

DRAINAGE LETTER REPORT

for

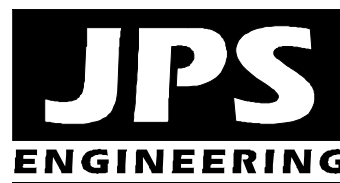
CATHEDRAL ROCK CHURCH 846 STRUTHERS RANCH ROAD TRACT A, STRUTHERS RANCH SUBDIVISION FILING NO. 2

Prepared for:

Hammers Construction, Inc.
1411 Woolsey Heights
Colorado Springs, CO 80915

September 20, 2024

Prepared by:



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JPS Project No. 082401
PCD Filing No. PPR__

PPR2436

**CATHEDRAL ROCK CHURCH
DRAINAGE LETTER REPORT
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DRAINAGE STATEMENT

Engineer's Statement:

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

John P. Schwab, P.E. #29891

Developer's Statement:

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

By:

Date

Hammers Construction, Inc.
1411 Woolsey Heights, Colorado Springs, CO 80915

El Paso County's Statement

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.
County Engineer / ECM Administrator

Date

Conditions:

I. INTRODUCTION

A. Property Location and Description

Cathedral Rock Church is planning to construct a new church building on the vacant 5.1-acre property at the northeast corner of Struthers Road and Struthers Ranch Road in northern El Paso County, Colorado. The property is described as Tract A, Struthers Ranch Subdivision Filing No. 2 (El Paso County Assessor's Parcel Number 71363-01-013).

The project consists of a new 8,125 square-foot Church Building with associated parking and site improvements. Future phases of site development are anticipated to include a 3,250 square-foot building addition on the east side of the Phase 1 building, an additional future 10,000-square foot building, and expanded parking areas. Additionally, the Church plans to process a minor subdivision to create a separate 1-acre lot reserved for future development in the southwest corner of the site.

The property is bounded by Struthers Road on the southwest side and Struthers Ranch Road on the southeast side. Struthers Road is a fully improved, asphalt-paved arterial public street, and Struthers Ranch Road is a fully improved local public street. Existing platted residential lots are located along the northeast boundary of the parcel (Struthers Ranch Filing No. 2). The north boundary of the site adjoins a vacant, unplatted 6.5-acre property (zoned R-4).

The property is zoned Planned Unit Development (PUD), and the proposed site development is fully consistent with the existing zoning of the site. Access to the site will be provided by the existing private driveway connection to Struthers Ranch Road along the southeast boundary of the site.

The site is located in the Black Forest Creek Drainage Basin, and surface drainage from this site sheet flows southwesterly to an existing public storm sewer system in Struthers Ranch Road, flowing to the existing Struthers Ranch stormwater detention pond on the west side of Struthers Road.

This report is intended to meet the requirements of a site-specific "Letter Type" drainage report in accordance with El Paso County subdivision drainage criteria.

B. References

JPS Engineering, Inc., "Preliminary & Final Drainage Report for Cathedral Rock Commons Commercial," revised March 8, 2023 (approved by El Paso County 3/29/23).

JPS Engineering, Inc., "Final Drainage Report for Struthers Ranch Filing No. 2," revised October 14, 2004 (approved by El Paso County 10/20/04).

JPS Engineering, Inc., “Drainage Letter Report for Struthers Ranch Polaris, Lots 1-2, Struthers Ranch Subdivision Filing No. 4,” revised April 7, 2023 (approved by El Paso County 5/4/23).

C. Drainage Analysis Methods and Criteria

| ITEM | DESCRIPTION | REFERENCE |
|--------------------------------|--|------------|
| Design Storm (initial/major) | 5-year/100-year | CS/EPC DCM |
| Storm Runoff | Rational Method (Area<100acres) | CS/EPC DCM |
| Major Drainage Basin | Black Forest Creek | |
| Floodplain Impacts | Parcel is located outside any delineated FEMA floodplains | FIRM |
| Existing Downstream Facilities | Existing storm sewer system on east side of Struthers Road; Existing detention pond on west side of Struthers Road | |

CS/EPC DCM = City of Colorado Springs & El Paso County Drainage Criteria Manual

II. EXISTING / PROPOSED DRAINAGE CONDITIONS

Subdivision Drainage Report

Drainage planning for this site was previously master planned during original development of the Struthers Ranch Subdivision, as detailed in the “Final Drainage Report (FDR) for Struthers Ranch Filing No. 2” by JPS Engineering, dated October 14, 2004 (see excerpts in Appendix A). The project area at the northeast corner of Struthers Road and Struthers Ranch Road was identified as a future commercial development area in the original planning of the subdivision.

According to the original FDR, Basins C (4.75 acres) and E1 (1.5 acres) comprise the future commercial development areas on the north side of Struthers Ranch Road. The previously approved subdivision drainage planning assumed full commercial development within all of Basins C and E1, with runoff coefficients of $C_5 = 0.90$ and $C_{100} = 0.90$, and impervious areas of 95 percent for the entirety of these basins. According to the Rational Method calculations in the original subdivision drainage report, developed peak flows from Basin C were calculated as $Q_5 = 22.2$ cfs and $Q_{100} = 38.5$ cfs, and peak flows from Basins OE1 and E1 (FDR DP#5) were calculated as $Q_5 = 4.6$ cfs and $Q_{100} = 8.9$ cfs (see Appendix A).

As shown on the enclosed Struthers Ranch Subdivision Drainage Plan (Figure D1, Appendix F), the proposed Church building and parking areas lie entirely within Basin C as delineated in the approved “Final Drainage Report for Struthers Ranch Filing No. 2.”

The site slopes downward to the southwest, with average grades of 1-4 percent. On-site soils are classified by SCS as type 71, “Pring” series coarse sandy loam soils. These soils have moderately rapid permeability and slow to medium surface runoff characteristics. The soils are classified as hydrologic soils group B.

In the developed condition the flows sheet flow southwesterly to the rain garden and connect to an existing 24" storm sewer (per the GEC Plan) prior to continuing to the 42" SS in Struthers Ranch Road. Clarify.

Developed drainage from this Church site will sheet flow southwesterly to the existing 42" public storm sewer system in Struthers Ranch Road. An existing 10-foot Type R public storm inlet collects street drainage at the northeast corner of Struthers Ranch Road and Struthers Road, and an existing 24" RCP storm sewer was stubbed north from the inlet during initial subdivision development. The existing 42" storm sewer in Struthers Ranch Road flows south along the east side of Struthers Road to a catch basin, where double 48-inch culverts convey developed flows across Struthers Road and into the existing detention pond. The previously approved drainage report for Struthers Ranch Filing No. 2 assumed full commercial development for this basin, which is consistent with the proposed site development. The existing detention pond was sized to account for fully developed flows from this commercial area.

The impervious area for the proposed Cathedral Rock Church development (delineated as Basins A1-A4 within this report, which correlates with Basin C in the FDR) amounts to approximately 65.8 percent of the site (as tabulated on Sh. D1.1 and Appendix B), which is well below the impervious area of 95 percent assumed for full commercial development in the previously approved subdivision drainage report (see Appendix A).

Based on the previous construction of drainage improvements for the Struthers Ranch Subdivision, no significant impact on downstream drainage facilities is anticipated from this site development and replat. Proper erosion control measures will be required for development of the site, including silt fence along downstream property boundaries to minimize off-site transport of construction sediment.

Existing Drainage Conditions

As shown on the enclosed Existing Conditions Drainage Plan (Figure EX1, Appendix F), the site has been delineated as two on-site drainage basins. The majority of the project area has been delineated as Basin A, and the north edge of the site has been delineated as Basin B. The site is impacted by small off-site basin areas (delineated as Basins OA1 and OB1) consisting of the rear sides of the adjoining single-family residential lots (platted as part of Struthers Ranch Filing No 2) along the northeast boundary of the site.

Surface drainage from off-site Basin OA1 (back sides of adjoining developed single-family residential lots along northeast boundary of project site) sheet flows into Basin A, and Basin A sheet flows southwesterly across the property to the existing public storm inlet (10' Type R) on the north side of Struthers Ranch Road. Flows from Basin OA1 combine with Basin A at Design Point #1, with existing peak flows calculated as $Q_5 = 1.4$ cfs and $Q_{100} = 8.5$ cfs.

Drainage from off-site Basin OB1 (back sides of adjoining developed single-family residential lots along northeast boundary of project site) sheet flows southwesterly into Basin B, and Basin B flows southwesterly to the existing curb and gutter along the east side of Struthers Road, ultimately flowing north into the existing public culvert crossing Struthers Road at the southeast corner of Spanish Bit Drive and Struthers Road.

Flows from Basins OB1 and B combine at Design Point #2, with existing peak flows calculated as $Q_5 = 0.7$ cfs and $Q_{100} = 4.1$ cfs.

Developed Drainage Plan

Developed flows have been calculated based on the impervious areas associated with the proposed building and parking improvements. Surface drainage swales and a private storm sewer system will convey developed flows to the proposed Rain Garden A along the south boundary of the site. Site grades will slope to storm inlets and curb openings at selected locations, collecting surface drainage and conveying stormwater to Rain Garden A. The proposed building pads will be graded with protective slopes to provide positive drainage away from the buildings, and the curb, gutter, drainage swales, and private storm sewer system will convey developed flows southwesterly into Rain Garden A.

Basin A

The proposed Church building and the majority of the central parking lot area have been delineated as Basin A1 (2.29-acres), which drains by sheet flow and curb and gutter to a private storm sewer system conveying flows to Rain Garden A. Private Storm Inlet A1.1 (5' Type R) will intercept surface drainage from the northwest side of the parking lot, and Private Storm Sewer A1 (18" HDPE) will convey this flow southeast to Private Storm Inlet A1.2. Storm Inlet A1.2 will intercept surface drainage from the south side of the parking lot, and Private Storm Sewer A1.2 (18" HDPE) will convey the combined flows southeasterly to Private Storm Inlet A2 in the southeast access drive.

Developed peak flows for Basin A1 are calculated as $Q_5 = 7.9$ cfs and $Q_{100} = 15.6$ cfs. Off-site flows from Basin OA1 combine with Basin A1 at Design Point A1.1, with developed peak flows calculated as $Q_5 = 5.6$ cfs and $Q_{100} = 11.2$ cfs.

The southeast access drive and southeast corner of the parking lot have been delineated as Basin A2 (0.86-acre), which drains southwesterly by sheet flow and curb and gutter to the proposed Private Storm Inlet A2 (5' Type R) at the southwest corner of the new access drive. Private Storm Sewer A2 (18" HDPE) will convey the combined flows southwesterly into the forebay at the east end of Rain Garden A.

Developed peak flows for Basin A2 are calculated as $Q_5 = 2.6$ cfs and $Q_{100} = 5.3$ cfs. Off-site flows from Basin OA2 combine with Basin A2 at Design Point A2.1, with developed peak flows calculated as $Q_5 = 2.3$ cfs and $Q_{100} = 5.2$ cfs. Off-site flows from Basins OA1-OA2 combine with Basins A1-A2 at Design Point A2.2, with developed peak flows calculated as $Q_5 = 8.1$ cfs and $Q_{100} = 16.7$ cfs.

The future development area in the southwest corner of the property has been delineated as Basin A3 (0.96-acre). The Church has plans to process a subdivision to create a separate 1-acre lot in this area for potential future sale and commercial development. Runoff calculations for Basin A3 have assumed an impervious area of 85 percent for

future commercial development of this area, with Basin A3 developed peak flows calculated as $Q_5 = 3.6$ cfs and $Q_{100} = 6.7$ cfs.

The proposed Rain Garden A area along the south boundary of the property has been delineated as Basin A4 (0.23-acre), and developed peak flows for Basin A4 are calculated as $Q_5 = 0.1$ cfs and $Q_{100} = 0.7$ cfs.

The 24" RCP discharge pipe from Rain Garden A (along with overflows from the pond spillway) will drain into the existing public storm inlet along the north side of Struthers Ranch Road, flowing into the existing 42-inch RCP public storm sewer in Struthers Ranch Road. The existing public storm sewer system flows south to the existing double 48-inch RCP storm sewer which crosses Struthers Road, draining southwesterly into the existing regional Struthers Ranch Detention Pond ("Detention Pond 11" per Black Forest Creek DBPS).

Combined Flows and Comparison to Subdivision FDR

Developed flows from Basins OA1-OA2, and A1-A4 combine at Design Point #1, with peak flows calculated as $Q_5 = 10.6$ cfs and $Q_{100} = 21.8$ cfs. For comparison with the original Struthers Ranch Subdivision FDR, the developed flows from FDR Basin C (equivalent to Design Point #1 in this report) were calculated as $Q_5 = 22.2$ cfs and $Q_{100} = 38.5$ cfs (significantly higher than the current developed flow calculations). As such, the proposed developed flows are well below the previously master planned developed flows entering the regional detention pond.

Hydrologic and hydraulic calculations for the site are detailed in the appendices (Appendix B and C), and peak flows are identified on Figure D1.1 (Appendix F).

Basin B

The proposed site development plan will minimize developed drainage impacts within Basin B along the north boundary of the site, as developed flows from the church building and parking areas will be conveyed southwesterly to Rain Garden A. Developed peak flows for Basin B are calculated as $Q_5 = 0.3$ cfs and $Q_{100} = 2.3$ cfs. Developed flows from Basins OB1 and B will continue to combine at Design Point #2, with peak flows calculated as $Q_5 = 0.4$ cfs and $Q_{100} = 1.9$ cfs (lower than existing conditions).

III. DRAINAGE PLANNING FOUR STEP PROCESS

El Paso County Drainage Criteria require drainage planning to include a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

As stated in ECM Appendix I.7., the Four Step Process is applicable to all new and re-development projects with construction activities that disturb 1 acre or greater or that

disturb less than 1 acre but are part of a larger common plan of development. The Four Step Process has been implemented as follows in the planning of this project:

Step 1: Employ Runoff Reduction Practices

- Rain Garden: The majority of developed flows will be routed through the on-site Rain Garden water quality facility, which will be vegetated to encourage stormwater infiltration.

Step 2: Stabilize Drainageways

- There are no drainageways directly adjacent to this project site. Implementation of the on-site drainage improvements and Rain Garden will minimize downstream drainage impacts from this site.
- Drainage basin fees were previously paid during recording of the subdivision plat, and these fees provided the applicable cost contribution towards regional drainage improvements.

Step 3: Provide Water Quality Capture Volume (WQCV)

- RG: The majority of the developed site will drain through an on-site Private Rain Garden (RG) along the south boundary of the property. The Rain Garden will capture and slowly release the WQCV over an extended release period.

Step 4: Consider Need for Industrial and Commercial BMPs

- No industrial uses are proposed for this site.
- The property owner will implement a Stormwater Management Plan including proper housekeeping practices and spill containment procedures.
- On-site developed drainage will be routed through the Rain Garden to minimize introduction of contaminants to the County's public drainage system.

IV. FLOODPLAIN IMPACTS

According to the FEMA floodplain map for this area, El Paso County FIRM Panel No. 08041C0287G, dated December 7, 2018, the site is located beyond the limits of any delineated floodplains.

V. STORMWATER DETENTION AND WATER QUALITY

Stormwater detention for this site is provided in the existing regional stormwater detention pond constructed during initial development of the Struthers Ranch Subdivision. The Struthers Ranch Homeowners Association is the owner of the existing Struthers Ranch Detention Pond located within Tract C, Struthers Ranch Filing No. 2. There currently appears to be a need for removal of excess vegetation within the pond to ensure proper operation of the detention facilities. The developer will need to coordinate with the HOA to ensure that the required maintenance is performed on the existing regional detention pond.

An on-site private Rain Garden will be constructed to meet stormwater quality requirements for this site in accordance with current El Paso County drainage criteria. As detailed in the Rain Garden calculations in Appendix D, the required Water Quality Capture Volume (WQCV) has been calculated as 0.13 acre-feet. The water quality capture volume has been calculated based on the actual impervious area of the proposed church site development within Basins A1-A2, along with the typical single-family residential impervious area of 40% within the adjoining developed Basins OA1-OA2, and a conservative estimated impervious area of 85% for the anticipated future commercial development within Basin A3. Water quality calculations have also accounted for future building improvements and future parking expansion areas within Basins A1-A2 as noted on the Developed Drainage Plan.

Please provide a copy of MHFD-Detention spreadsheet for design of rain garden

The proposed Rain Garden has been designed utilizing the Denver Mile High Flood District’s “UD-BMP_v3.07” software package. Calculations and details for the proposed Rain Garden are enclosed in Appendix D, and design parameters for the Rain Garden are summarized as follows:

| Water Quality Facility (RG) | Tributary Drainage Basins | Tributary Area (ac) | Impervious Percentage | Min. WQCV (cf) | Design Volume (af) |
|-----------------------------|---------------------------|---------------------|-----------------------|----------------|--------------------|
| A | A1-A4 | 4.79 | 65.8 | 3,579 | 3,817 |

The proposed on-site Rain Garden A provides a storage volume of 3,817 cubic feet, which meets the required WQCV volume.

Rain gardens have a release time of 12-hours. Please revise.

The proposed Rain Garden will include a concrete forebay for erosion control at the entry. The outlet structure has been designed with a water quality orifice plate to maintain a 40-hour release of the WQCV. The Rain Garden will have a vegetated bottom to encourage infiltration of stormwater prior to discharging into the downstream public drainage system.

The new on-site Rain Garden will be privately owned and maintained by the property owner, and maintenance access will be provided from the access drive at the southeast corner of the site.

VI. PUBLIC IMPROVEMENTS / DRAINAGE BASIN FEES

No public drainage improvements are required or proposed for this project. As detailed in Appendix E, the proposed private Rain Garden A has an estimated cost of approximately \$19,267.

The site lies completely within the Black Forest Creek Drainage Basin. Applicable drainage basin fees were paid at the time of original platting of Struthers Ranch Filing No. 2, so no drainage basin fees or bridge fees are applicable at this time.

VII. SUMMARY

The developed drainage patterns for the proposed Cathedral Rock Church site development on Tract A, Struthers Ranch Filing No. 2 will remain consistent with the established drainage plan for this subdivision. The grading and drainage plan for the proposed church site development fully conforms to the approved drainage plan for Struthers Ranch Filing No. 2.

Developed flows from the site will drain through a Private Rain Garden water quality facility along the south boundary of the property prior to discharging into the existing downstream public storm sewer system. Stormwater detention is provided by the existing Struthers Ranch Detention Pond which was designed to accept fully developed flows from the commercial area encompassing this site. The proposed on-site Rain Garden will meet current stormwater quality requirements for this site. Construction and proper maintenance of the on-site drainage facilities and Rain Garden, in conjunction with proper erosion control practices, will ensure that this developed site has no significant adverse drainage impact on downstream or surrounding areas.

APPENDIX A

EXCERPTS FROM SUBDIVISION DRAINAGE REPORT

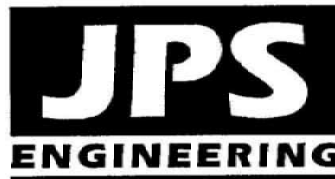
FINAL DRAINAGE REPORT
for
STRUTHERS RANCH FILING NO. 2

Prepared for:

WL Homes LLC
8610 Explorer Drive, Suite 300
Colorado Springs, CO 80920

November 6, 2003
Revised April 12, 2004
Revised May 7, 2004
Revised May 25, 2004
Revised September 3, 2004
Revised October 14, 2004

Prepared by:



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JPS Project No. 080006

11 15 2004

2959

2. Developed Drainage Conditions

The developed drainage basins and projected flows are shown in Figure D1, and preliminary hydrologic calculations are enclosed in Appendix B. The developed site has been divided into five major basins (A-E) and five design points (DP1-DP5), as shown on the enclosed Drainage Plan (Sheets D1 and D1.02). Hydrologic flow schematics and calculations are enclosed in Appendix B.

Struthers Ranch Filing No. 2 is located within parts of Basins C-F at the northwest corner of the site. The majority of developed areas ultimately flow to the proposed detention pond at Design Point No. 4. The internal road gutters of sub-basins D1-D10 will be graded to drain southwesterly through the interior road system. Storm inlets will be constructed in the interior roads as required to intercept developed flows exceeding the allowable street capacity. Storm sewer outfalls will be extended to the proposed detention pond.

To minimize the impacts of developed drainage from Struthers Ranch, flows from Basins C, D, and F will be routed through the proposed detention pond. Off-site Basins OC1 and OD1 will combine with flows from on-site Sub-basins D1-D10, C, E2, E3, and F at the proposed detention pond (Design Point #4), with developed flows of $Q_5 = 66$ cfs and $Q_{100} = 191$ cfs (SCS Method). The detention pond will discharge historic flows to the existing swale at the southerly site boundary, flowing into the existing 48-inch culvert crossing I-25. The proposed 48-inch RCP discharge pipe from the detention pond will be released to a riprap apron, flowing to an existing stable grass-lined swale across a parcel owned by the U.S Air Force Academy, ultimately crossing I-25 through the existing 48-inch CMP culvert.

The proposed site layout will significantly reduce the amount of developed flow reaching the existing 3.5'x2' culvert (Structure #11) at the westerly site boundary (Design Point #3). Flows from Sub-basin E4 ($Q_5 = 1.9$ cfs and $Q_{100} = 3.7$ cfs) represent the westerly side of the proposed Struthers Road draining to the existing culvert crossing I-25.

Basin E1 represents the small developed area at the northwest corner of the site, draining to the existing 4'x4' box culvert at Design Point #5. The proposed grading scheme for the commercial area north of Struthers Ranch Road will direct the majority of developed flows into Basin C, ultimately flowing to the proposed detention pond. As a result, developed flow impacts to the Jackson Creek Basin at the northwest corner of the site will be minimized. Estimated developed peak flows of $Q_5 = 4.6$ cfs and $Q_{100} = 8.9$ cfs at Design Point #5 remain within the capacity of the existing culvert.

C. Comparison of Developed to Historic Discharges

Based on the hydrologic calculations in Appendix B, the total undetained developed flow from the site will exceed historic flow from the parcel. Projected increases in developed flows will be mitigated by routing flows through a proposed on-site stormwater detention pond. The comparison of developed to historic discharges at key design points is summarized as follows:

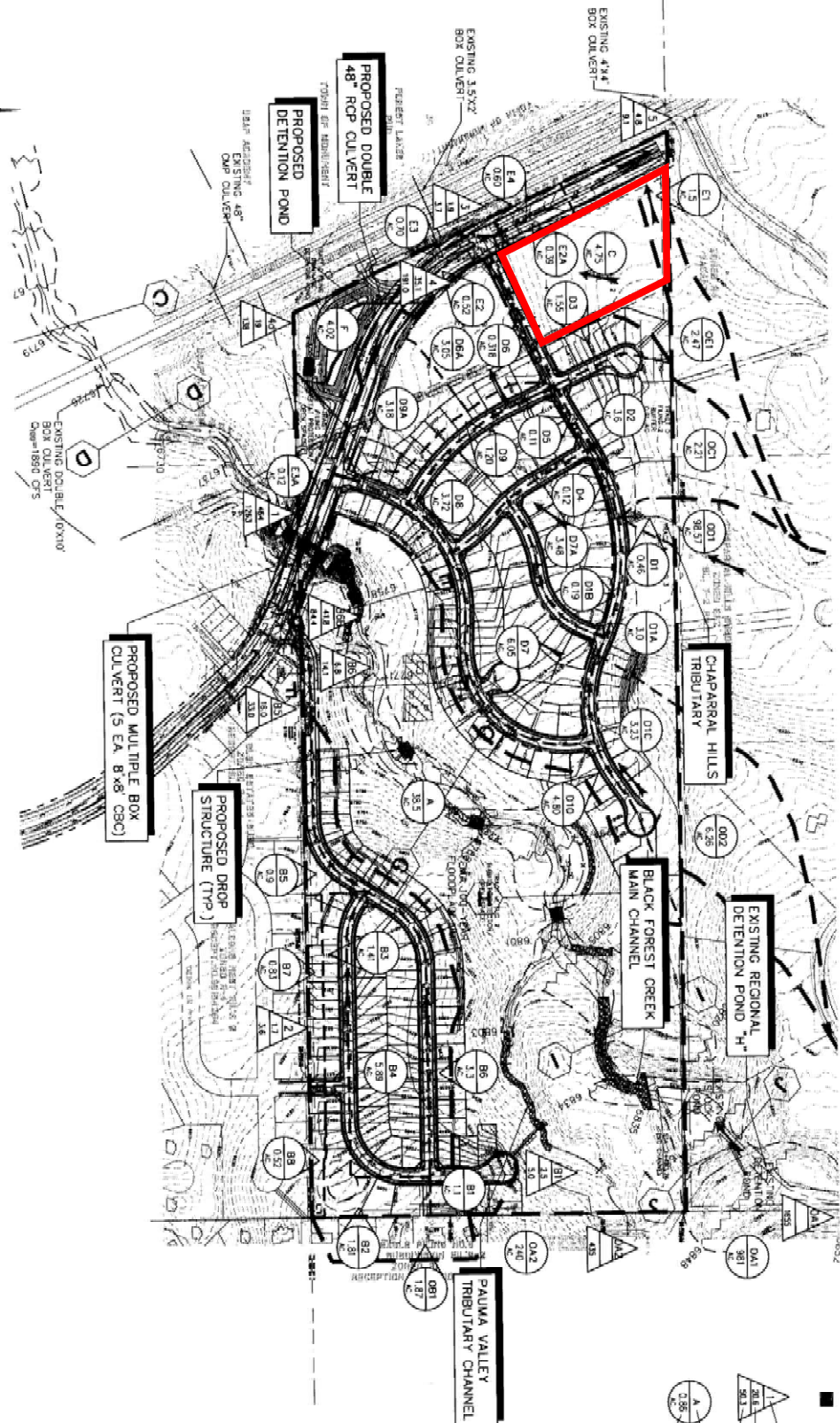
| Design Point | Historic Flow | | | Developed Flow | | | Comparison of Developed to Historic Flow (Q ₅ %/Q ₁₀₀ %) |
|--------------|---------------|----------------------|------------------------|----------------|----------------------|------------------------|--|
| | Area (ac) | Q ₅ (cfs) | Q ₁₀₀ (cfs) | Area (ac) | Q ₅ (cfs) | Q ₁₀₀ (cfs) | |
| 1 (SCS) | 1,266 | 473 | 1,281 | 1,274 | 464 | 1,263 | 98% / 99% (decrease) |
| 2 | 15.1 | 9.3 | 22.4 | 1.4 | 1.7 | 3.6 | 18% / 16% (decrease) |
| 3 | 16.0 | 9.9 | 24.0 | 0.6 | 1.9 | 3.7 | 19% / 15% (decrease) |
| 4 (SCS) | 133.6 | 50 | 148 | 155.4 | 66 | 191 | 132% / 129% (increase) |
| 5 | 6.8 | 8 | 9.2 | 4.0 | 4.6 | 8.9 | 121% / 99% (increase) |

D. Detention Ponds

The total developed storm runoff downstream of Struthers Ranch will be maintained at historic levels by routing flows through the proposed on-site detention pond located at the westerly boundary of the Struthers Ranch property (equivalent to "Detention Pond #11" as identified in the DBPS). The proposed detention facility will be sized to attenuate peak flows through the pond, based on the difference between outflow and inflow hydrographs. Flows from Basins C and D will be routed through the proposed detention pond at Design Point #4. The pond will be designed to "over-detain" to account for release of developed flows from Basins A and B, ensuring that the net discharge from the overall site will be maintained below historic levels.

As depicted on Sheet C1.02 (Appendix A), the proposed interim access connection from the I-25 Frontage Road to Struthers Road will bisect the pond, providing for a forebay at the upstream end of the pond. Once the interim access to the frontage road is abandoned, the maintenance access road will remain, and the forebay will continue to serve as a water quality enhancement feature. A detailed pond routing analysis utilizing the "Intelisolve Hydraflow" software package is enclosed in Appendix C1, resulting in the following pond design parameters:

| Pond | Pond Inflow (Q ₅ / Q ₁₀₀ , cfs) | Pond Outflow (Q ₅ / Q ₁₀₀ , cfs) | Pond Volume (ac-ft) |
|------------------|---|--|---------------------|
| DP4 ("Pond #11") | 35 / 191 | 19.3 / 138.4 | 4.7 |



- NOTES
1. DEVELOPMENT SHALL FOLLOW ALL REQUIREMENTS OF THE APPROVED HABITAT CONSERVATION PLAN (HCP) AND ASSOCIATED ENVIRONMENTAL PERMITS.
 2. PERMITS ORAINS SHALL BE REQUIRED FOR ALL HOMES WITH BASINMENTS.



STRUTHERS RANCH SUBDIVISION

DEVELOPED DRAINAGE PLAN

| No. | REVISION | BY | DATE |
|-----|---------------------|-----|---------|
| 1 | EPC COMMENTS | JPS | 4/8/04 |
| 2 | EPC COMMENTS | JPS | 5/7/04 |
| 3 | EPC COMMENTS | JPS | 5/25/04 |
| 4 | EPC COMMENTS | JPS | 9/2/04 |
| 5 | RE-SUBMITTAL TO EPC | JPS | 9/30/04 |

PROJECT: STRUTHERS RANCH SUBDIVISION
 SHEET: D1

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TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

| LAND USE OR SURFACE CHARACTERISTICS | PERCENT IMPERVIOUS | "C" FREQUENCY | | | |
|--|-----------------------|------------------|------|------|------|
| | | 10 | | 100 | |
| | | A&B* | C&D* | A&B* | C&D* |
| Business | | | | | |
| Commercial Areas | 95 | 0.90 | 0.90 | 0.90 | 0.90 |
| Neighborhood Areas | 70 | 0.75 | 0.75 | 0.80 | 0.80 |
| Residential | | | | | |
| 1/8 Acre or less | 65 | 0.60 | 0.70 | 0.70 | 0.80 |
| 1/4 Acre | 40 | 0.50 | 0.60 | 0.60 | 0.70 |
| 1/3 Acre | 30 | 0.40 | 0.50 | 0.55 | 0.60 |
| 1/2 Acre | 25 | 0.35 | 0.45 | 0.45 | 0.55 |
| 1 Acre | 20 | 0.30 | 0.40 | 0.40 | 0.50 |
| Industrial | | | | | |
| Light Areas | 80 | 0.70 | 0.70 | 0.80 | 0.80 |
| Heavy Areas | 90 | 0.80 | 0.80 | 0.90 | 0.90 |
| Parks and Cemeteries | | | | | |
| Park Areas | 7 | 0.30 | 0.35 | 0.55 | 0.60 |
| Playgrounds | 13 | 0.30 | 0.35 | 0.60 | 0.65 |
| Railroad Yard Areas | 40 | 0.50 | 0.55 | 0.60 | 0.65 |
| Undeveloped Areas | | | | | |
| Historic Flow Analysis- Greenbelts, Agricultural | 2 | 0.15 | 0.25 | 0.20 | 0.30 |
| Pasture/Meadow | 0 | 0.25 | 0.30 | 0.35 | 0.45 |
| Forest | 0 | 0.10 | 0.15 | 0.15 | 0.20 |
| Exposed Rock | 100 | 0.90 | 0.90 | 0.95 | 0.95 |
| Offsite Flow Analysis (when land use not defined) | 45 | 0.55 | 0.60 | 0.65 | 0.70 |
| Streets | | | | | |
| Paved | 100 | 0.90 | 0.90 | 0.95 | 0.95 |
| Gravel | 80 | 0.80 | 0.80 | 0.85 | 0.85 |
| Drive and Walks | | | | | |
| Drive and Walks | 100 | 0.90 | 0.90 | 0.95 | 0.95 |
| Roofs | 90 | 0.90 | 0.90 | 0.95 | 0.95 |
| Lawns | 0 | 0.25 | 0.30 | 0.35 | 0.45 |

* Hydrologic Soil Group

9/30/90

(EPC-DCM)

STRUTHERS RANCH
COMPOSITE RUNOFF COEFFICIENTS

| DEVELOPED CONDITIONS | | | | | | | | | | | | |
|----------------------|-----------------|-----------|-------|-------------------------------|------|-----------|-------------------------------|------|------|-------------------------------|---|------------------|
| 5-YEAR C VALUES | | | | | | | | | | | | |
| BASIN | TOTAL AREA (AC) | SOIL TYPE | (AC) | SUB-AREA 1 DEVELOPMENT/ COVER | C | AREA (AC) | SUB-AREA 2 DEVELOPMENT/ COVER | C | (AC) | SUB-AREA 3 DEVELOPMENT/ COVER | C | WEIGHTED C VALUE |
| OA1 | 981 | B | 981 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| OA2 | 240 | B | 240 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| OA1,OA2 | 1221 | | | | | | | | | | | 0.500 |
| B1 | 1.1 | B | 1.1 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| A | 38.5 | B | 38.5 | OPEN SPACE | 0.25 | | | | | | | 0.250 |
| OA1,OA2,B1,A | 1260.6 | | | | | | | | | | | 0.492 |
| OB1 | 1.87 | B | 1.87 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| B2 | 1.81 | B | 1.81 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| B3 | 1.4 | B | 1.41 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| B4 | 5.8 | B | 5.8 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| OB1,B2-B4 | 10.9 | | | | | | | | | | | 0.500 |
| B5 | 0.9 | B | 0.9 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| OB1,B2-B5 | 11.8 | | | | | | | | | | | 0.500 |
| B6 | 3.3 | B | 3.3 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| OB1,B2-B6 | 15.1 | | | | | | | | | | | 0.500 |
| OA1,OA2,A,B1-B6 | 1275.7 | | | | | | | | | | | 0.492 |
| B7 | 0.83 | B | 0.83 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| B8 | 0.52 | B | 0.52 | 0.25-AC LOTS | 0.5 | | | | | | | 0.500 |
| B7,B8 | 1.4 | | | | | | | | | | | 0.500 |
| E4 | 0.6 | B | 0.34 | PAVED | 0.9 | 0.3 | LANDSCAPE | 0.25 | | | | 0.618 |
| OD1 | 98.57 | B | 98.57 | 5-AC LOTS | 0.3 | | | | | | | 0.300 |
| D1 | 0.46 | B | 0.46 | MEADOW | 0.25 | | | | | | | 0.250 |
| OD1,D1 | 99.03 | | | | | | | | | | | 0.300 |

| | | | | | | | | | | | |
|----------------------|--------|---|-------|--------------|------|-----|------------|------|--|--|-------|
| OD2 | 6.26 | B | 6.26 | 5-AC LOTS | 0.3 | | | | | | 0.300 |
| D1C | 3.23 | B | 1.5 | 0.25-AC LOTS | 0.5 | 1.7 | OPEN SPACE | 0.25 | | | 0.366 |
| OD2,D1C | 9.49 | | | | | | | | | | 0.322 |
| D1A | 3.00 | B | 0.8 | 0.25-AC LOTS | 0.5 | 2.2 | PARK / OS | 0.25 | | | 0.317 |
| OD2,D1C,D1A | 12.49 | | | | | | | | | | 0.321 |
| D1B | 0.19 | B | 0.19 | ROADWAY | 0.9 | | | | | | 0.900 |
| OD1,D1,D1A,D1B | 111.71 | | | | | | | | | | 0.303 |
| D4 | 0.12 | B | 0.12 | ROADWAY | 0.9 | | | | | | 0.900 |
| OD1,D1,D1A,D1B,D4 | 111.83 | | | | | | | | | | 0.304 |
| D5 | 0.11 | B | 0.11 | ROADWAY | 0.9 | | | | | | 0.900 |
| OD1,D1,D1A,D1B,D4,D5 | 111.94 | | | | | | | | | | 0.304 |
| D6 | 0.32 | B | 0.318 | ROADWAY | 0.9 | | | | | | 0.900 |
| OD1,D1,D1A,D1B,D4-D6 | 112.26 | | | | | | | | | | 0.306 |
| OC1 | 2.21 | B | 2.21 | 5-AC LOTS | 0.3 | | | | | | 0.300 |
| D2 | 3.60 | B | 3.6 | 0.25-AC LOTS | 0.5 | | | | | | 0.500 |
| OC1,D2 | 5.81 | | | | | | | | | | 0.424 |
| E2A | 0.39 | B | 0.3 | PAVED | 0.9 | 0.1 | LANDSCAPE | 0.25 | | | 0.750 |
| D3 | 1.55 | B | 1.55 | 0.25-AC LOTS | 0.5 | | | | | | 0.500 |
| C | 4.75 | B | 4.75 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| D3,C | 6.30 | | | | | | | | | | 0.802 |
| OD1,OC1,C,E2A,D1-D6 | 124.76 | | | | | | | | | | 0.338 |
| E2 | 0.52 | B | 0.4 | PAVED | 0.9 | 0.1 | LANDSCAPE | 0.25 | | | 0.750 |
| D6A | 3.00 | B | 3 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| OD1,OC1,C,D1-D6A | 128.28 | | | | | | | | | | 0.350 |
| D7A | 3.48 | B | 3.48 | 0.25-AC LOTS | 0.5 | | | | | | 0.500 |
| D7 | 6.05 | B | 6.05 | 0.25-AC LOTS | 0.5 | | | | | | 0.500 |
| D7A,D7 | 9.53 | | | | | | | | | | 0.500 |
| D8 | 3.72 | B | 3.72 | 0.25-AC LOTS | 0.5 | | | | | | 0.500 |
| D7A,D7,D8 | 13.25 | | | | | | | | | | 0.500 |
| D9 | 1.20 | B | 1.2 | 0.25-AC LOTS | 0.5 | | | | | | 0.500 |
| D7A-D9 | 14.45 | | | | | | | | | | 0.500 |
| E3A | 0.12 | B | 0.12 | MEDIAN | 0.25 | | | | | | 0.250 |
| D10 | 4.80 | B | 4.8 | 0.25-AC LOTS | 0.5 | | | | | | 0.500 |
| D7A-D10,E3A | 19.37 | | | | | | | | | | 0.498 |
| D9A | 3.18 | B | 3.18 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| D7A-D10,E3A | 22.55 | | | | | | | | | | 0.555 |
| E3 | 0.70 | B | 0.5 | PAVED | 0.9 | 0.2 | LANDSCAPE | 0.25 | | | 0.714 |
| F | 4.02 | B | 4.02 | OPEN SPACE | 0.25 | | | | | | 0.250 |
| OD1,C,D1-D10,E2-E3,F | 155.55 | B | | | | | | | | | 0.379 |
| OE1 | 2.47 | B | 2.47 | 5-AC LOTS | 0.3 | | | | | | 0.300 |
| E1 | 1.5 | B | 1.5 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| OE1,E1 | 4.0 | | | | | | | | | | 0.527 |

STRUTHERS RANCH
COMPOSITE RUNOFF COEFFICIENTS

| DEVELOPED CONDITIONS | | | | | | | | | | | | |
|----------------------|-----------------|-----------|-------|------------------------------|------|-----------|------------------------------|------|------|------------------------------|---|------------------|
| 100-YEAR C VALUES | | | | | | | | | | | | |
| BASIN | TOTAL AREA (AC) | SOIL TYPE | (AC) | SUB-AREA 1 DEVELOPMENT/COVER | C | AREA (AC) | SUB-AREA 2 DEVELOPMENT/COVER | C | (AC) | SUB-AREA 3 DEVELOPMENT/COVER | C | WEIGHTED C VALUE |
| OA1 | 981 | B | 981 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| OA2 | 240 | B | 240 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| OA1,OA2 | 1221 | | | | | | | | | | | 0.600 |
| B1 | 1.1 | B | 1.1 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| A | 38.5 | B | 38.5 | OPEN SPACE | 0.35 | | | | | | | 0.350 |
| OA1,OA2,B1,A | 1260.6 | | | | | | | | | | | 0.592 |
| OB1 | 1.87 | B | 1.87 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| B2 | 1.81 | B | 1.81 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| B3 | 1.4 | B | 1.41 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| B4 | 5.8 | B | 5.8 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| OB1,B2-B4 | 10.9 | | | | | | | | | | | 0.600 |
| B5 | 0.9 | B | 0.9 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| OB1,B2-B5 | 11.8 | | | | | | | | | | | 0.600 |
| B6 | 3.3 | B | 3.3 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| OB1,B2-B6 | 15.1 | | | | | | | | | | | 0.600 |
| OA1,OA2,A,B1-B6 | 1275.7 | | | | | | | | | | | 0.592 |
| B7 | 0.83 | B | 0.83 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| B8 | 0.52 | B | 0.52 | 0.25-AC LOTS | 0.6 | | | | | | | 0.600 |
| B7,B8 | 1.4 | | | | | | | | | | | 0.600 |
| E4 | 0.6 | B | 0.34 | PAVED | 0.95 | 0.3 | LANDSCAPE | 0.35 | | | | 0.690 |
| OD1 | 98.57 | B | 98.57 | 5-AC LOTS | 0.4 | | | | | | | 0.400 |
| D1 | 0.46 | B | 0.46 | MEADOW | 0.35 | | | | | | | 0.350 |
| OD1,D1 | 99.03 | | | | | | | | | | | 0.400 |

| | | | | | | | | | | | |
|----------------------|--------|---|-------|--------------|------|-----|------------|------|--|--|-------|
| OD2 | 6.26 | B | 6.26 | 5-AC LOTS | 0.4 | | | | | | 0.400 |
| D1C | 3.23 | B | 1.5 | 0.25-AC LOTS | 0.6 | 1.7 | OPEN SPACE | 0.35 | | | 0.466 |
| OD2,D1C | 9.49 | | | | | | | | | | 0.422 |
| D1A | 3.00 | B | 0.8 | 0.25-AC LOTS | 0.6 | 2.2 | PARK / OS | 0.35 | | | 0.417 |
| OD2,D1C,D1A | 12.49 | | | | | | | | | | 0.421 |
| D1B | 0.19 | B | 0.19 | ROADWAY | 0.95 | | | | | | 0.950 |
| OD1,D1,D1A,D1B | 111.71 | | | | | | | | | | 0.403 |
| D4 | 0.12 | B | 0.12 | ROADWAY | 0.95 | | | | | | 0.950 |
| OD1,D1,D1A,D1B,D4 | 111.83 | | | | | | | | | | 0.404 |
| D5 | 0.11 | B | 0.11 | ROADWAY | 0.95 | | | | | | 0.950 |
| OD1,D1,D1A,D1B,D4,D5 | 111.94 | | | | | | | | | | 0.404 |
| D6 | 0.32 | B | 0.318 | ROADWAY | 0.95 | | | | | | 0.950 |
| OD1,D1,D1A,D1B,D4-D6 | 112.26 | | | | | | | | | | 0.406 |
| OC1 | 2.21 | B | 2.21 | 5-AC LOTS | 0.4 | | | | | | 0.400 |
| D2 | 3.60 | B | 3.6 | 0.25-AC LOTS | 0.6 | | | | | | 0.600 |
| OC1,D2 | 5.81 | | | | | | | | | | 0.524 |
| E2A | 0.39 | B | 0.3 | PAVED | 0.95 | 0.1 | LANDSCAPE | 0.35 | | | 0.812 |
| D3 | 1.55 | B | 1.55 | 0.25-AC LOTS | 0.6 | | | | | | 0.600 |
| C | 4.75 | B | 4.75 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| D3,C | 6.30 | | | | | | | | | | 0.826 |
| OD1,OC1,C,E2A,D1-D6 | 124.76 | | | | | | | | | | 0.434 |
| E2 | 0.52 | B | 0.4 | PAVED | 0.95 | 0.1 | LANDSCAPE | 0.35 | | | 0.812 |
| D6A | 3.00 | B | 3 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| OD1,OC1,C,D1-D6A | 128.28 | | | | | | | | | | 0.443 |
| D7A | 3.48 | B | 3.48 | 0.25-AC LOTS | 0.6 | | | | | | 0.600 |
| D7 | 6.05 | B | 6.05 | 0.25-AC LOTS | 0.6 | | | | | | 0.600 |
| D7A,D7 | 9.53 | | | | | | | | | | 0.600 |
| D8 | 3.72 | B | 3.72 | 0.25-AC LOTS | 0.6 | | | | | | 0.600 |
| D7A,D7,D8 | 13.25 | | | | | | | | | | 0.600 |
| D9 | 1.20 | B | 1.2 | 0.25-AC LOTS | 0.6 | | | | | | 0.600 |
| D7A-D9 | 14.45 | | | | | | | | | | 0.600 |
| E3A | 0.12 | B | 0.12 | MEDIAN | 0.35 | | | | | | 0.350 |
| D10 | 4.80 | B | 4.8 | 0.25-AC LOTS | 0.6 | | | | | | 0.600 |
| D7A-D10,E3A | 19.37 | | | | | | | | | | 0.598 |
| D9A | 3.18 | B | 3.18 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| D7A-D10,E3A | 22.55 | | | | | | | | | | 0.641 |
| E3 | 0.70 | B | 0.5 | PAVED | 0.95 | 0.2 | LANDSCAPE | 0.35 | | | 0.779 |
| F | 4.02 | B | 4.02 | OPEN SPACE | 0.35 | | | | | | 0.350 |
| OD1,C,D1-D10,E2-E3,F | 155.55 | B | | | | | | | | | 0.471 |
| OE1 | 2.47 | B | 2.47 | 5-AC LOTS | 0.4 | | | | | | 0.400 |
| E1 | 1.5 | B | 1.5 | COMMERCIAL | 0.9 | | | | | | 0.900 |
| OE1,E1 | 4.0 | | | | | | | | | | 0.589 |

STRUTHERS RANCH
RATIONAL METHOD - DRAINAGE CALCULATIONS

DEVELOPED FLOWS

| BASIN | DESIGN POINT | AREA (AC) | C | | OVERLAND LENGTH (FT) | SLOPE (%) | T _{co} ⁽¹⁾ (MIN) | CHANNEL LENGTH (FT) | CONVEYANCE COEFFICIENT K | SLOPE (%) | SCS ⁽²⁾ VELOCITY (FT/S) | T _t ⁽³⁾ (MIN) | TOTAL T _c ⁽⁴⁾ (MIN) | INTENSITY ⁽⁵⁾ | | PEAK FLOW | |
|---------------------------|--------------|-----------|-----------------------|-------------------------|----------------------|-----------|--------------------------------------|---------------------|--------------------------|-----------|------------------------------------|-------------------------------------|---|--------------------------|----------------|-------------------------|---------------------------|
| | | | 5-YEAR ⁽⁷⁾ | 100-YEAR ⁽⁷⁾ | | | | | | | | | | 5-YR (IN/HR) | 100-YR (IN/HR) | Q5 ⁽⁶⁾ (CFS) | Q100 ⁽⁶⁾ (CFS) |
| OA1 | | 981.00 | 0.500 | 0.600 | 300 | 5.4 | 10.7 | 11900 | 1.50 | 5.4 | 3.49 | 56.9 | 67.6 | 1.50 | 2.65 | 735.75 | 1559.79 |
| OA2 | | 240.00 | 0.500 | 0.600 | 300 | 5.5 | 10.6 | 620 | 1.50 | 5.5 | 3.52 | 2.9 | 13.5 | 3.60 | 6.10 | 432.00 | 878.40 |
| OA1, OA2 | OA1 | 1221.00 | 0.500 | 0.600 | | | | | | | | | 67.6 | 1.50 | 2.65 | 915.75 | 1941.39 |
| B1 | B1 | 1.10 | 0.500 | 0.600 | 250 | 12.8 | 7.3 | 0 | | | | 0.0 | 7.3 | 4.50 | 7.60 | 2.48 | 5.02 |
| A | | 38.50 | 0.250 | 0.350 | 0 | | 0.0 | 2730 | 1.50 | 3.2 | 2.68 | 17.0 | 17.0 | 3.20 | 5.50 | 30.80 | 74.11 |
| OA1, OA2, B1, A | | 1260.60 | 0.492 | 0.592 | | | | | | | | | 84.5 | 1.50 | 2.65 | 930.32 | 1977.63 |
| B2 | | 1.81 | 0.500 | 0.600 | 150 | 5.3 | 7.6 | 450 | 2.00 | 4.9 | 4.43 | 1.7 | 9.3 | 4.10 | 7.10 | 3.71 | 7.71 |
| B3 | | 1.41 | 0.500 | 0.600 | 0 | | 0.0 | 700 | 2.00 | 3 | 3.46 | 3.4 | 3.4 | 5.20 | 9.00 | 3.67 | 7.61 |
| B4 | | 5.89 | 0.500 | 0.600 | 0 | | 0.0 | 1180 | 2.00 | 3.7 | 3.85 | 5.1 | 5.1 | 5.20 | 9.00 | 15.31 | 31.81 |
| OB1, B2, B3, B4 | B3 | 9.11 | 0.500 | 0.600 | | | | | | | | | 12.7 | 3.70 | 6.20 | 16.85 | 33.89 |
| B5 | | 0.90 | 0.500 | 0.600 | 0 | | 0.0 | 1000 | 2.00 | 3.3 | 3.63 | 4.6 | 4.6 | 5.20 | 9.00 | 2.34 | 4.86 |
| OB1, B2, B5 | B5 | 10.01 | 0.500 | 0.600 | | | | | | | | | 17.2 | 3.20 | 5.50 | 16.02 | 33.03 |
| B6 | B6 | 3.30 | 0.500 | 0.600 | 0 | | 0.0 | 2100 | 2.00 | 3.7 | 3.85 | 9.1 | 9.1 | 4.10 | 7.10 | 6.77 | 14.06 |
| OB1, B2, B6 | B6A | 13.31 | 0.500 | 0.600 | | | | | | | | | 17.2 | 3.20 | 5.50 | 21.30 | 43.92 |
| B6A | B6B | | | | | | | | | | | | | | | 41.80 | 84.40 |
| OA1, OA2, A, B1, B6 | 1 | 1273.9 | 0.492 | 0.592 | | | | | | | | | 84.5 | 1.50 | 2.65 | 940.15 | 1998.51 |
| B7 | | 0.83 | 0.500 | 0.600 | 150 | 4.0 | 8.3 | 0 | | | | 0.0 | 8.3 | 4.25 | 7.50 | 1.76 | 3.74 |
| B8 | | 0.52 | 0.500 | 0.600 | 850 | 5.5 | 17.8 | 0 | | | | 0.0 | 17.8 | 3.10 | 5.20 | 0.81 | 1.62 |
| B7, B8 | 2 | 1.35 | 0.500 | 0.600 | | | | | | | | | 26.2 | 2.50 | 4.40 | 1.69 | 3.56 |
| E4 | 3 | 0.60 | 0.618 | 0.690 | 0 | | 0.0 | 450 | 1.50 | 5.5 | 3.52 | 2.1 | 2.1 | 5.20 | 9.00 | 1.93 | 3.73 |
| OD1 | | 98.57 | 0.300 | 0.400 | 1000 | 10.0 | 21.2 | 3300 | 1.50 | 3.9 | 2.96 | 18.6 | 39.7 | 1.90 | 3.40 | 56.18 | 134.06 |
| D1 | | 0.46 | 0.250 | 0.350 | 0 | | 0.0 | 180 | 1.50 | 2.5 | 2.37 | 1.3 | 1.3 | | | | |
| OD1, D1 | D1 | 99.03 | 0.300 | 0.400 | | | | | | | | | 41.0 | 1.90 | 3.40 | 56.45 | 134.68 |
| OD2 | | 6.26 | 0.300 | 0.400 | 1000 | 3.5 | 30.0 | 0 | | | | 0.0 | 30.0 | 2.35 | 4.10 | 4.41 | 10.27 |
| D1C | | 3.23 | 0.366 | 0.466 | 0 | | 0.0 | 700 | 2.00 | 3.4 | 3.69 | 3.2 | 3.2 | | | | |
| OD2, D1C | D1C | 9.49 | 0.322 | 0.422 | | | | | | | | | 33.2 | 2.20 | 3.85 | 6.72 | 15.42 |
| D1A | | 3.00 | 0.317 | 0.417 | 0 | | 0.0 | 370 | 2.00 | 2.7 | 3.29 | 1.9 | 1.9 | | | | |
| OD2, D1C, D1A | D1A | 12.49 | 0.321 | 0.421 | | | | | | | | | 35.0 | 2.10 | 3.75 | 8.42 | 19.72 |
| D1B | D1B | 0.19 | 0.900 | 0.950 | 0 | | 0.0 | 420 | 2.00 | 1.6 | 2.53 | 2.8 | 2.8 | 5.20 | 9.00 | 0.89 | 1.62 |
| OD1, D1, D1A, D1B | D1A1 | 111.71 | 0.303 | 0.403 | | | | | | | | | 41.0 | 1.90 | 3.40 | 64.31 | 153.07 |
| D4 | D4 | 0.12 | 0.900 | 0.950 | 0 | | 0.0 | 700 | 2.00 | 1.56 | 2.50 | 4.7 | 4.7 | 5.20 | 9.00 | 0.56 | 1.03 |
| OD1, D1, D1A, D1B, D4 | D4A | 111.83 | 0.304 | 0.404 | | | | | | | | | 45.7 | 1.75 | 3.20 | 64.87 | 154.09 |
| D5 | D5 | 0.11 | 0.900 | 0.950 | 0 | | 0.0 | 250 | 2.00 | 3.27 | 3.62 | 1.2 | 1.2 | 5.20 | 9.00 | 0.51 | 0.94 |
| OD1, D1, D1A, D1B, D4, D5 | D5A | 111.94 | 0.304 | 0.404 | | | | | | | | | 46.8 | 1.70 | 3.15 | 65.39 | 155.03 |
| D6 | D6 | 0.32 | 0.900 | 0.950 | 0 | | 0.0 | 480 | 2.00 | 4.44 | 4.21 | 1.9 | 1.9 | 5.20 | 9.00 | 1.49 | 2.72 |
| OD1, D1, D1A, D1B, D4, D6 | D6A1 | 112.26 | 0.306 | 0.406 | | | | | | | | | 48.7 | 1.70 | 3.00 | 66.88 | 157.75 |

| BASIN | DESIGN POINT | AREA (AC) | C | | OVERLAND LENGTH (FT) | SLOPE (%) | T _{CO} ⁽¹⁾ (MIN) | CHANNEL LENGTH (FT) | CONVEYANCE COEFFICIENT K | SLOPE (%) | SCS ⁽²⁾ VELOCITY (FT/S) | T _T ⁽³⁾ (MIN) | TOTAL T _C ⁽⁴⁾ (MIN) | INTENSITY ⁽⁵⁾ | | PEAK FLOW | |
|--------------------------|--------------|-----------|-----------------------|-------------------------|----------------------|-----------|--------------------------------------|---------------------|--------------------------|-----------|------------------------------------|-------------------------------------|---|--------------------------|----------------|-------------------------|---------------------------|
| | | | 5-YEAR ⁽⁷⁾ | 100-YEAR ⁽⁷⁾ | | | | | | | | | | 5-YR (IN/HR) | 100-YR (IN/HR) | Q5 ⁽⁶⁾ (CFS) | Q100 ⁽⁶⁾ (CFS) |
| OC1 | | 2.21 | 0.300 | 0.400 | 550 | 3.3 | 22.7 | | | | | 0.0 | 22.7 | 2.70 | 4.70 | 1.79 | 4.15 |
| D2 | | 3.60 | 0.500 | 0.600 | 0 | | 0.0 | 600 | 2.00 | 3.6 | 3.79 | 2.6 | 2.6 | | | | |
| OC1,D2 | D2 | 5.81 | 0.424 | 0.524 | | | | | | | | | 25.3 | 2.60 | 4.50 | 6.40 | 13.70 |
| E2A | E2A | 0.39 | 0.750 | 0.812 | 0 | | 0.0 | 300 | 1.50 | 4 | 3.00 | 1.7 | 1.7 | 5.20 | 9.00 | 1.52 | 2.85 |
| D3 | | 1.55 | 0.500 | 0.600 | 0 | | 0.0 | 580 | 2.00 | 4.3 | 4.15 | 2.3 | 2.3 | 5.20 | 9.00 | 4.03 | 8.37 |
| C | | 4.75 | 0.900 | 0.900 | 0 | | 0.0 | 750 | 2.00 | 3.3 | 3.63 | 3.4 | 3.4 | 5.20 | 9.00 | 22.23 | 38.48 |
| D3,C | C | 6.30 | 0.802 | 0.826 | | | | | | | | | 5.8 | 5.00 | 8.50 | 25.26 | 44.23 |
| OD1,OC1,E2A,C,D1-D6 | C1 | 124.76 | 0.338 | 0.434 | | | | | | | | | 48.7 | 1.70 | 3.00 | 71.69 | 162.43 |
| E2 | | 0.52 | 0.750 | 0.812 | 0 | | 0.0 | 300 | 1.50 | 4 | 3.00 | 1.7 | 1.7 | 5.20 | 9.00 | 2.03 | 3.80 |
| D6A | D6A | 3.00 | 0.900 | 0.900 | 0 | | 0.0 | 470 | 2.00 | 3.4 | 3.69 | 2.1 | 2.1 | 5.20 | 9.00 | 14.04 | 24.30 |
| OD1,OC1,C,D1-D6A | D6A2 | 128.28 | 0.350 | 0.443 | | | | | | | | | 50.8 | 1.60 | 2.90 | 71.84 | 164.80 |
| D7A | D7A | 3.48 | 0.500 | 0.600 | 0 | | 0.0 | 950 | 2.00 | 1.68 | 2.59 | 6.1 | 6.1 | 5.00 | 8.50 | 8.70 | 17.75 |
| D7 | | 6.05 | 0.500 | 0.600 | 0 | | 0.0 | 1244 | 2.00 | 2.17 | 2.95 | 7.0 | 7.0 | 4.60 | 8.00 | 13.92 | 29.04 |
| D7A,D7 | D7 | 9.53 | 0.500 | 0.600 | | | | | | | | | 7.0 | 4.60 | 8.00 | 21.92 | 45.74 |
| D8 | D8 | 3.72 | 0.500 | 0.600 | 0 | | 0.0 | 225 | 2.00 | 3.4 | 3.69 | 1.0 | 1.0 | 5.20 | 9.00 | 9.67 | 20.09 |
| D7A-D8 | D8A | 13.25 | 0.500 | 0.600 | | | | | | | | | 8.1 | 4.40 | 7.50 | 29.15 | 59.63 |
| D9 | D9 | 1.20 | 0.500 | 0.600 | 0 | | 0.0 | 210 | 2.00 | 3.4 | 3.69 | 0.9 | 0.9 | 5.20 | 9.00 | 3.12 | 6.48 |
| D7A-D9 | D9A | 14.45 | 0.500 | 0.600 | | | | | | | | | 9.0 | 4.20 | 7.20 | 30.35 | 62.42 |
| E3A | E3A | 0.12 | 0.250 | 0.350 | 0 | | 0.0 | 220 | 1.50 | 4.3 | 3.11 | 1.2 | 1.2 | 5.20 | 9.00 | 0.16 | 0.38 |
| D10 | D10 | 4.80 | 0.500 | 0.600 | 300 | 4.0 | 11.8 | 1820 | 2.00 | 3 | 3.46 | 8.8 | 20.5 | 2.95 | 5.05 | 7.08 | 14.54 |
| D10A | D10A | 0.23 | 0.500 | 0.600 | 0 | | 0.0 | 200 | 1.50 | 0.5 | 1.06 | 3.1 | 3.1 | 5.20 | 9.00 | 0.60 | 1.24 |
| D7A-D10,E3A | D10B | 19.37 | 0.498 | 0.598 | | | | | | | | | 20.5 | 2.95 | 5.05 | 28.46 | 58.50 |
| D9A | | 3.18 | 0.900 | 0.900 | 0 | | 0.0 | 620 | 1.50 | 0.5 | 1.06 | 9.7 | 9.7 | 5.20 | 9.00 | 14.88 | 25.76 |
| D7A-D10,E3A | D9B | 22.55 | 0.555 | 0.641 | | | | | | | | | 30.3 | 2.30 | 4.05 | 28.79 | 58.54 |
| E3 | E3 | 0.70 | 0.714 | 0.779 | 0 | | 0.0 | 620 | 1.50 | 0.8 | 1.34 | 7.7 | 7.7 | 4.40 | 7.50 | 2.20 | 4.09 |
| F | | 4.02 | 0.250 | 0.350 | 0 | | 0.0 | 570 | 1.50 | 1.0 | 1.50 | 6.3 | 6.3 | 5.00 | 8.50 | 5.03 | 11.96 |
| OD1,OC1,C,D1-D10,E2-E3,F | 4 | 155.55 | 0.379 | 0.471 | | | | | | | | | 50.8 | 1.60 | 2.90 | 94.32 | 212.46 |
| OE1 | | 2.47 | 0.300 | 0.400 | 850 | 2.8 | 29.8 | 0 | | | | 0.0 | 29.8 | 2.35 | 4.10 | 1.74 | 4.05 |
| E1 | | 1.50 | 0.900 | 0.900 | 0 | | 0.0 | 700 | 2.00 | 2.3 | 3.03 | 3.8 | 3.8 | 5.20 | 9.00 | 7.02 | 12.15 |
| OE1,E1 | 5 | 3.97 | 0.527 | 0.589 | | | | | | | | | 33.6 | 2.20 | 3.80 | 4.60 | 8.89 |

1) OVERLAND FLOW T_{CO} = (1.87 * (1.1 - RUNOFF COEFFICIENT) * (OVERLAND FLOW LENGTH^{0.5}) / (SLOPE^{0.333}))

2) SCS VELOCITY = K * ((SLOPE(%))^{0.5})

K = 0.70 FOR MEADOW / FOREST

K = 1.0 FOR BARE SOIL

K = 1.5 FOR GRASS CHANNEL

K = 2.0 FOR PAVEMENT

3) GUTTER/SWALE FLOW, TRAVEL TIME, T_T = (CHANNEL LENGTH / SCS VELOCITY) / 60 SEC

4) T_C = T_{CO} + T_T

*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED

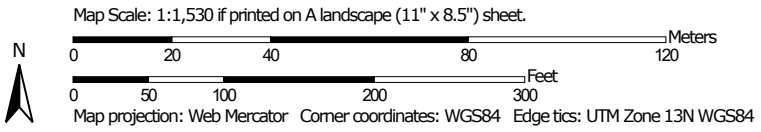
5) INTENSITY BASED ON I-D-F CURVE IN EL PASO COUNTY DRAINAGE CRITERIA MANUAL

6) Q = C_IA

7) WEIGHTED AVERAGE C VALUES FOR COMBINED BASINS

APPENDIX B
HYDROLOGIC CALCULATIONS

Hydrologic Soil Group—El Paso County Area, Colorado
(Cathedral Rock Church)



Hydrologic Soil Group—El Paso County Area, Colorado
(Cathedral Rock Church)

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 21, Aug 24, 2023

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 |
|------------------------------------|--|--------|--------------|----------------|
| 68 | Peyton-Pring complex, 3 to 8 percent slopes | B | 1.3 | 25.1% |
| 71 | Pring coarse sandy loam, 3 to 8 percent slopes | B | 3.9 | 74.9% |
| Totals for Area of Interest | | | 5.2 | 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

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

| Land Use or Surface Characteristics | Percent Impervious | Runoff Coefficients | | | | | | | | | | | |
|--|--------------------|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---------|
| | | 2-year | | 5-year | | 10-year | | 25-year | | 50-year | | 100-year | |
| | | HSG A&B | HSG C&D | HSG A&B | HSG C&D | HSG A&B | HSG C&D | HSG A&B | HSG C&D | HSG A&B | HSG C&D | HSG A&B | HSG C&D |
| Business | | | | | | | | | | | | | |
| Commercial Areas | 95 | 0.79 | 0.80 | 0.81 | 0.82 | 0.83 | 0.84 | 0.85 | 0.87 | 0.87 | 0.88 | 0.88 | 0.89 |
| Neighborhood Areas | 70 | 0.45 | 0.49 | 0.49 | 0.53 | 0.53 | 0.57 | 0.58 | 0.62 | 0.60 | 0.65 | 0.62 | 0.68 |
| Residential | | | | | | | | | | | | | |
| 1/8 Acre or less | 65 | 0.41 | 0.45 | 0.45 | 0.49 | 0.49 | 0.54 | 0.54 | 0.59 | 0.57 | 0.62 | 0.59 | 0.65 |
| 1/4 Acre | 40 | 0.23 | 0.28 | 0.30 | 0.35 | 0.36 | 0.42 | 0.42 | 0.50 | 0.46 | 0.54 | 0.50 | 0.58 |
| 1/3 Acre | 30 | 0.18 | 0.22 | 0.25 | 0.30 | 0.32 | 0.38 | 0.39 | 0.47 | 0.43 | 0.52 | 0.47 | 0.57 |
| 1/2 Acre | 25 | 0.15 | 0.20 | 0.22 | 0.28 | 0.30 | 0.36 | 0.37 | 0.46 | 0.41 | 0.51 | 0.46 | 0.56 |
| 1 Acre | 20 | 0.12 | 0.17 | 0.20 | 0.26 | 0.27 | 0.34 | 0.35 | 0.44 | 0.40 | 0.50 | 0.44 | 0.55 |
| Industrial | | | | | | | | | | | | | |
| Light Areas | 80 | 0.57 | 0.60 | 0.59 | 0.63 | 0.63 | 0.66 | 0.66 | 0.70 | 0.68 | 0.72 | 0.70 | 0.74 |
| Heavy Areas | 90 | 0.71 | 0.73 | 0.73 | 0.75 | 0.75 | 0.77 | 0.78 | 0.80 | 0.80 | 0.82 | 0.81 | 0.83 |
| Parks and Cemeteries | 7 | 0.05 | 0.09 | 0.12 | 0.19 | 0.20 | 0.29 | 0.30 | 0.40 | 0.34 | 0.46 | 0.39 | 0.52 |
| Playgrounds | 13 | 0.07 | 0.13 | 0.16 | 0.23 | 0.24 | 0.31 | 0.32 | 0.42 | 0.37 | 0.48 | 0.41 | 0.54 |
| Railroad Yard Areas | 40 | 0.23 | 0.28 | 0.30 | 0.35 | 0.36 | 0.42 | 0.42 | 0.50 | 0.46 | 0.54 | 0.50 | 0.58 |
| Undeveloped Areas | | | | | | | | | | | | | |
| Historic Flow Analysis-- Greenbelts, Agriculture | 2 | 0.03 | 0.05 | 0.09 | 0.16 | 0.17 | 0.26 | 0.26 | 0.38 | 0.31 | 0.45 | 0.36 | 0.51 |
| Pasture/Meadow | 0 | 0.02 | 0.04 | 0.08 | 0.15 | 0.15 | 0.25 | 0.25 | 0.37 | 0.30 | 0.44 | 0.35 | 0.50 |
| Forest | 0 | 0.02 | 0.04 | 0.08 | 0.15 | 0.15 | 0.25 | 0.25 | 0.37 | 0.30 | 0.44 | 0.35 | 0.50 |
| Exposed Rock | 100 | 0.89 | 0.89 | 0.90 | 0.90 | 0.92 | 0.92 | 0.94 | 0.94 | 0.95 | 0.95 | 0.96 | 0.96 |
| Offsite Flow Analysis (when landuse is undefined) | 45 | 0.26 | 0.31 | 0.32 | 0.37 | 0.38 | 0.44 | 0.44 | 0.51 | 0.48 | 0.55 | 0.51 | 0.59 |
| Streets | | | | | | | | | | | | | |
| Paved | 100 | 0.89 | 0.89 | 0.90 | 0.90 | 0.92 | 0.92 | 0.94 | 0.94 | 0.95 | 0.95 | 0.96 | 0.96 |
| Gravel | 80 | 0.57 | 0.60 | 0.59 | 0.63 | 0.63 | 0.66 | 0.66 | 0.70 | 0.68 | 0.72 | 0.70 | 0.74 |
| Drive and Walks | 100 | 0.89 | 0.89 | 0.90 | 0.90 | 0.92 | 0.92 | 0.94 | 0.94 | 0.95 | 0.95 | 0.96 | 0.96 |
| Roofs | 90 | 0.71 | 0.73 | 0.73 | 0.75 | 0.75 | 0.77 | 0.78 | 0.80 | 0.80 | 0.82 | 0.81 | 0.83 |
| Lawns | 0 | 0.02 | 0.04 | 0.08 | 0.15 | 0.15 | 0.25 | 0.25 | 0.37 | 0.30 | 0.44 | 0.35 | 0.50 |

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_r) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_r) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

$$t_c = t_i + t_t \quad (\text{Eq. 6-7})$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i , may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

t_i = overland (initial) flow time (min)

C_5 = runoff coefficient for 5-year frequency (see Table 6-6)

L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)

S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

| Type of Land Surface | C_v |
|--------------------------------------|-------|
| Heavy meadow | 2.5 |
| Tillage/field | 5 |
| Riprap (not buried)* | 6.5 |
| Short pasture and lawns | 7 |
| Nearly bare ground | 10 |
| Grassed waterway | 15 |
| Paved areas and shallow paved swales | 20 |

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \quad (\text{Eq. 6-10})$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional “calibration” of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

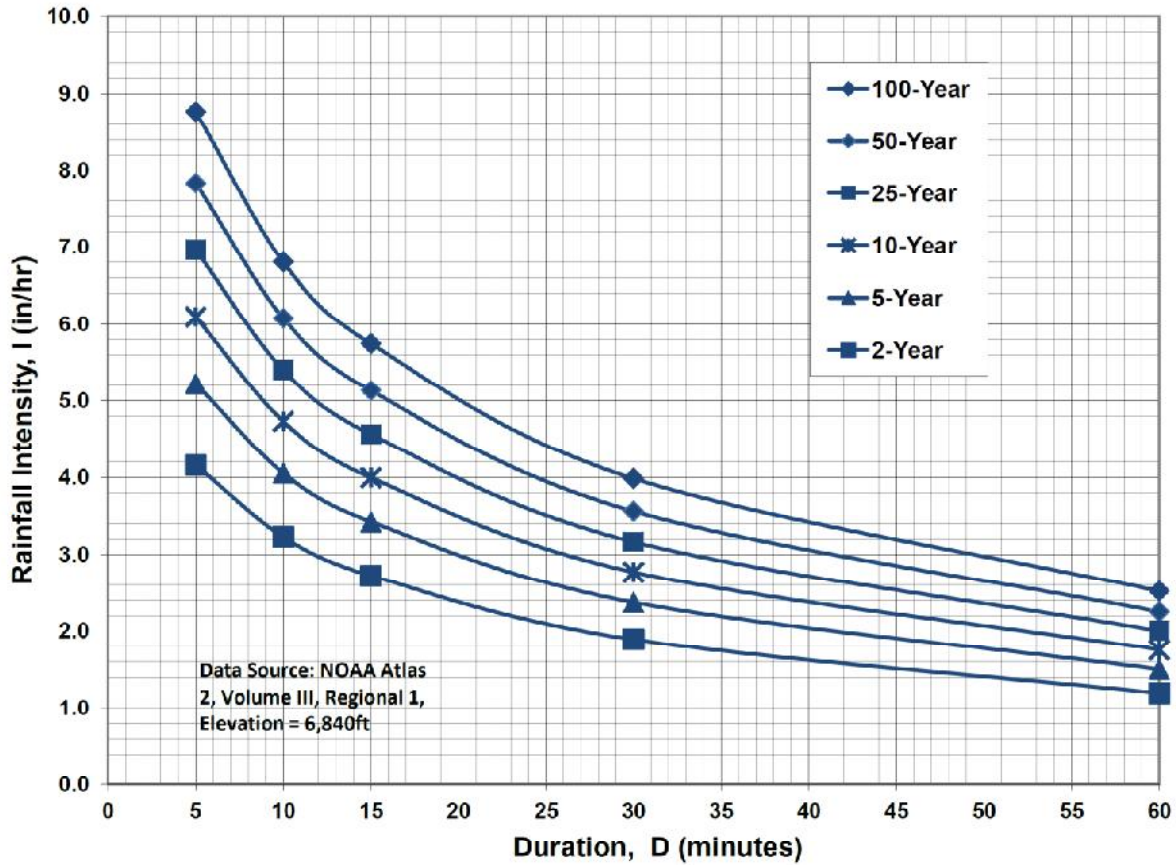
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$$I_{100} = -2.52 \ln(D) + 12.735$$

$$I_{50} = -2.25 \ln(D) + 11.375$$

$$I_{25} = -2.00 \ln(D) + 10.111$$

$$I_{10} = -1.75 \ln(D) + 8.847$$

$$I_5 = -1.50 \ln(D) + 7.583$$

$$I_2 = -1.19 \ln(D) + 6.035$$

Note: Values calculated by equations may not precisely duplicate values read from figure.

CATHEDRAL ROCK CHURCH
COMPOSITE RUNOFF COEFFICIENTS

| DEVELOPED CONDITIONS | | | | | | | | | | | |
|----------------------|-----------------|-------|-------------------------------|------|-----------|-------------------------------|------|------|-------------------------------|---|------------------|
| 5-YEAR C VALUES | | | | | | | | | | | |
| BASIN | TOTAL AREA (AC) | (AC) | SUB-AREA 1 DEVELOPMENT/ COVER | C | AREA (AC) | SUB-AREA 2 DEVELOPMENT/ COVER | C | (AC) | SUB-AREA 3 DEVELOPMENT/ COVER | C | WEIGHTED C VALUE |
| OA1 | 0.05 | 0.00 | SF RESIDENTIAL | 0.3 | | | | | | | 0.300 |
| A1 | 2.29 | 1.632 | PAVED/IMPERVIOUS | 0.9 | 0.66 | LANDSCAPED | 0.08 | | | | 0.664 |
| OA1,A1 | 2.34 | | | | | | | | | | 0.657 |
| OA2 | 0.40 | 0.00 | SF RESIDENTIAL | 0.3 | | | | | | | 0.300 |
| A2 | 0.86 | 0.523 | PAVED/IMPERVIOUS | 0.9 | 0.34 | LANDSCAPED | 0.08 | | | | 0.579 |
| OA2,A2 | 1.26 | | | | | | | | | | 0.490 |
| OA1-OA2,A1-A2 | 3.60 | | | | | | | | | | 0.598 |
| A3 | 0.96 | 0.82 | PAVED/IMPERVIOUS | 0.9 | 0.14 | LANDSCAPED | 0.08 | | | | 0.777 |
| A1-A3 | 4.56 | | | | | | | | | | 0.636 |
| A4 | 0.23 | 0.00 | PAVED/IMPERVIOUS | 100 | 0.23 | LANDSCAPED | 0.08 | | | | 0.080 |
| A1-A4 | 4.79 | | | | | | | | | | 0.609 |
| OB1 | 0.13 | 0.00 | SF RESIDENTIAL | 0.3 | | | | | | | 0.300 |
| B | 0.74 | 0.00 | PAVED/IMPERVIOUS | 0.9 | 0.74 | LANDSCAPED | 0.08 | | | | 0.080 |
| OB1,B | 0.87 | | | | | | | | | | 0.113 |
| 100-YEAR C VALUES | | | | | | | | | | | |
| BASIN | TOTAL AREA (AC) | (AC) | SUB-AREA 1 DEVELOPMENT/ COVER | C | AREA (AC) | SUB-AREA 2 DEVELOPMENT/ COVER | C | (AC) | SUB-AREA 3 DEVELOPMENT/ COVER | C | WEIGHTED C VALUE |
| OA1 | 0.05 | 0.00 | SF RESIDENTIAL | 0.5 | | | | | | | 0.500 |
| A1 | 2.29 | 1.632 | PAVED/IMPERVIOUS | 0.96 | 0.66 | LANDSCAPED | 0.35 | | | | 0.785 |
| OA1,A1 | 2.34 | | | | | | | | | | 0.779 |
| OA2 | 0.40 | 0.00 | SF RESIDENTIAL | 0.5 | | | | | | | 0.500 |
| A2 | 0.86 | 0.523 | PAVED/IMPERVIOUS | 0.96 | 0.34 | LANDSCAPED | 0.35 | | | | 0.721 |
| OA2,A2 | 1.26 | | | | | | | | | | 0.651 |
| OA1-OA2,A1-A2 | 3.60 | | | | | | | | | | 0.734 |
| A3 | 0.96 | 0.82 | PAVED/IMPERVIOUS | 0.96 | 0.14 | LANDSCAPED | 0.35 | | | | 0.869 |
| A1-A3 | 4.56 | | | | | | | | | | 0.762 |
| A4 | 0.23 | 0.00 | PAVED/IMPERVIOUS | 100 | 0.23 | LANDSCAPED | 0.35 | | | | 0.350 |
| A1-A4 | 4.79 | | | | | | | | | | 0.742 |
| OB1 | 0.13 | 0.00 | SF RESIDENTIAL | 0.5 | | | | | | | 0.500 |
| B | 0.74 | 0.00 | PAVED/IMPERVIOUS | 0.96 | 0.74 | LANDSCAPED | 0.35 | | | | 0.350 |
| OB1,B | 0.87 | | | | | | | | | | 0.372 |

CATHEDRAL ROCK CHURCH
RATIONAL METHOD

EXISTING CONDITIONS

| BASIN | DESIGN POINT | AREA (AC) | C | | Overland Flow | | | Channel flow | | | | | TOTAL Tc ⁽⁴⁾ (MIN) | TOTAL Tc ⁽⁴⁾ (MIN) | INTENSITY ⁽⁵⁾ | | PEAK FLOW | | |
|---------------|--------------|-----------|--------|----------|---------------|---------------|--------------------------|---------------------|--------------------------|---------------|------------------------------------|-------------------------|-------------------------------|-------------------------------|--------------------------|----------------|-------------------------|---------------------------|------|
| | | | 5-YEAR | 100-YEAR | LENGTH (FT) | SLOPE (FT/FT) | Tco ⁽¹⁾ (MIN) | CHANNEL LENGTH (FT) | CONVEYANCE COEFFICIENT C | SLOPE (FT/FT) | SCS ⁽²⁾ VELOCITY (FT/S) | Tt ⁽³⁾ (MIN) | | | 5-YR (IN/HR) | 100-YR (IN/HR) | Q5 ⁽⁶⁾ (CFS) | Q100 ⁽⁶⁾ (CFS) | |
| | | | OA1 | | 0.40 | 0.300 | 0.500 | 100 | 0.020 | 11.6 | | | | | | | 0.0 | 11.6 | 11.6 |
| Tt OA1 to DP1 | | | | | | | | | | | | | | | | | | | |
| A | | 3.36 | 0.080 | 0.350 | 100 | 0.070 | 9.8 | 430 | 15 | 0.056 | 3.55 | 2.0 | 12.0 | 12.0 | 3.86 | 6.48 | 1.04 | 7.62 | |
| OA1,A | 1 | 3.76 | 0.103 | 0.366 | | | | 430 | 15 | 0.047 | 3.25 | 2.2 | 13.6 | 13.6 | 3.66 | 6.15 | 1.42 | 8.46 | |
| OB1 | | 0.18 | 0.300 | 0.500 | 100 | 0.020 | 11.6 | 30 | 15 | 0.02 | 2.12 | 0.2 | 11.9 | 11.9 | 3.87 | 6.50 | 0.21 | 0.59 | |
| B | | 1.72 | 0.080 | 0.350 | | | 0.0 | 535 | 15 | 0.034 | 2.77 | 3.2 | 3.2 | 5.0 | 5.17 | 8.68 | 0.71 | 5.22 | |
| OB1,B | 2 | 1.90 | 0.101 | 0.364 | | | | | | | | | 15.1 | 15.1 | 3.51 | 5.90 | 0.67 | 4.08 | |

DEVELOPED CONDITIONS

| BASIN | DESIGN POINT | AREA (AC) | C | | Overland Flow | | | Channel flow | | | | | TOTAL Tc ⁽⁴⁾ (MIN) | TOTAL Tc ⁽⁴⁾ (MIN) | INTENSITY ⁽⁵⁾ | | PEAK FLOW | |
|----------------------|--------------|-------------|--------------|--------------|---------------|---------------|--------------------------|---------------------|--------------------------|---------------|------------------------------------|-------------------------|-------------------------------|-------------------------------|--------------------------|----------------|-------------------------|---------------------------|
| | | | 5-YEAR | 100-YEAR | LENGTH (FT) | SLOPE (FT/FT) | Tco ⁽¹⁾ (MIN) | CHANNEL LENGTH (FT) | CONVEYANCE COEFFICIENT C | SLOPE (FT/FT) | SCS ⁽²⁾ VELOCITY (FT/S) | Tt ⁽³⁾ (MIN) | | | 5-YR (IN/HR) | 100-YR (IN/HR) | Q5 ⁽⁶⁾ (CFS) | Q100 ⁽⁶⁾ (CFS) |
| | | | OA1 | | 0.05 | 0.300 | 0.500 | 60 | 0.020 | 9.0 | | | | | | | 0.0 | 9.0 |
| A1 | | 2.29 | 0.664 | 0.785 | 40 | 0.050 | 3.0 | 400 | 20 | 0.032 | 3.58 | 1.9 | 4.8 | 5.0 | 5.17 | 8.68 | 7.86 | 15.60 |
| Tt DP-A1 to A2.2 | | | | | | | | 250 | 20 | 0.041 | 4.05 | 1.0 | | | | | | |
| OA1,A1 | A1.1 | 2.34 | 0.657 | 0.779 | | | | | | | | | 13.8 | 13.8 | 3.64 | 6.12 | 5.60 | 11.15 |
| OA2 | | 0.40 | 0.300 | 0.500 | 100 | 0.020 | 11.6 | | | | | 0.0 | 11.6 | 11.6 | 3.90 | 6.55 | 0.47 | 1.31 |
| Tt OA2 to A2.1 | | | | | | | | 340 | 20 | 0.065 | 5.10 | 1.1 | | | | | | |
| A2 | | 0.86 | 0.579 | 0.721 | 90 | 0.100 | 4.2 | 255 | 20 | 0.051 | 4.52 | 0.9 | 5.1 | 5.1 | 5.13 | 8.61 | 2.55 | 5.34 |
| OA2,A2 | A2.1 | 1.26 | 0.490 | 0.651 | | | | | | | | | 12.7 | 12.7 | 3.77 | 6.32 | 2.33 | 5.19 |
| OA1-OA2,A1-A2 | A2.2 | 3.60 | 0.598 | 0.734 | | | | | | | | | 12.7 | 12.7 | 3.77 | 6.32 | 8.11 | 16.71 |
| A3 | | 0.96 | 0.777 | 0.869 | 100 | 0.010 | 5.9 | 160 | 20 | 0.069 | 5.25 | 0.5 | 6.4 | 6.4 | 4.79 | 8.05 | 3.58 | 6.71 |
| OA1-OA2,A1-A3 | A3.1 | 4.56 | 0.636 | 0.762 | | | | | | | | | 6.4 | 6.4 | 4.79 | 8.05 | 13.90 | 27.97 |
| A4 | | 0.23 | 0.080 | 0.350 | | | 0.0 | 185 | 20 | 0.022 | 2.97 | 1.0 | 1.0 | 5.0 | 5.17 | 8.68 | 0.10 | 0.70 |
| OA1-OA2,A1-A4 | 1 | 4.79 | 0.609 | 0.742 | | | | | | | | | 13.8 | 13.8 | 3.65 | 6.13 | 10.64 | 21.77 |
| OB1 | | 0.13 | 0.300 | 0.500 | 100 | 0.020 | 11.6 | 30 | 15 | 0.02 | 2.12 | 0.2 | 11.9 | 11.9 | 3.87 | 6.50 | 0.15 | 0.42 |
| B | | 0.74 | 0.080 | 0.350 | | | 0.0 | 535 | 15 | 0.034 | 2.77 | 3.2 | 3.2 | 5.0 | 5.17 | 8.68 | 0.31 | 2.25 |
| OB1,B | 2 | 0.87 | 0.113 | 0.372 | | | | | | | | | 15.1 | 15.1 | 3.51 | 5.90 | 0.35 | 1.91 |

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)^(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333)))

2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)

C = 2.5 FOR HEAVY MEADOW

C = 5 FOR TILLAGE/FIELD

C = 7 FOR SHORT PASTURE AND LAWNS

C = 10 FOR NEARLY BARE GROUND

C = 15 FOR GRASSED WATERWAY

C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)

4) Tc = Tco + Tt

*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED

5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL

I₅ = -1.5 * ln(Tc) + 7.583

I₁₀₀ = -2.52 * ln(Tc) + 12.735

6) Q = CiA

APPENDIX C
HYDRAULIC CALCULATIONS

CATHEDRAL ROCK CHURCH
 STORM INLET SIZING SUMMARY

| INLET | BASIN FLOW | | | INLET FLOW | | | INLET CONDITION / TYPE | INLET SIZE (FT) | INLET CAPACITY (CFS) |
|-------|------------|---------------|-----------------|-----------------------|---------------|-----------------|------------------------|-----------------|----------------------|
| | DP | Q5 FLOW (CFS) | Q100 FLOW (CFS) | INLET FLOW % OF BASIN | Q5 FLOW (CFS) | Q100 FLOW (CFS) | | | |
| A1.1 | A1 | 7.9 | 15.6 | 50 | 4.0 | 7.8 | SUMP TYPE R | 5' | 9.7 |
| A1.2 | A1 | 7.9 | 15.6 | 40 | 3.2 | 6.2 | SUMP TYPE R | 5' | 8.1 |
| A2 | A2 | 2.6 | 5.3 | 100 | 2.6 | 5.3 | SUMP TYPE R | 5' | 11.7 |
| | | | | | | | | | |

INLET MANAGEMENT

Worksheet Protected

| | | | |
|------------------------------------|----------------------------|----------------------------|--------------------------|
| INLET NAME | Inlet A1.1 | Inlet A1.2 | Inlet A2 |
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | In Sump | In Sump | In Sump |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

USER-DEFINED INPUT

User-Defined Design Flows

| | | | |
|-------------------------|-----|-----|-----|
| Minor Q_{Known} (cfs) | 4.0 | 3.2 | 2.6 |
| Major Q_{Known} (cfs) | 7.8 | 6.2 | 5.3 |

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

| | | | |
|---|-------------------------|-------------------------|-------------------------|
| Receive Bypass Flow from: | No Bypass Flow Received | No Bypass Flow Received | No Bypass Flow Received |
| Minor Bypass Flow Received, Q_b (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, Q_b (cfs) | 0.0 | 0.0 | 0.0 |

Watershed Characteristics

| | | | |
|---------------------------|--|--|--|
| Subcatchment Area (acres) | | | |
| Percent Impervious | | | |
| NRCS Soil Type | | | |

Watershed Profile

| | | | |
|------------------------|--|--|--|
| Overland Slope (ft/ft) | | | |
| Overland Length (ft) | | | |
| Channel Slope (ft/ft) | | | |
| Channel Length (ft) | | | |

Minor Storm Rainfall Input

| | | | |
|---|--|--|--|
| Design Storm Return Period, T_r (years) | | | |
| One-Hour Precipitation, P_1 (inches) | | | |

Major Storm Rainfall Input

| | | | |
|---|--|--|--|
| Design Storm Return Period, T_r (years) | | | |
| One-Hour Precipitation, P_1 (inches) | | | |

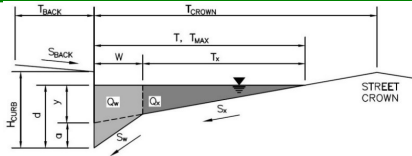
CALCULATED OUTPUT

| | | | |
|---|------------|------------|------------|
| Minor Total Design Peak Flow, Q (cfs) | 4.0 | 3.2 | 2.6 |
| Major Total Design Peak Flow, Q (cfs) | 7.8 | 6.2 | 5.3 |
| Minor Flow Bypassed Downstream, Q_b (cfs) | N/A | N/A | N/A |
| Major Flow Bypassed Downstream, Q_b (cfs) | N/A | N/A | N/A |

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

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

Project: Cathedral Rock Church
Inlet ID: Inlet A1.1



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 4.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.013$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 50.0$ ft
 $W = 2.00$ ft
 $S_X = 0.011$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_O = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

| | Minor Storm | Major Storm | |
|-------------|--------------------------|--------------------------|--------|
| $T_{MAX} =$ | 50.0 | 50.0 | ft |
| $d_{MAX} =$ | 6.0 | 12.0 | inches |
| | <input type="checkbox"/> | <input type="checkbox"/> | |

MINOR STORM Allowable Capacity is not applicable to Sump Condition
 MAJOR STORM Allowable Capacity is not applicable to Sump Condition

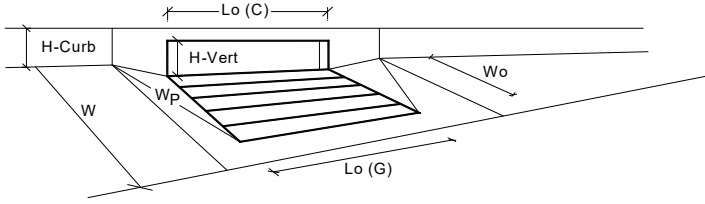
$Q_{allow} =$

| Minor Storm | Major Storm |
|-------------|-------------|
| SUMP | SUMP |

 cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

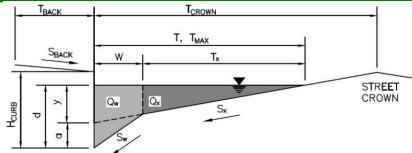


| Design Information (Input) | | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="width: 50%;">MINOR</th> <th style="width: 50%;">MAJOR</th> </tr> <tr> <td colspan="2" style="text-align: center;">CDOT Type R Curb Opening</td> </tr> <tr> <td>Type =</td> <td>CDOT Type R Curb Opening</td> </tr> <tr> <td>a_{local} =</td> <td>3.00</td> <td>3.00</td> <td>inches</td> </tr> <tr> <td>No =</td> <td>1</td> <td>1</td> <td></td> </tr> <tr> <td>Ponding Depth =</td> <td>6.0</td> <td>8.3</td> <td>inches</td> </tr> <tr> <td colspan="4" style="text-align: right;"><input type="checkbox"/> Override Depths</td> </tr> <tr> <td>L_o (G) =</td> <td>N/A</td> <td>N/A</td> <td>feet</td> </tr> <tr> <td>W_o =</td> <td>N/A</td> <td>N/A</td> <td>feet</td> </tr> <tr> <td>A_{ratio} =</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td>C_f (G) =</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td>C_w (G) =</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td>C_o (G) =</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: center;"> <table border="1" style="margin-left: auto; 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|--|--------------------------|--|---------|-------|-------|--------------------------|------|--------|--------------------------|------------------------------|------|------|--------|-----------------------|------|------|--------|----------------------|-------|-------|---------|--|------|------|------|----------------------|------|------|------|----------------------|------|------|------|----------------------|------|------|--|----------------------|-----|-----|--|----------------------|-----|-----|--|----------------------|-----|-----|--|--|--|--|--|-------|-------|----------------------|------|------|------|---------------------|------|------|--------|-----------------------|------|------|--------|---------|-------|-------|---------|------------------|------|------|------|----------------------|------|------|--|----------------------|------|------|--|----------------------|------|------|--|--------------------------|--|--|--|-------|-------|----------------------|-----|-----|----|---------------------|------|------|----|-----------------------|-----|-----|--|----------------------|------|------|--|-----------------------------|-----|-----|--|---------------------------------|--|---|--|-------|-------|------------------|-----|-----|-----|------------------------------|-----|-----|-----|--|--|--|--|--------------------------|--|--|--|--------------------------------------|--|--|--|---|--|--|--|---|--|--|--|--|--|--|--|---|--|--|--|---|--|--|--|
| MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CDOT Type R Curb Opening | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type = | CDOT Type R Curb Opening | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| a _{local} = | 3.00 | 3.00 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No = | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ponding Depth = | 6.0 | 8.3 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Override Depths | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L _o (G) = | N/A | N/A | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W _o = | N/A | N/A | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A _{ratio} = | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C _f (G) = | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C _w (G) = | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C _o (G) = | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="width: 50%;">MINOR</th> <th style="width: 50%;">MAJOR</th> </tr> <tr> <td>L_o (C) =</td> <td>5.00</td> <td>5.00</td> <td>feet</td> </tr> <tr> <td>H_{vert} =</td> <td>6.00</td> <td>6.00</td> <td>inches</td> </tr> <tr> <td>H_{throat} =</td> <td>6.00</td> <td>6.00</td> <td>inches</td> </tr> <tr> <td>Theta =</td> <td>63.40</td> <td>63.40</td> <td>degrees</td> </tr> <tr> <td>W_p =</td> <td>2.00</td> <td>2.00</td> <td>feet</td> </tr> <tr> <td>C_f (C) =</td> <td>0.10</td> <td>0.10</td> <td></td> </tr> <tr> <td>C_w (C) =</td> <td>3.60</td> <td>3.60</td> <td></td> </tr> <tr> <td>C_o (C) =</td> <td>0.67</td> <td>0.67</td> <td></td> </tr> </table> | | | | MINOR | MAJOR | L _o (C) = | 5.00 | 5.00 | feet | H _{vert} = | 6.00 | 6.00 | inches | H _{throat} = | 6.00 | 6.00 | inches | Theta = | 63.40 | 63.40 | degrees | W _p = | 2.00 | 2.00 | feet | C _f (C) = | 0.10 | 0.10 | | C _w (C) = | 3.60 | 3.60 | | C _o (C) = | 0.67 | 0.67 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L _o (C) = | 5.00 | 5.00 | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H _{vert} = | 6.00 | 6.00 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H _{throat} = | 6.00 | 6.00 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Theta = | 63.40 | 63.40 | degrees | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W _p = | 2.00 | 2.00 | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C _f (C) = | 0.10 | 0.10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C _w (C) = | 3.60 | 3.60 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C _o (C) = | 0.67 | 0.67 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grate Information | | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="width: 50%;">MINOR</th> <th style="width: 50%;">MAJOR</th> </tr> <tr> <td>d_{Grate} =</td> <td>N/A</td> <td>N/A</td> <td>ft</td> </tr> <tr> <td>d_{Curb} =</td> <td>0.33</td> <td>0.53</td> <td>ft</td> </tr> <tr> <td>RF_{Grate} =</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td>RF_{Curb} =</td> <td>1.00</td> <td>1.00</td> <td></td> </tr> <tr> <td>RF_{Combination} =</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> </table> | | MINOR | MAJOR | d _{Grate} = | N/A | N/A | ft | d _{Curb} = | 0.33 | 0.53 | ft | RF _{Grate} = | N/A | N/A | | RF _{Curb} = | 1.00 | 1.00 | | RF _{Combination} = | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| d _{Grate} = | N/A | N/A | ft | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| d _{Curb} = | 0.33 | 0.53 | ft | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RF _{Grate} = | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RF _{Curb} = | 1.00 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RF _{Combination} = | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Curb Opening Information | | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="width: 50%;">MINOR</th> <th style="width: 50%;">MAJOR</th> </tr> <tr> <td>Q_s =</td> <td>5.4</td> <td>9.7</td> <td>cfs</td> </tr> <tr> <td>Q_{PEAK REQUIRED} =</td> <td>4.0</td> <td>7.8</td> <td>cfs</td> </tr> </table> | | MINOR | MAJOR | Q _s = | 5.4 | 9.7 | cfs | Q _{PEAK REQUIRED} = | 4.0 | 7.8 | cfs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Q _s = | 5.4 | 9.7 | cfs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Q _{PEAK REQUIRED} = | 4.0 | 7.8 | cfs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Low Head Performance Reduction (Calculated) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Depth for Grate Midwidth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Depth for Curb Opening Weir Equation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grated Inlet Performance Reduction Factor for Long Inlets | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Curb Opening Performance Reduction Factor for Long Inlets | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Combination Inlet Performance Reduction Factor for Long Inlets | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Inlet Interception Capacity (assumes clogged condition) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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

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

Project: Cathedral Rock Church
Inlet ID: Inlet A1.2



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

| | | | |
|--------------|---|-------|--------|
| T_{BACK} | = | 4.0 | ft |
| S_{BACK} | = | 0.020 | ft/ft |
| n_{BACK} | = | 0.020 | |
| H_{CURB} | = | 6.00 | inches |
| T_{CROWN} | = | 42.0 | ft |
| W | = | 2.00 | ft |
| S_x | = | 0.011 | ft/ft |
| S_w | = | 0.083 | ft/ft |
| S_o | = | 0.000 | ft/ft |
| n_{STREET} | = | 0.016 | |

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

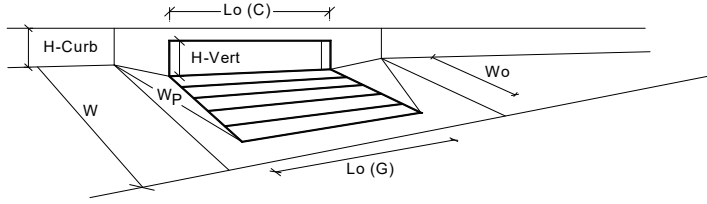
| | | | | |
|-----------|---|--------------------------|--------------------------|--------|
| | | Minor Storm | Major Storm | |
| T_{MAX} | = | 42.0 | 42.0 | ft |
| d_{MAX} | = | 6.0 | 12.0 | inches |
| | | <input type="checkbox"/> | <input type="checkbox"/> | |

MINOR STORM Allowable Capacity is not applicable to Sump Condition
 MAJOR STORM Allowable Capacity is not applicable to Sump Condition

| | | | | |
|-------------|---|-------------|-------------|-----|
| | | Minor Storm | Major Storm | |
| Q_{allow} | = | SUMP | SUMP | cfs |

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

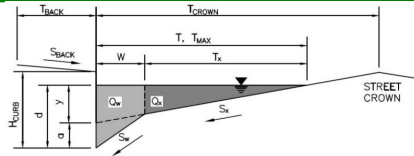


| Design Information (Input) | MINOR | | MAJOR | |
|--|--|------------|------------|---------|
| Type of Inlet | CDOT Type R Curb Opening | | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | $a_{local} =$ | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | $N_o =$ | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 6.0 | 7.3 | inches |
| Grate Information | <input type="checkbox"/> Override Depths | | | |
| Length of a Unit Grate | $L_o (G) =$ | N/A | N/A | feet |
| Width of a Unit Grate | $W_o =$ | N/A | N/A | feet |
| Open Area Ratio for a Grate (typical values 0.15-0.90) | $A_{ratio} =$ | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | $C_f (G) =$ | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | $C_w (G) =$ | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | $C_o (G) =$ | N/A | N/A | |
| Curb Opening Information | | | | |
| Length of a Unit Curb Opening | $L_o (C) =$ | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | $H_{vert} =$ | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | $H_{throat} =$ | 6.00 | 6.00 | inches |
| Angle of Throat | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | $W_p =$ | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | $C_f (C) =$ | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | $C_w (C) =$ | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | $C_o (C) =$ | 0.67 | 0.67 | |
| Low Head Performance Reduction (Calculated) | | | | |
| Depth for Grate Midwidth | $d_{Grate} =$ | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb} =$ | 0.33 | 0.44 | ft |
| Grated Inlet Performance Reduction Factor for Long Inlets | RF _{Grate} = | N/A | N/A | |
| Curb Opening Performance Reduction Factor for Long Inlets | RF _{Curb} = | 1.00 | 1.00 | |
| Combination Inlet Performance Reduction Factor for Long Inlets | RF _{Combination} = | N/A | N/A | |
| Total Inlet Interception Capacity (assumes clogged condition) | $Q_s =$ | 5.4 | 8.1 | cfs |
| Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak) | Q _{PEAK REQUIRED} = | 3.2 | 6.2 | cfs |

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

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

Project: Cathedral Rock Church
Inlet ID: Inlet A2



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

| | | |
|-----------------------|-------|--------|
| T _{BACK} = | 4.0 | ft |
| S _{BACK} = | 0.020 | ft/ft |
| n _{BACK} = | 0.020 | |
| H _{CURB} = | 6.00 | inches |
| T _{CROWN} = | 36.0 | ft |
| W = | 2.00 | ft |
| S _X = | 0.022 | ft/ft |
| S _W = | 0.083 | ft/ft |
| S _O = | 0.000 | ft/ft |
| n _{STREET} = | 0.016 | |

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

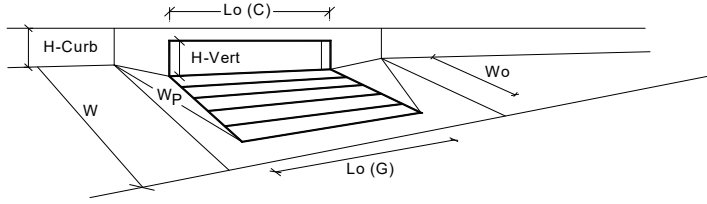
| | Minor Storm | Major Storm | |
|--------------------|--------------------------|--------------------------|--------|
| T _{MAX} = | 36.0 | 36.0 | ft |
| d _{MAX} = | 6.0 | 12.0 | inches |
| | <input type="checkbox"/> | <input type="checkbox"/> | |

MINOR STORM Allowable Capacity is not applicable to Sump Condition
 MAJOR STORM Allowable Capacity is not applicable to Sump Condition

| | Minor Storm | Major Storm | |
|----------------------|-------------|-------------|-----|
| Q _{allow} = | SUMP | SUMP | cfs |

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



| Design Information (Input) | MINOR | | MAJOR | |
|--|--------------------------|-------------|------------|--|
| Type of Inlet | CDOT Type R Curb Opening | | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | 3.00 | 3.00 | inches | |
| Number of Unit Inlets (Grate or Curb Opening) | 1 | 1 | | |
| Water Depth at Flowline (outside of local depression) | 6.0 | 11.0 | inches | |
| Grate Information | | | | |
| Length of a Unit Grate | N/A | N/A | feet | |
| Width of a Unit Grate | N/A | N/A | feet | |
| Open Area Ratio for a Grate (typical values 0.15-0.90) | N/A | N/A | | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | N/A | N/A | | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | N/A | N/A | | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | N/A | N/A | | |
| Curb Opening Information | | | | |
| Length of a Unit Curb Opening | 5.00 | 5.00 | feet | |
| Height of Vertical Curb Opening in Inches | 6.00 | 6.00 | inches | |
| Height of Curb Orifice Throat in Inches | 6.00 | 6.00 | inches | |
| Angle of Throat | 63.40 | 63.40 | degrees | |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | 2.00 | 2.00 | feet | |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | 0.10 | 0.10 | | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | 3.60 | 3.60 | | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | 0.67 | 0.67 | | |
| Low Head Performance Reduction (Calculated) | | | | |
| Depth for Grate Midwidth | N/A | N/A | ft | |
| Depth for Curb Opening Weir Equation | 0.33 | 0.75 | ft | |
| Grated Inlet Performance Reduction Factor for Long Inlets | N/A | N/A | | |
| Curb Opening Performance Reduction Factor for Long Inlets | 1.00 | 1.00 | | |
| Combination Inlet Performance Reduction Factor for Long Inlets | N/A | N/A | | |
| Total Inlet Interception Capacity (assumes clogged condition) | | | | |
| Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak) | 5.4 | 11.7 | cfs | |
| Q _{PEAK REQUIRED} | 2.6 | 5.3 | cfs | |

**CATHEDRAL ROCK CHURCH
STORM SEWER SIZING SUMMARY**

| PIPE | PIPE FLOW | | | PIPE CAPACITY | | |
|------|--------------|---------------|-----------------|---------------|-----------------|---------------------|
| | DESIGN POINT | Q5 FLOW (CFS) | Q100 FLOW (CFS) | PIPE SIZE | MIN. PIPE SLOPE | PIPE CAPACITY (CFS) |
| A1.1 | A1.1 | 4.0 | 7.8 | 18 | 1.0% | 10.5 |
| A1.2 | A1.1-A1.2 | 7.1 | 14.0 | 18 | 2.0% | 14.9 |
| A2 | A1.1-A2 | 9.7 | 19.3 | 18 | 3.5% | 19.7 |
| | | | | | | |
| | | | | | | |

ASSUMPTIONS:

1. STORM DRAIN PIPE ASSUMED TO BE RCP OR HDPE

Hydraulic Analysis Report

Project Data

Project Title: Project - Cathedral Rock Church
Designer: JPS
Project Date: Monday, September 16, 2024
Project Units: U.S. Customary Units
Notes:

Channel Analysis: SD-A1.1

Notes:

Input Parameters

Channel Type: Circular
Pipe Diameter: 1.5000 ft
Longitudinal Slope: 0.0100 ft/ft
Manning's n: 0.0130
Depth: 1.5000 ft

Result Parameters

Flow: 10.5043 cfs
Area of Flow: 1.7671 ft²
Wetted Perimeter: 4.7124 ft
Hydraulic Radius: 0.3750 ft
Average Velocity: 5.9442 ft/s
Top Width: 0.0000 ft
Froude Number: 0.0000
Critical Depth: 1.2451 ft
Critical Velocity: 6.6989 ft/s
Critical Slope: 0.0098 ft/ft
Critical Top Width: 1.13 ft
Calculated Max Shear Stress: 0.9360 lb/ft²
Calculated Avg Shear Stress: 0.2340 lb/ft²

Channel Analysis: SD-A1.2

Notes:

Input Parameters

Channel Type: Circular
Pipe Diameter: 1.5000 ft
Longitudinal Slope: 0.0200 ft/ft
Manning's n: 0.0130
Depth: 1.5000 ft

Result Parameters

Flow: 14.8554 cfs
Area of Flow: 1.7671 ft²
Wetted Perimeter: 4.7124 ft
Hydraulic Radius: 0.3750 ft
Average Velocity: 8.4064 ft/s
Top Width: 0.0000 ft
Froude Number: 0.0000
Critical Depth: 1.4026 ft
Critical Velocity: 8.6445 ft/s
Critical Slope: 0.0173 ft/ft
Critical Top Width: 0.74 ft
Calculated Max Shear Stress: 1.8720 lb/ft²
Calculated Avg Shear Stress: 0.4680 lb/ft²

Channel Analysis: SD-A2

Notes:

Input Parameters

Channel Type: Circular
Pipe Diameter: 1.5000 ft
Longitudinal Slope: 0.0350 ft/ft
Manning's n: 0.0130
Depth: 1.5000 ft

Result Parameters

Flow: 19.6518 cfs
Area of Flow: 1.7671 ft²
Wetted Perimeter: 4.7124 ft
Hydraulic Radius: 0.3750 ft
Average Velocity: 11.1207 ft/s
Top Width: 0.0000 ft
Froude Number: 0.0000
Critical Depth: 1.4652 ft
Critical Velocity: 11.1873 ft/s
Critical Slope: 0.0311 ft/ft
Critical Top Width: 0.45 ft
Calculated Max Shear Stress: 3.2760 lb/ft²
Calculated Avg Shear Stress: 0.8190 lb/ft²

APPENDIX D
RAIN GARDEN CALCULATIONS

| CATHEDRAL ROCK CHURCH COMPOSITE IMPERVIOUS AREAS | | | | | | | | | | | |
|---|-----------------|-------|-------------------------------|--------------------|-----------|-------------------------------|--------------------|------|-------------------------------|--------------------|----------------|
| IMPERVIOUS AREAS | | | | | | | | | | | |
| BASIN | TOTAL AREA (AC) | (AC) | SUB-AREA 1 DEVELOPMENT/ COVER | PERCENT IMPERVIOUS | AREA (AC) | SUB-AREA 2 DEVELOPMENT/ COVER | PERCENT IMPERVIOUS | (AC) | SUB-AREA 3 DEVELOPMENT/ COVER | PERCENT IMPERVIOUS | WEIGHTED % IMP |
| OA1 | 0.05 | 0.00 | SF RESIDENTIAL | 40 | | | | | | | 40.000 |
| A1 | 2.29 | 1.632 | PAVED/IMPERVIOUS | 100 | 0.66 | LANDSCAPED | 0.00 | | | | 71.266 |
| OA1,A1 | 2.34 | | | | | | | | | | 70.598 |
| OA2 | 0.40 | 0.00 | SF RESIDENTIAL | 40 | | | | | | | 40.000 |
| A2 | 0.86 | 0.523 | PAVED/IMPERVIOUS | 100 | 0.34 | LANDSCAPED | 0.00 | | | | 60.814 |
| OA2,A2 | 1.26 | | | | | | | | | | 54.206 |
| OA1-OA2,A1-A2 | 3.60 | | | | | | | | | | 64.861 |
| A3 | 0.96 | 0.82 | PAVED/IMPERVIOUS | 100 | 0.14 | LANDSCAPED | 0.00 | | | | 85.000 |
| A1-A3 | 4.56 | | | | | | | | | | 69.101 |
| A4 | 0.23 | 0.00 | PAVED/IMPERVIOUS | 100 | 0.23 | LANDSCAPED | 0.00 | | | | 0.000 |
| A1-A4 | 4.79 | | | | | | | | | | 65.783 |
| OB1 | 0.13 | 0.00 | SF RESIDENTIAL | 40 | | | | | | | 40.000 |
| B | 0.74 | 0.00 | PAVED/IMPERVIOUS | 100 | 0.74 | LANDSCAPED | 0.00 | | | | 0.000 |
| OB1,B | 0.87 | | | | | | | | | | 5.977 |

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: JPS
Company: JPS
Date: September 14, 2024
Project: Cathedral Rock Church - Rain Garden A
Location: Tract A, Struthers Ranch Filing No. 2

Use up to date MHFD UD-BMP spreadsheet. This will be reviewed in more detail once the updated spreadsheet is provided.

| | |
|--|--|
| <p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)</p> <p>C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time ($WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$)</p> <p>D) Contributing Watershed Area (including rain garden area)</p> <p>E) Water Quality Capture Volume (WQCV) Design Volume $Vol = (WQCV / 12) * Area$</p> <p>F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> | <p>$I_a =$ <input type="text" value="65.8"/> %</p> <p>$i =$ <input type="text" value="0.658"/></p> <p>WQCV = <input type="text" value="0.21"/> watershed inches</p> <p>Area = <input type="text" value="208,652"/> sq ft</p> <p>$V_{WQCV} =$ <input type="text" value="3,579"/> cu ft</p> <p>$d_e =$ <input type="text" value=""/> in</p> <p>$V_{WQCV\ OTHER} =$ <input type="text" value=""/> cu ft</p> <p>$V_{WQCV\ USER} =$ <input type="text" value=""/> cu ft</p> |
| <p>2. Basin Geometry</p> <p>A) WQCV Depth (12-inch maximum)</p> <p>B) Rain Garden Side Slopes ($Z = 4$ min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)</p> <p>C) Minimum Flat Surface Area</p> <p>D) Actual Flat Surface Area</p> <p>E) Area at Design Depth (Top Surface Area)</p> <p>F) Rain Garden Total Volume ($V_T = ((A_{Top} + A_{Actual}) / 2) * Depth$)</p> | <p>$D_{WQCV} =$ <input type="text" value="12"/> in</p> <p>$Z =$ <input type="text" value="4.00"/> ft / ft</p> <p>$A_{Min} =$ <input type="text" value="2746"/> sq ft</p> <p>$A_{Actual} =$ <input type="text" value="2829"/> sq ft</p> <p>$A_{Top} =$ <input type="text" value="4804"/> sq ft</p> <p>$V_T =$ <input type="text" value="3,817"/> cu ft</p> |
| <p>3. Growing Media</p> | <p>Choose One</p> <p><input checked="" type="radio"/> 18" Rain Garden Growing Media</p> <p><input type="radio"/> Other (Explain):</p> <p>_____</p> <p>_____</p> |
| <p>4. Underdrain System</p> <p>A) Are underdrains provided?</p> <p>B) Underdrain system orifice diameter for 12 hour drain time</p> <p style="margin-left: 20px;">i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice</p> <p style="margin-left: 20px;">ii) Volume to Drain in 12 Hours</p> <p style="margin-left: 20px;">iii) Orifice Diameter, 3/8" Minimum</p> | <p>Choose One</p> <p><input checked="" type="radio"/> YES</p> <p><input type="radio"/> NO</p> <p>$y =$ <input type="text" value="2.0"/> ft</p> <p>$Vol_{12} =$ <input type="text" value="3,579"/> cu ft</p> <p>$D_o =$ <input type="text" value="1 3/8"/> in</p> |

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: JPS
Company: JPS
Date: September 14, 2024
Project: Cathedral Rock Church - Rain Garden A
Location: Tract A, Struthers Ranch Filing No. 2

| | |
|---|---|
| <p>5. Impermeable Geomembrane Liner and Geotextile Separator Fabric</p> <p>A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?</p> | <p>Choose One</p> <p><input type="radio"/> YES</p> <p><input checked="" type="radio"/> NO</p> |
| <p>6. Inlet / Outlet Control</p> <p>A) Inlet Control</p> | <p>Choose One</p> <p><input type="radio"/> Sheet Flow- No Energy Dissipation Required</p> <p><input checked="" type="radio"/> Concentrated Flow- Energy Dissipation Provided</p> |
| <p>7. Vegetation</p> | <p>Choose One</p> <p><input type="radio"/> Seed (Plan for frequent weed control)</p> <p><input checked="" type="radio"/> Plantings</p> <p><input type="radio"/> Sand Grown or Other High Infiltration Sod</p> |
| <p>8. Irrigation</p> <p>A) Will the rain garden be irrigated?</p> | <p>Choose One</p> <p><input type="radio"/> YES</p> <p><input type="radio"/> NO</p> |

Notes: _____

RAIN GARDEN A FOREBAY CALCULATION

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: JPS
Company: JPS
Date: September 9, 2024
Project: Cathedral Rock Church - Rain Garden A
Location: Tract A, Struthers Ranch Filing No. 2

Provide MHFD-Detention spreadsheet for Rain Garden design

| | |
|---|---|
| <p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * V_{DESIGN} / 0.43)$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) NRCS Hydrologic Soil Groups of Tributary Watershed i) Percentage of Watershed consisting of Type A Soils ii) Percentage of Watershed consisting of Type B Soils iii) Percentage of Watershed consisting of Type C/D Soils</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$</p> <p>K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)</p> | <p>$I_a =$ <input type="text" value="65.8"/> %</p> <p>$i =$ <input type="text" value="0.658"/></p> <p>Area = <input type="text" value="4.790"/> ac</p> <p>$d_6 =$ <input type="text" value=""/></p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Choose One</p> <p><input checked="" type="radio"/> Water Quality Capture Volume (WQCV)</p> <p><input type="radio"/> Excess Urban Runoff Volume (EURV)</p> </div> <p>$V_{DESIGN} =$ <input type="text" value="0.103"/> ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ <input type="text" value=""/> ac-ft</p> <p>$V_{DESIGN\ USER} =$ <input type="text" value=""/> ac-ft</p> <p>HSG _A = <input type="text" value=""/> % HSG _B = <input type="text" value=""/> % HSG _{C/D} = <input type="text" value=""/> %</p> <p>EURV_{DESIGN} = <input type="text" value=""/> ac-ft</p> <p>EURV_{DESIGN\ USER} = <input type="text" value=""/> ac-ft</p> |
| <p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p> | <p>L : W = <input type="text" value="4.0"/> : 1</p> |
| <p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p> | <p>Z = <input type="text" value="4.00"/> ft / ft</p> |
| <p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p> | <p><u>Concrete Forebay</u></p> <hr/> <hr/> |
| <p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMN} =$ <input type="text" value="2%"/> of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F =$ <input type="text" value="18"/> inch maximum)</p> <p>D) Forebay Discharge</p> <p>i) Undetained 100-year Peak Discharge</p> <p>ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p> | <p>$V_{FMN} =$ <input type="text" value="0.002"/> ac-ft</p> <p>$V_F =$ <input type="text" value="0.002"/> ac-ft</p> <p>$D_F =$ <input type="text" value="12.0"/> in</p> <p>$Q_{100} =$ <input type="text" value="21.80"/> cfs</p> <p>$Q_F =$ <input type="text" value="0.44"/> cfs</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p>Calculated $D_P =$ <input type="text" value=""/> in</p> <p>Calculated $W_N =$ <input type="text" value="4.0"/> in</p> |

Use up to date MHFD UD-BMP spreadsheet. This will be reviewed in more detail once the updated spreadsheet is provided. Provide sheets 2 and 3 for outlet sizing.

PROPOSED FOREBAY VOLUME:
 = (12'L x 8'W x 12" DEEP)
 = .0022 AF

Flow too small for berm w/ pipe

Cathedral Rock Church Rain Garden A Spillway

Figure 13-12c. Emergency Spillway Protection

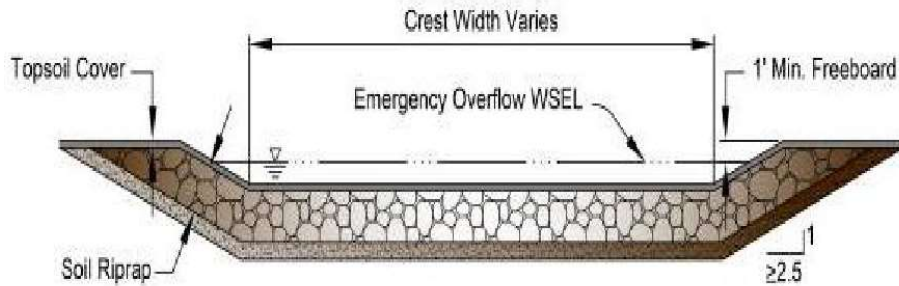
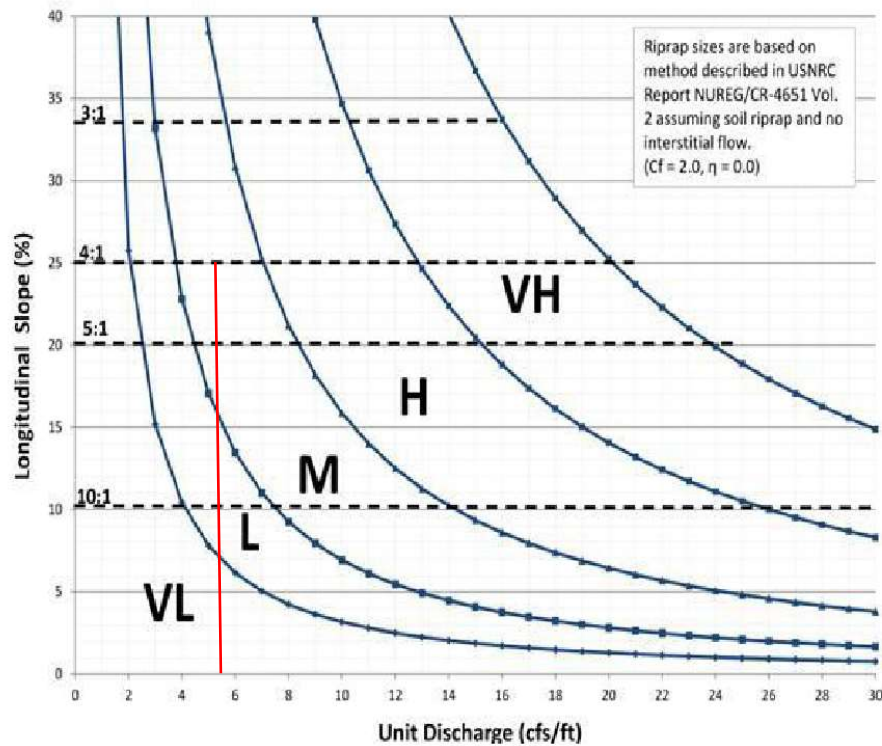


Figure 13-12d. Riprap Types for Emergency Spillway Protection



Spillway Q100 = 21.8 cfs (Undetained DP-1)
Unit Discharge = (21.8 cfs / 4 ft) = 5.5

APPENDIX E

RAIN GARDEN COST ESTIMATE

**CATHEDRAL ROCK CHURCH
TRACT A, STRUTHERS RANCH FILING NO. 2
ENGINEER'S COST ESTIMATE
DRAINAGE IMPROVEMENTS - WATER QUALITY RAIN GARDEN**

| Item No. | Description | Quantity | Unit | Unit Cost (\$\$) | Total Cost (\$\$) |
|--|-------------------------------------|----------|------|------------------|-------------------|
| PRIVATE DRAINAGE FACILITIES (NON-REIMBURSABLE) | | | | | |
| | Earthwork | 150 | CY | \$5 | \$750 |
| | Aggregate Base Course (Access Ramp) | 15 | CY | \$66 | \$990 |
| | Rain Garden Infiltration Media | 355 | CY | \$20 | \$7,100 |
| | Concrete Forebay | 1 | LS | \$1,800 | \$1,800 |
| | 24" RCP Outlet Pipe | 5 | LF | \$98 | \$490 |
| | Outlet Structure | 1 | LS | \$5,000 | \$5,000 |
| | Buried Soil Riprap Spillway | 6 | TN | \$104 | \$624 |
| | SUBTOTAL | | | | \$16,754 |
| | Engineering @ 10% | | | | \$1,675 |
| | Contingency @ 5% | | | | \$838 |
| | TOTAL (NON-REIMBURSABLE) | | | | \$19,267 |
| Note: This estimate does not include costs for street improvements and general civil costs (curb & gutter, crosspans, retaining walls, etc.) | | | | | |

The cost estimate submitted herein is based on time-honored practices within the construction industry. As such the engineer does not control the cost of labor, materials, equipment or a contractor's method of determining prices and competitive bidding practices or market conditions. The estimate represents our best judgement as design professionals using current information available at the time of the preparation. The engineer cannot guarantee that proposals, bids and/or construction costs will not vary from this cost estimate.

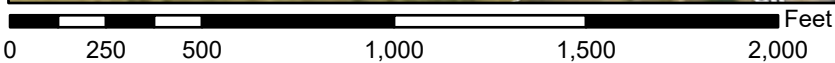
APPENDIX F

FIGURES

National Flood Hazard Layer FIRMMette



104°50'52"W 39°2'56"N



1:6,000

104°50'15"W 39°2'28"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

| | | |
|-----------------------------|--|---|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | | Area with Reduced Flood Risk due to Levee. See Notes. Zone X |
| | | Area with Flood Risk due to Levee Zone D |
| OTHER AREAS | | NO SCREEN Area of Minimal Flood Hazard Zone X |
| | | Effective LOMRs |
| GENERAL STRUCTURES | | Area of Undetermined Flood Hazard Zone D |
| | | Channel, Culvert, or Storm Sewer |
| | | Levee, Dike, or Floodwall |
| OTHER FEATURES | | 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation |
| | | 17.5 Water Surface Elevation |
| | | Coastal Transect |
| | | Base Flood Elevation Line (BFE) |
| | | Limit of Study |
| MAP PANELS | | Digital Data Available |
| | | No Digital Data Available |
| | | Unmapped |
| | | The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location. |



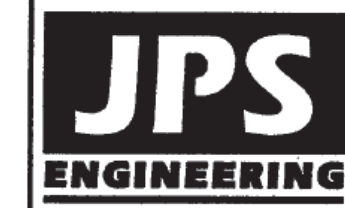
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/20/2024 at 2:03 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

LEGEND

- FILING LIMITS
- MAJOR BASIN BOUNDARY
- MINOR BASIN BOUNDARY
- 6520 EXISTING CONTOUR
- FLOWLINE
- ← PROPOSED FLOW DIRECTION ARROW
- PROPOSED DROP STRUCTURE
- ▲ DESIGN POINT
- ▲ Q_s (cfs)
▲ Q₁₀₀(cfs)
- BASIN DESIGNATION
- BASIN AREA (ACRES)

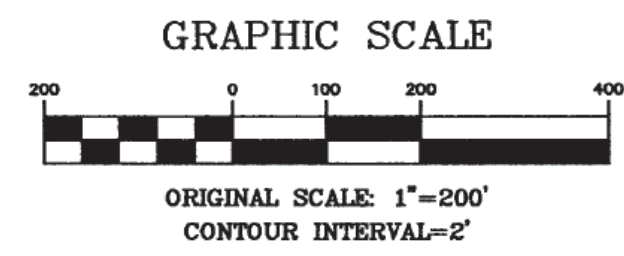
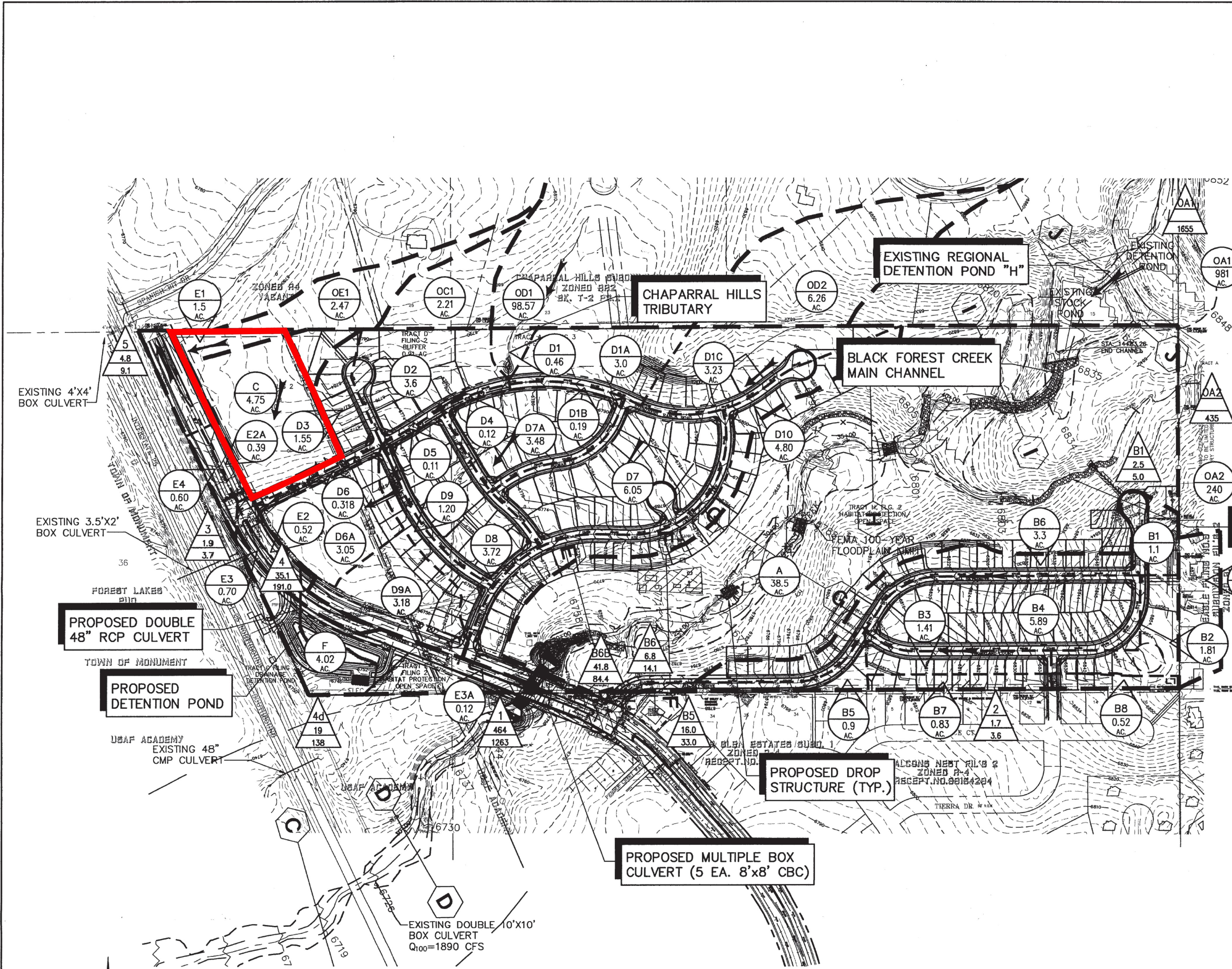


19 E. Willamette Ave.
Colorado Springs, CO
80903
PH: 719-477-9429
FAX: 719-471-0766

STRUTHERS RANCH SUBDIVISION

DEVELOPED DRAINAGE PLAN

| No. | REVISION | BY | DATE |
|-----|---------------------|-----|---------|
| 1 | EPC COMMENTS | JPS | 4/8/04 |
| 2 | EPC COMMENTS | JPS | 5/7/04 |
| 3 | EPC COMMENTS | JPS | 5/25/04 |
| 4 | EPC COMMENTS | JPS | 9/2/04 |
| 5 | RE-SUBMITTAL TO EPC | JPS | 9/30/04 |



- NOTES:
- DEVELOPMENT SHALL FOLLOW ALL REQUIREMENTS OF THE APPROVED HABITAT CONSERVATION PLAN (HCP) AND ASSOCIATED ENVIRONMENTAL PERMITS.
 - PERIMETER DRAINS SHALL BE REQUIRED FOR ALL HOMES WITH BASEMENTS.

| | |
|-----------------------|-------------------------|
| HORIZ. SCALE: 1"=200' | DRAWN: MJP |
| VERT. SCALE: N/A | DESIGNED: JPS |
| SURVEYED: PINNACLE | CHECKED: JPS |
| CREATED: 9/11/00 | LAST MODIFIED: 10/15/04 |
| PROJECT NO: 080006 | MODIFIED BY: MJP |

D1

J:_p\projects\080006\struthers_ranch\civil\01.dwg Oct 15, 2004 -- 12:12pm

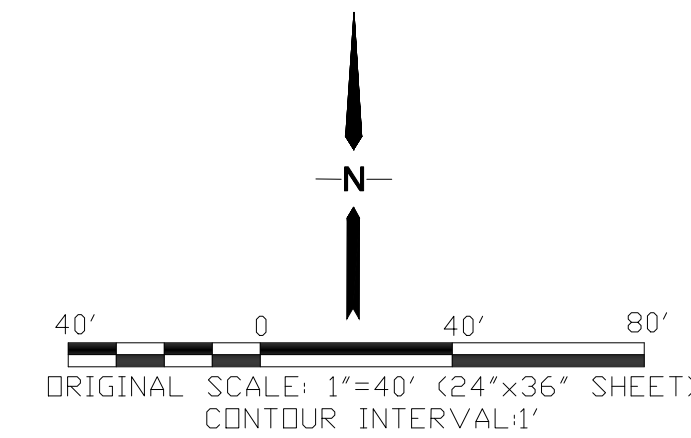


CALL UTILITY NOTIFICATION
CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE, OR EXCAVATE
FOR THE MARKING OF UNDERGROUND
MEMBER UTILITIES.

| NO. | REVISION | DATE |
|-----|----------|------|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**EXISTING CONDITIONS
DRAINAGE PLAN**

**CATHEDRAL ROCK CHURCH
TRACT A, STRUTHERS RANCH FILING NO. 2**



LEGEND

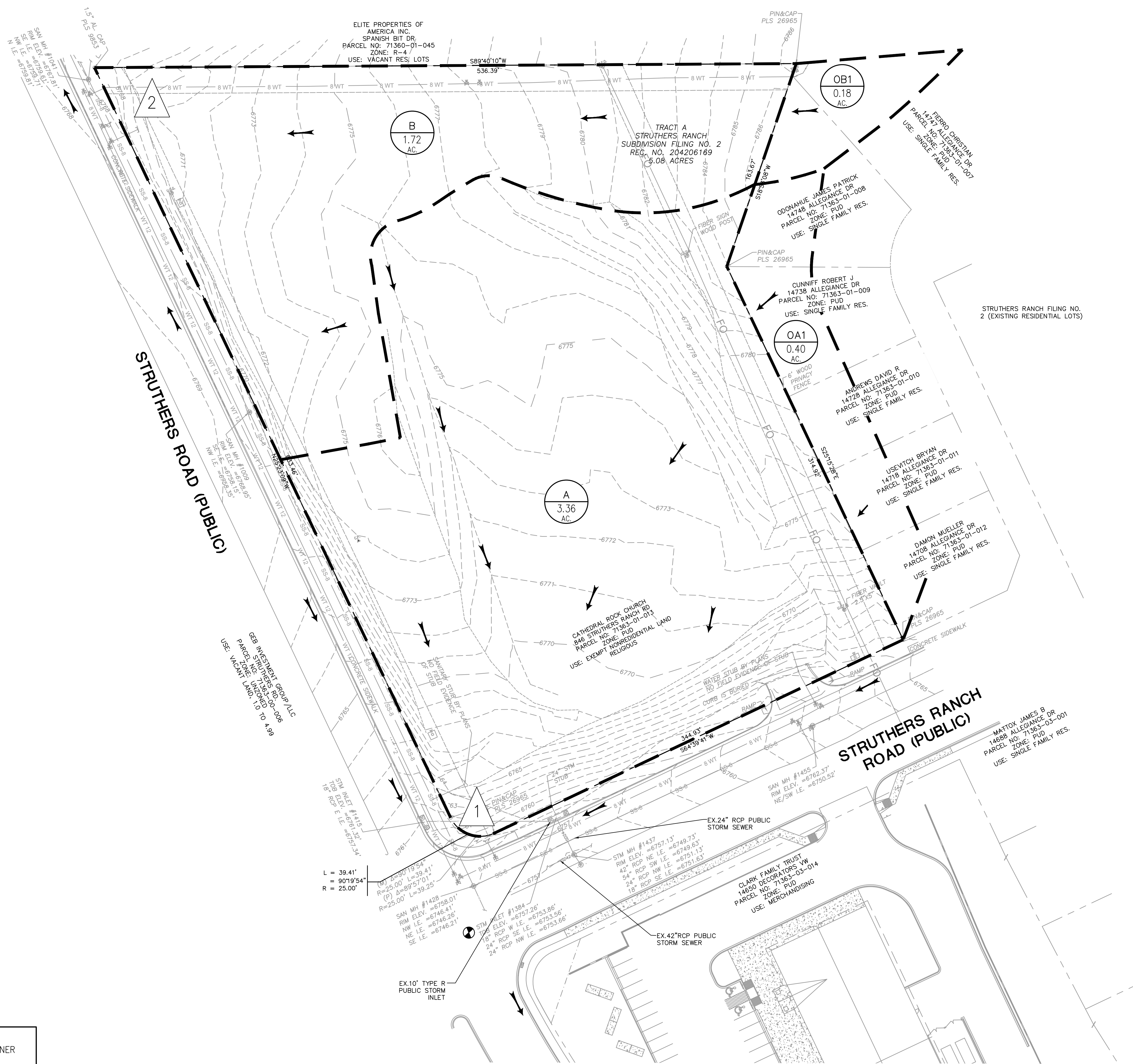
- PROPERTY LINE
- - - DRAINAGE BASIN BOUNDARY
- 6760 PROPOSED CONTOUR
- 6760 EXISTING CONTOUR
- FLOWLINE
- FLOW DIRECTION ARROW
- △ DESIGN POINT
- BASIN DESIGNATION
- BASIN AREA (ACRES)

BASIN SUMMARY TABLE

| BASIN | Q5 (CFS) | Q100 (CFS) |
|-------|----------|------------|
| OA1 | 0.5 | 1.3 |
| A | 1.0 | 7.6 |
| OB1 | 0.2 | 0.6 |
| B | 0.7 | 5.2 |

SUMMARY HYDROLOGY TABLE

| DESIGN POINT | Q5 (CFS) | Q100 (CFS) |
|--------------|----------|------------|
| 1 | 1.4 | 8.5 |
| 2 | 0.7 | 4.1 |



BENCHMARK
STORM INLET NEAR SW CORNER
OF SITE TOB EL=6757.26
(DATUM: NGVD 1929)

HORZ. SCALE: 1"=40'
VERT. SCALE: N/A
SURVEYED: RIDGELINE
CREATED: 05/27/20
PROJECT NO: 082401

DRAWN: PV
DESIGNED: JPS
CHECKED: JPS
LAST MODIFIED: 09/23/24
MODIFIED BY: PV

SHEET: **EX1**

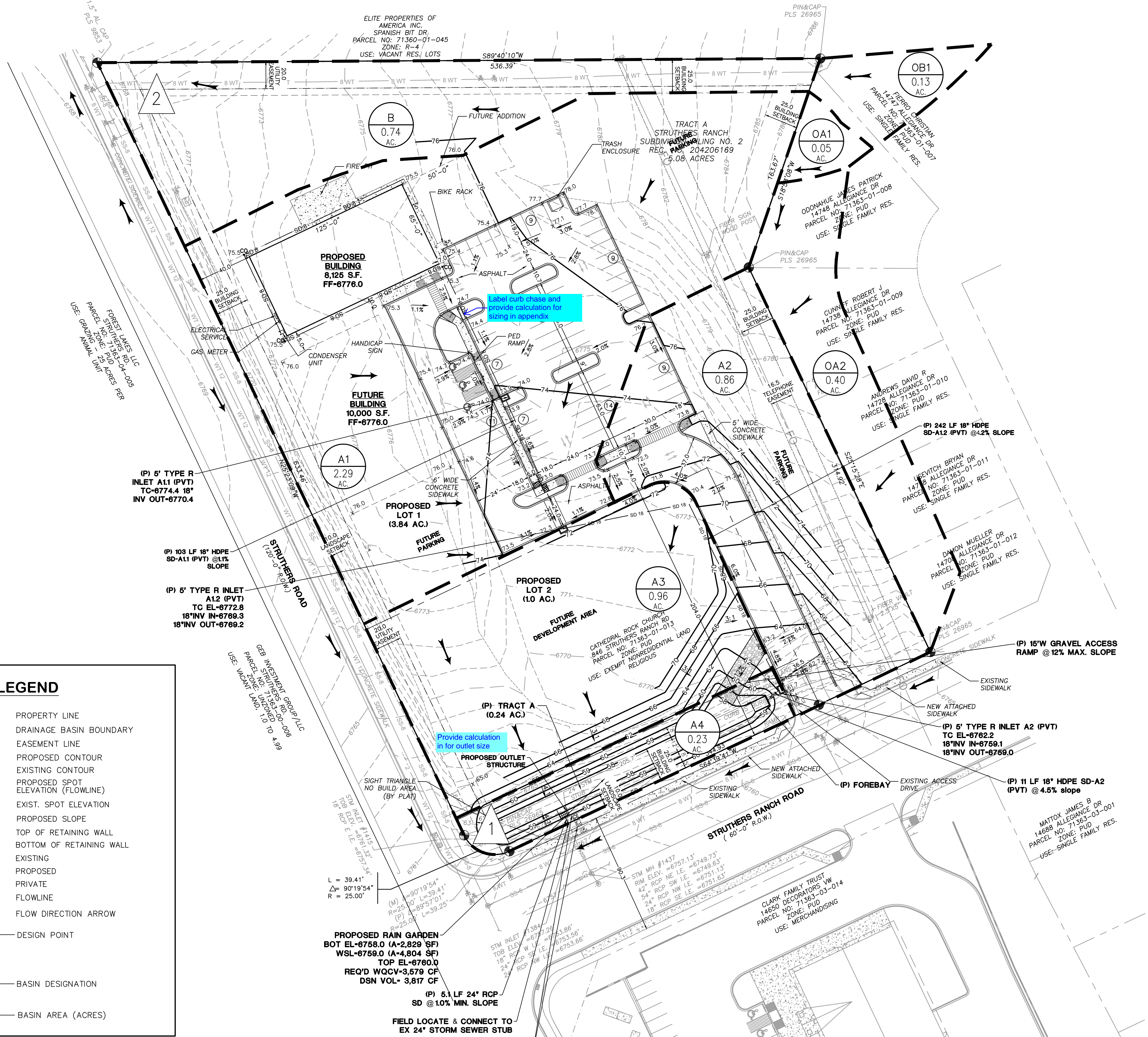
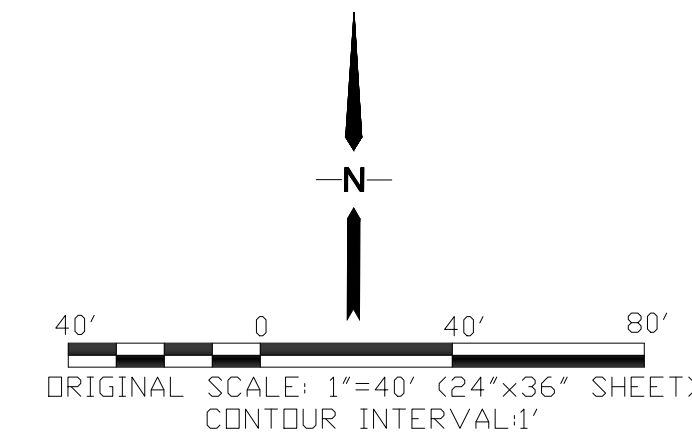


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BEFORE YOU DIG, GRADE, OR EXCAVATE
FOR THE MARKING OF UNDERGROUND
MEMBER UTILITIES.

| NO. | DATE | BY | REVISION |
|-----|------|----|----------|
| | | | |
| | | | |
| | | | |

DEVELOPED DRAINAGE PLAN

CATHEDRAL ROCK CHURCH TRACT A, STRUTHERS RANCH FILING NO. 2



LEGEND

- PROPERTY LINE
- DRAINAGE BASIN BOUNDARY
- EASEMENT LINE
- - - PROPOSED CONTOUR
- - - EXISTING CONTOUR
- × 49.0 PROPOSED SPOT ELEVATION (FLOWLINE)
- × 74.5 EXIST. SPOT ELEVATION
- 10% PROPOSED SLOPE
- TW TOP OF RETAINING WALL
- BW BOTTOM OF RETAINING WALL
- (E) EXISTING
- (P) PROPOSED
- PVT PRIVATE
- FLOWLINE
- FLOW DIRECTION ARROW
- 1 DESIGN POINT
- A BASIN DESIGNATION
- XX BASIN AREA (ACRES)

BENCHMARK.
STORM INLET NEAR SW CORNER
OF SITE TOB EL=6757.26
(DATUM: NGVD 1929)

BASIN SUMMARY TABLE

| DESIGN BASIN | Q5 (CFS) | Q100 (CFS) |
|--------------|----------|------------|
| OA1 | 0.1 | 0.2 |
| OA2 | 0.5 | 1.3 |
| A1 | 7.9 | 15.6 |
| A2 | 2.6 | 5.3 |
| A3 | 3.6 | 6.7 |
| A4 | 0.1 | 0.7 |
| OB1 | 0.2 | 0.4 |
| B | 0.3 | 2.3 |

DEVELOPED CONDITIONS SUMMARY HYDROLOGY TABLE

| DESIGN POINT | Q5 (CFS) | Q100 (CFS) |
|--------------|----------|------------|
| 1 | 10.6 | 21.8 |
| 2 | 0.4 | 1.9 |

IMPERVIOUS AREA CALCULATIONS:

BASIN A1 AREA = 2.29 AC.

| SURFACE TYPE | AREA |
|------------------------------|---------------------------|
| CONC. SIDEWALK | 5,071 SF |
| ASPHALT PAVEMENT | 27,048 SF |
| BUILDING (PH.1) | 8,125 SF |
| BUILDING (FUTURE) | 13,250 SF |
| PAVEMENT (FUTURE) | 17,584 SF |
| TOTAL IMPERVIOUS AREA | 71,078 SF = 1.6 AC |

= **69.86%**

IMPERVIOUS AREA CALCULATIONS:

BASIN A2 AREA = 0.86 AC.

| SURFACE TYPE | AREA |
|------------------------------|---------------------------|
| CONC. SIDEWALK | 1,691 SF |
| ASPHALT PAVEMENT | 11,876 SF |
| PAVEMENT (FUTURE) | 9,213 SF |
| TOTAL IMPERVIOUS AREA | 22,780 SF = 0.5 AC |

= **58.13%**

IMPERVIOUS AREA CALCULATIONS:

BASIN A3 AREA = 0.96 AC.

FUTURE COMMERCIAL DEVELOPMENT ASSUMED IMPERVIOUS AREA = **85%**

IMPERVIOUS AREA CALCULATIONS:

BASIN A4 AREA = 0.23 AC.

| SURFACE TYPE | AREA |
|------------------------------|--------------------|
| CONC. SIDEWALK | 0 SF |
| ASPHALT PAVEMENT | 0 SF |
| BUILDING (PH.) | 0 SF |
| BUILDING (FUTURE) | 0 SF |
| PAVEMENT (FUTURE) | 0 SF |
| TOTAL IMPERVIOUS AREA | 0 SF = 0 AC |

= **0%**

IMPERVIOUS AREA CALCULATIONS:

BASIN B AREA = 0.74 AC.

| SURFACE TYPE | AREA |
|------------------------------|--------------------|
| CONC. SIDEWALK | 0 SF |
| ASPHALT PAVEMENT | 0 SF |
| BUILDING (PH.) | 0 SF |
| BUILDING (FUTURE) | 0 SF |
| PAVEMENT (FUTURE) | 0 SF |
| TOTAL IMPERVIOUS AREA | 0 SF = 0 AC |

= **0%**

| | |
|---------------------|-------------------------|
| HORZ. SCALE: 1"=40' | DRAWN: PV |
| VERT. SCALE: N/A | DESIGNED: JPS |
| SURVEYED: RIDGELINE | CHECKED: JPS |
| CREATED: 05/27/20 | LAST MODIFIED: 09/23/24 |
| PROJECT NO: 082401 | MODIFIED BY: PV |

D1.1