.42	11.9	1.7	6.7

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	4.8	16.9
2	4.0	11.8
2.1	5.9	19.7
3	0.5	2.1
4	1.1	4.5
5	1.0	4.5
6	0.8	3.4
6.1	2.7	11.4
7	1.1	4.8
8	2.7	11.8
9	2.0	8.6
9.1	2.4	10.7
10	0.5	2.4
11	2.6	11.4
11.1	7.2	26.2
12	1.8	7.5
12.1	3.1	12.6
NP	1.9	8.0
SP	4.6	14.8
P1	3.7	10.9
O1	1.7	6.7

Update the drainage plan. The highlighted DP (3, 7, 9.1, 11.1, 12.1) release rates in the developed condition shall not exceed the historic runoff rate.

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

PROPOSED DRAINAGE MAP
ESTATES AT CATHEDRAL PINES
JOB NO. 25260.00
9/21/2022
SHEET 1 OF 1

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