FINAL DRAINAGE REPORT

for

CARVANA/ADESA EXPANSION LOT
FOUNTAIN, CO

Prepared for

CARVANA
300 E. RIO SALADO PKWY BLDG. 1
TEMPE, AZ 85281

Submitted by: Atwell, LLC

05/28/2026

CONTENTS

CERTIFICATION STATEMENT

This report and plan for final drainage design of Carvana/Adesa Expansion Lot was prepared under my direction and supervision and is correct to the best of my knowledge and belief. Said drainage letter has been prepared according to the criteria established by the City for drainage letters and said letter is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent act, errors, or omissions on my part in preparing this letter.

SIGNATURE

Benjamin Satterwhite, Project Manager
Registered Professional Engineer
State Of Colorado **No. LICENSE #54925**

DEVELOPER CERTIFICATION STATEMENT

I, Jo Ryan, the owner/developer, have read and will comply with all the requirements specified in this drainage letter and plan.

Date: _____

By: _____

Signature: _____

Fountain, Colorado:

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

Conditions:

GENERAL LOCATION AND DESCRIPTION

The site is located within Lot 1, Christian Subdivision Filing No. 1, Lot 1 and Tract A, Cristian Subdivision Filing No. 2, Tract A, Christian Subdivision Filing No. 3, and a portion of the southwest quarter of section 6 and the northwest quarter of section 7, township 16 south, range 65 west of the sixth principal meridian, City of Fountain, El Paso County, Colorado.

The overall site encompasses approximately 94.720 acres. Of this total area, approximately 27.7 acres within the northern parcel, consisting of previously unplatted land, are proposed to be developed as a paved parking area. The remaining portions of the site will remain in their existing condition and will continue to convey runoff in accordance with existing drainage patterns.

The southern portion of the site, platted as Christian Subdivision Filing No. 2 Lot 1, is currently developed and is proposed to remain in its existing developed condition. The previously approved MDDP and Final Drainage Report for the southern parcel are included in the appendix.
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SOILS AND EXISTING SITE CONDITIONS

The project site consists of two parcels separated by an unnamed drainage channel. The southern parcel is currently developed and will remain in its existing condition, while the northern parcel is presently undeveloped and is proposed for future drainage improvements associated with the project.

The existing developed southern parcel contains multiple buildings, paved parking areas, an existing detention pond, and stormwater infrastructure including inlets, manholes, and reinforced concrete pipe (RCP) systems. Existing on-site runoff is collected and conveyed through the established storm drainage system to the existing drainage channel, which ultimately discharges to Fountain Creek. The southern developed area was previously analyzed and designed under the Major Drainageway Planning and Design Process (MDDP) study and Final Drainage Report prepared by Obering, Wurth & Associates (1999). Copies of these reports are included in the Appendix. The existing drainage patterns and stormwater infrastructure within the southern parcel are proposed to remain unchanged.

The northern parcel is currently undeveloped and is predominantly covered by native grasses and vegetation. Existing ground slopes generally range from approximately 2% to 20% and primarily drain from north to south toward the unnamed drainage channel located between the two parcels, which ultimately conveys runoff to Fountain Creek. The site is bounded by Fort Carson to the west and South Oak Ranch Road to the east.

According to available soil mapping, on-site soils consist of Hydrologic Soil Groups A through D. Type A soils comprise approximately 22.2% of the site and consist primarily of the Schamber-Razor Complex. Type B soils comprise approximately 11.1% of the site and consist of Ustic Torrifluvents loamy soils. Type C soils represent approximately 54.4% of the site and consist primarily of Heldt clay loam and Kimera loam. Type D soils comprise approximately 12.3% of the site and consist primarily of Midway-Razor clay loam soils.

An unnamed drainage channel traverses the site from west to east and separates the northern and southern parcels. This channel was previously evaluated as part of the referenced MDDP study, which determined an existing 100-year peak flow rate of approximately 4,328 cubic feet per second (cfs).

Proposed drainage improvements associated with this project will occur only within the northern parcel and portions of the unnamed drainage channel. Improvements will generally consist of private storm sewer infrastructure designed to collect and convey stormwater runoff generated by the proposed development. No modifications are proposed within the existing developed southern parcel, and the existing stormwater infrastructure and detention facilities will remain in place and continue to function under existing drainage patterns.

FLOODPLAIN

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map No. 08041C0962G dated December 7, 2018, the site lies within Zone X, which is designated as "Areas determined to be outside the 0.2% annual chance flood hazard area."

El Paso County is involved with the Colorado Hazard Mapping Program (CHAMP) because the CWCB delegates its authority to the County to enforce the regulatory floodplain. El Paso County is part of the NFIP (National Flood Insurance Program) which provides assistance to property owners affected by flooding. Inclusion into this program requires that the County enforce floodplain regulations and any changes made to the regulatory maps. Failure to implement these changes could result in the County losing its NFIP status as such a Preliminary FEMA FIRM panel is also included in Appendix C that was remapped as part of CHAMP.

DRAINAGE BASIN CRITERIA

The Fountain Creek Watershed District (FCWD) Design Manuals were used in conjunction with the Mile High Flood District Criteria Manual. The rational method was used for drainage basins less than 100-acres. The 5-year design frequency was used for the minor storm, and a 100-year design frequency was used for the major storm in calculating onsite storm facility hydraulics. The one-hour point rainfall depth used for the 5-year storm was 1.28 inches and 2.78 inches for the 100-year event.

Waivers from Criteria

A request for underground detention will be submitted.

HISTORIC AND OFFSITE DRAINAGE BASINS

The site is currently undeveloped and existing. It is currently covered in existing vegetation and generally flows south to the existing drainage channel running through the south of the site.

The channel was previously designed and evaluated as part of an existing MDDP and Final Drainage Report prepared by Obering, Wurth & Associates, dated 1999.

Descriptions of the major basins are provided below. A drainage basin exhibit is included in the Appendix.

Offsite Basins

OS-1 (23.24 ac, Q_5 = 0.68 cfs, Q_{100} = 11.76 cfs) is an off-site basin located on the northernmost section and consists of undeveloped open space. The historic drainage pattern sheet flows down to

defined lowpoints where channels have been created between two ridges. Where it eventually flows into Basin EX-1.

OS-2 (3.48 ac, Q_5 = 0.76 cfs, Q_{100} = 11.76 cfs) is an off-site basin located in the north part of the site, just south of Basin OS-1 and consists of undeveloped open space and an existing off-site pond. Flows from this basin continue south and drain into the channel running through the middle of the site.

OS-3 (1.57 ac, Q_5 = 0.29 cfs, Q_{100} = 4.14 cfs) is an off-site basin located on the west of the side near the middle of the southern parcel and consists of undeveloped open space that flows into basin F1 where it then flows into the channel flowing through the middle of the site.

OS-4 (63.66 ac, Q_5 = 8.16 cfs, Q_{100} = 118.04 cfs) is an off-site basin located on the southern most part of the site and generally sheet flows from south to north where is picked up by a natural swlae and flows into basin F1 where it then flows into the channel flowing through the middle of the site.

On-site Bains (undeveloped)

G1 (0.91 ac, Q_5 = 0.04 cfs, Q_{100} = 0.72 cfs) is a major basin located in the northern tip of the site. This basin sheet flows west to east at generally steep slopes greater than 15% where is flows offsite toward South Oak Ranch Road

A1 (4.52 ac, Q_5 = 0.18 cfs, Q_{100} = 3.11 cfs) is a major basin located in the north of site, directly south of basin G1. This basin sheet flows west to east at generally steep slopes greater than 15% where is flows offsite toward South Oak Ranch Road.

B1 (16.79 ac, Q_5 = 2.36 cfs, Q_{100} = 34.13 cfs) is a major basin located in the northern portion of the site, directly south of basin A1. This basin generally sheet flows north tot south where it drains directly into the unnamed channel.

C1 (6.43 ac, Q_5 = 0.36 cfs, Q_{100} = 1.64 cfs) is a major basin that separates the north and south parcels, it comprises of the unnamed channel that flows west to east. This channel was previously studied in the MDDP by Obering, Wurth & Associates, dated 1999, and was shown to have a 100-year flow of 4,328 cfs.

D1 (12.30 ac, Q_5 = 35.50 cfs, Q_{100} = 82.56 cfs) is a major basin that is in the southern parcel just south of the channel. This basin consists of existing paved parking areas, curb and gutter, existing buildings and existing stormwater infrastructure and existing pond 2. Runoff from this basin sheet flows south to north where it is directed to existing detention pond 2. Existing pond 2 outfalls directly into the channel. This basin was described in the Final Drainage Report and Plan Christian Subdivision Filing No. 2 by Obering, Wurth & Associates, dated 1999, as Basin C (12.3 acres).

H1 (5.10 ac, Q_5 = 15.34 cfs, Q_{100} = 35.67 cfs) is a major basin in the southern parcel. This basin consists of existing paved parking areas, curb and gutter, existing buildings and existing stormwater infrastructure. Runoff flows west to east where it drains directly into a roadside ditch and directly into the existing channel.

E1 (35.80 ac, Q_5 = 103.34 cfs, Q_{100} = 240.29 cfs) is a major basin and is in the most southern basin if the site. This basin consists of existing paved parking areas, curb and gutter, existing buildings and

existing stormwater infrastructure and existing detention pond 1. Runoff sheet flows across the site to local low points where it is picked up and conveyed by the exiting stormwater infrastructure. The run off is conveyed to exiting detention pond 1 where it is released to the existing channel.

F1 (10.46 ac, Q_5 = 0.38cfs, Q_{100} = 11.40 cfs) is a major basin on the western edge of the southern site. This basin consists of a swale that conveys drainage south to north into the existing channel. This existing swale conveys runoff from offsite basin OS-4.

I1 (10.46 ac, Q_5 = 1.16 cfs, Q_{100} = 34.44 cfs) is a major basin south of basin E1. It is currently undeveloped open space and generally slopes east to west. Stormwater runoff in this basin follows exiting drainage patterns and eventually outfalls DRAINAGE FACILITY DESIGN
The Site consists of one major basin that has been broken down into multiple sub-basins within the property boundary. A drainage map is included in the appendix.

PROPOSED DRAINAGE BASINS

Site grading design is preliminary at this stage of development. As a result, the proposed developed drainage patterns presented within this MDDP are based on the assumption that post-development runoff patterns will generally mimic existing drainage conditions to the maximum extent practicable. As the project design advances, drainage patterns and associated infrastructure should be further evaluated and refined in subsequent drainage studies and Final Drainage Reports prepared for individual site development phases.

For the purposes of this report, only the northern parcel is proposed for future development. The southern parcel, including all existing stormwater infrastructure and drainage facilities, is proposed to remain in its current condition and continue to function in accordance with the approved Final Drainage Report and Plan for Christian Subdivision Filing No. 2 prepared by Obering, Wurth & Associates (1999).

The preliminary drainage design concept for the northern parcel is based on conveying runoff via sheet flow across paved and landscaped areas toward localized low points containing sump inlets. Stormwater runoff captured by the proposed inlets will be conveyed through a private storm sewer system to a proposed underground detention and water quality facility. Detained flows will then be released at controlled rates into the existing drainage channel. Preliminary detention sizing and water quality volume requirements will be further evaluated and refined during subsequent phases of design to ensure compliance with applicable drainage criteria and standards.

No drainage improvements or modifications are proposed within the southern parcel. Existing drainage patterns, stormwater conveyance infrastructure, and detention facilities within the southern parcel will remain unchanged and continue to operate in accordance with the existing Final Drainage Report.

Drainage Basin A Sub-Basin Descriptions

Basin A-1 (0.91 ac, Q_5 = 0.04 cfs, Q_{100} = 0.72 cfs) is a major basin located in the northern tip of the site. This basin sheet flows west to east at generally steep slopes greater than 15% where is flows offsite toward South Oak Ranch Road

Basin A-2 (2.04 ac, Q5= 3.05 cfs, Q100=7.80 cfs) is the northernmost basin of the site. It consists of asphalt pavement and curb and gutter. The stormwater sheet-flows west to east where it is picked up in curb and gutter and flows into a 10' Type R inlet, (Design point A1).

Basin A-3 (3.18 ac, Q5= 9.80 cfs, Q100=22.94 cfs) is located in the northern half of the site and consists of asphalt pavement and curb and gutter. The stormwater sheet-flows west to east where it is picked up in curb and gutter and flows into a 10' Type R inlet, (Design point A3).

Basin A-4 (2.44 ac, Q5= 7.86 cfs, Q100=18.41 cfs) is located in the southern half of the site on the eastern boundary and consists of asphalt pavement and curb and gutter. The stormwater sheet-flows northwest to southeast where it is picked up in a CDOT Type D inlet, (Design point A4).

Basin A-5 (1.61 ac, Q5= 4.96 cfs, Q100=11.61 cfs) is located in the southern half of the site on the eastern boundary and consists of asphalt pavement and curb and gutter. The stormwater sheet-flows northwest to southeast where it is picked up in curb and gutter and flows into a 10' Type R inlet, (Design point A5).

Basin A-6 (1.28 ac, Q5= 4.15 cfs, Q100=9.71 cfs) is located on the southeast corner of the site and consists of asphalt pavement and curb and gutter. The stormwater sheet-flows north to south where it is picked up in curb and gutter and flows into a 10' Type R inlet, (Design point A6).

Basin A-7 (1.33 ac, Q5= 4.38 cfs, Q100=10.25 cfs) is located in the south of the site and consists of asphalt pavement and curb and gutter. The stormwater sheet-flows north to south where it is picked up in curb and gutter and flows into a 10' Type R inlet, (Design point A7).

Basin A-8 (1.29 ac, Q5= 3.74 cfs, Q100=8.75 cfs) is located on the southwest corner of the site and consists of asphalt pavement and curb and gutter. The stormwater sheet-flows north to south where it is picked up in curb and gutter and flows into a 10' Type R inlet, (Design point A8).

Basin A-9 (0.59 ac, Q5= 2.07 cfs, Q100=4.85 cfs) is located to the south of the site and contains the access path over the existing channel. The basin consists of a paved road and curb and gutter. Stormwater sheet flows across the street where it is captured and conveyed by the curb and gutter to a 10' type R inlet.

C1 (6.43 ac, Q_5 = 0.87 cfs, Q_{100} = 25.81 cfs) is a major basin that separates the north and south parcels, it comprises of the unnamed channel that flows west to east. This channel was previously studied in the MDDP by Obering, Wurth & Associates, dated 1999, and was shown to have a 100-year flow of 4,328 cfs.

D1 (12.30 ac, Q_5 = 35.50 cfs, Q_{100} = 82.56 cfs) is a major basin that is in the southern parcel just south of the channel. This basin consists of existing paved parking areas, curb and gutter, existing buildings and existing stormwater infrastructure and existing pond 2. Runoff from this basin sheet flows south to north where it is directed to existing detention pond 2. Existing pond 2 outfalls directly into the channel. This basin was described in the Final Drainage Report and Plan Christian Subdivision Filing No. 2 by Obering, Wurth & Associates, dated 1999, as Basin C (12.3 acres).

H1 (5.10 ac, Q_5 = 15.34 cfs, Q_{100} = 35.67 cfs) is a major basin in the southern parcel. This basin consists of existing paved parking areas, curb and gutter, existing buildings and existing stormwater

infrastructure. Runoff flows west to east where it drains directly into a roadside ditch and directly into the existing channel.

E1 (35.80 ac, Q_5 = 103.34 cfs, Q_{100} = 240.29 cfs) is a major basin and is in the most southern basin if the site. This basin consists of existing paved parking areas, curb and gutter, existing buildings and existing stormwater infrastructure and existing detention pond 1. Runoff sheet flows across the site to local low points where it is picked up and conveyed by the exiting stormwater infrastructure. The run off is conveyed to exiting detention pond 1 where it is released to the existing channel.

F1 (10.46 ac, Q_5 = 0.38cfs, Q_{100} = 11.40 cfs) is a major basin on the western edge of the southern site. This basin consists of a swale that conveys drainage south to north into the existing channel. This existing swale conveys runoff from offsite basin OS-4.

I1 (10.46 ac, Q_5 = 1.16 cfs, Q_{100} = 34.44 cfs) is a major basin south of basin E1. It is currently undeveloped open space and generally slopes east to west. This basin is planned to remain undeveloped. Stormwater runoff in this basin follows exiting drainage patterns and eventually outfalls into Fountain Creek.

STORM WATER CONVEYANCE AND STORAGE FACILITIES

The proposed on-site conveyance facilities will consist of a combination of storm pipes, inlets, manholes, and curb and gutter and has been designed using runoff data from calculations shown in Appendix D. Proposed drainage patterns will generally follow historic patterns outlined in this report. At sump conditions, inlets will be sized to collect the 100-year flows. Runoff entering inlets will ultimately be conveyed to proposed detention basin Pond A.

Pond A is designed as an underground full-spectrum extended detention basin to provide water quality treatment and detention for runoff from Basin A. Pond A is sized to accommodate the WQCV, EURV, and 100-year storm volumes.

Pond A is calculated to require a total volume of 2.122 acre-ft and has been designed with a total volume of 2.176 acre-ft. Pond A was sized using the MHFD Detention spreadsheet software. Pond A has a 5-year detained release rate of 0.3 cfs and a 100-year detained release rate of 15.8 cfs. Pond A is designed to be an underground detention facility by Contech Engineers Solutions LLC. The underground detention facility will utilize 1200 linear feet if 10’ CMP for a total storage volume of 2.176 ac-ft.

Once stormwater drainage leaves the underground detention facility it will enter a downstream manhole with an orifice plate inside to control the release rates from the stormwater system. Three consecutive orifice holes of 1-15/16-inch diameter will be used to control the release rate for the detained WQCV and EURV storm events. An additional 10”x2” orifice hole will allow the detained 100-year storm event to be released at a 0.8 ratio of peak outflow to the predevelopment flow. The orifice plate will be 7.0 feet in height. The top on the manhole is at a height of 12.5 feet from the bottom of the orifice plate to ground level. In the case of emergency, the stormwater will overtop the orifice plate and flow into the downstream 24” RCP, in the emergency event the orifice plate will act as a weir. The height of the 100-year event will be 8.88 feet heigh, leaving 3.62’ between the 100-year WSEL and the top of the manhole, in compliance with the 1-foot freeboard requirement.

FOUR STEP PROCESS

The Four Step Process focuses on reducing runoff volumes, treating the WQCV, stabilizing drainageways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring events, as opposed to larger storms for which drainage and flood control infrastructure are sized. The Four Step Process is summarized below and elements of the designed development are presented as a means to address and follow this process. This project in conformance with the Green Infrastructure Manual.

1. Step 1: Employ Runoff Reduction Practices

The Site is developed to capture runoff from impervious areas at sump locations and local low points within the private storm system. Impervious area is avoided where functional hardscape is not needed for drive aisles, parking stalls, and pedestrian walkways. Seeding and mulching will be planted on the perimeter of the size to help reduce erosion and act as an effective buffer from the adjacent proposed paved parking lot.

2. Step 2: Implement Control Measures That Provide A Water Quality Capture Volume with Slow Release

A private underground extended detention basin is proposed for water quality and full-spectrum detention for the car wash development. An orifice plate within the outlet structure is designed to release the WQCV event at approximately the 40-hour mark, the EURV event at approximately the 68-hour mark, and the 100-year event at approximately the 72-hour mark. The private storm drain system throughout the Site collects and conveys stormwater runoff from impervious areas directly to the WQ control measure.

3. Step 3: Stabilize Drainageways

The Site utilizes concrete curb and gutter to channel stormwater from impervious runoff, mostly from paved parking areas. There are no formal drainageways within the Site. Sloped landscaped areas do not exceed 3H:1V grades and are to be seeded and mulched where plantings are not proposed.

Step 4: Implement Site Specific and Other Source Control Measures

Site construction is to follow a Stormwater Management Report and Grading and Erosion Control Plan that includes non-structural control measures during the initial, interim, and final phases of construction.

A Grading and Erosion Control Plan will be submitted for review and approval prior to construction.

CHANNEL MODIFICATION

The channel intersecting the site was analyzed using HEC-RAS version 6.6 utilizing a one-dimensional (1-D) hydraulic flow analysis based on the previously established 100-year design flow of 4,328 cfs from the prior MDDP study done by by Obering, Wurth & Associates, dated 1999.

As part of the proposed development, a channel crossing was identified as necessary to provide fire access connectivity between the northern and southern portions of the site. Due to the proposed crossing, a1-D hydraulic analysis was performed to evaluate and size the proposed culvert crossing such that the 100-year design flow can be conveyed without increasing upstream or downstream water surface elevations and without creating adverse hydraulic impacts to the channel system.

Based on the hydraulic modeling results, seven 12-foot by 12-foot box culverts, providing a minimum cumulative flow area of 1,008 square feet, are required to convey the design flow conditions. Supporting calculations, model outputs, and hydraulic results are provided in the Appendix.

MAINTENANCE

The private storm sewer system within the site, including inlets, pipes, and detention facilities are to be owned and maintained by the property owner.

CONCLUSION

This Final Drainage Plan report follows all standard criteria set forth by the City of Fountain drainage standards, the City of Colorado Springs Drainage Criteria Manual, and the Mile High Flood District Urban Drainage Criteria Manual, with a requested variance for underground detention. Downstream drainage facilities will not be negatively impacted, as existing drainage patterns and allowable release rates are planned to be maintained. Proposed flows leaving the site will enter the existing channel at the south end of the site. The existing channel will also be modified to include seven 12’x12’ box culverts to maintain the existing WSEL upstream and downstream a proposed fire access path across the channel. Allowable release rates are planned to be maintained so as not to adversely affect the downstream and surrounding developments.

REFERENCES

1) Urban Storm Drainage Criteria Manuals; Mile High Flood District; latest edition

2) City of Fountain, Colorado Design Manual Volume 1 - Policies and Procedures, Hydrology, Hydraulics and Revegetation

3) City of Fountain, Colorado Design Manual Volume 2 - Stormwater Quality and Best Management Practices

4) City of Colorado Springs Drainage Criteria Manuals, Volumes 1 and 2, latest revision May 2014, latest DCM revision dates (Vol 1 – 2021, Vol 2 -2020)

5) Flood Insurance Rate Map of El Paso County Colorado, Federal Emergency Management Agency, Flood Insurance Rate Map No. 08041C0962G

6) Hydrologic Soil Group – El Paso County, Colorado, Web Soil Survey, National Cooperative Soils Survey, February 27, 2026

7) Final Drainage Report and Plan Christian Subdivision Filing No. 2, Obering, Wurth & Associates, August 1999, Revised October 1999

8) Master Development Drainage Plan for Christian Annexation Phase I and Phase II, Obering, Wurth & Associates, August 1999, Revised October 1999

APPENDIX A
VICINITY MAP

CARVANA/ADESA EXPANSION LOT

PROJECT NO. 25010228
DATE: 05/08/2026

ATWELL
866.850.4200 www.atwell.com
4900 N SCOTTSDALE RD, SUITE 1600
SCOTTSDALE, AZ 85251
866.850.4200

APPENDIX B
SOILS SURVEY & FEMA FIRM MAP

NOTES TO USERS

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

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

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

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

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

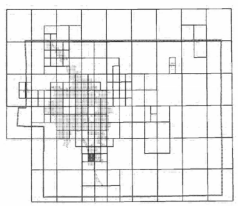
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

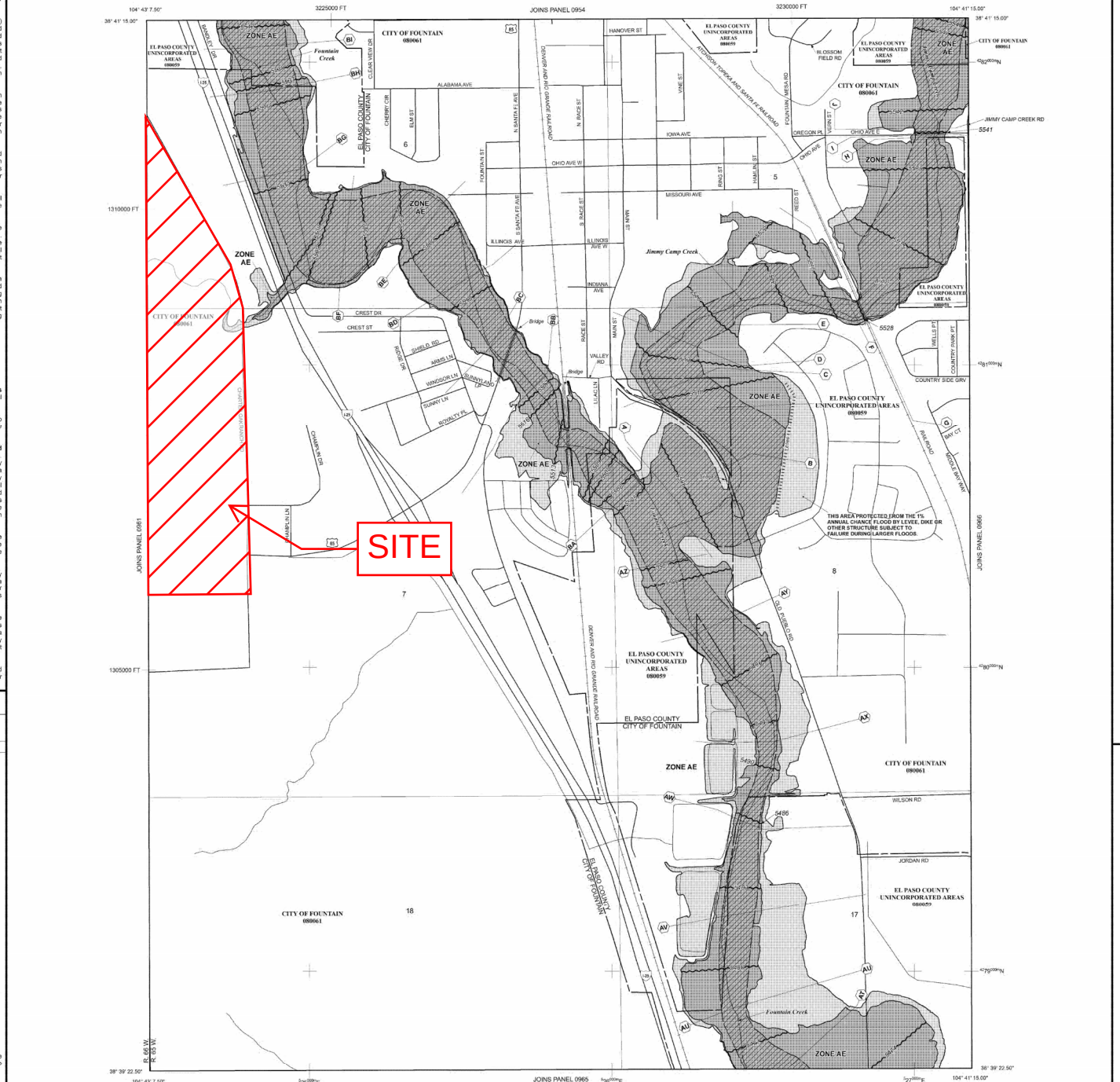
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
* Referenced to the North American Vertical Datum of 1988 (NAVD 88)
A — A — Cross section line
23 — 23 — Transect line
97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0962G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 962 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0962	G
FOUNTAIN, CITY OF	080061	0962	G

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

MAP NUMBER 08041C0962G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

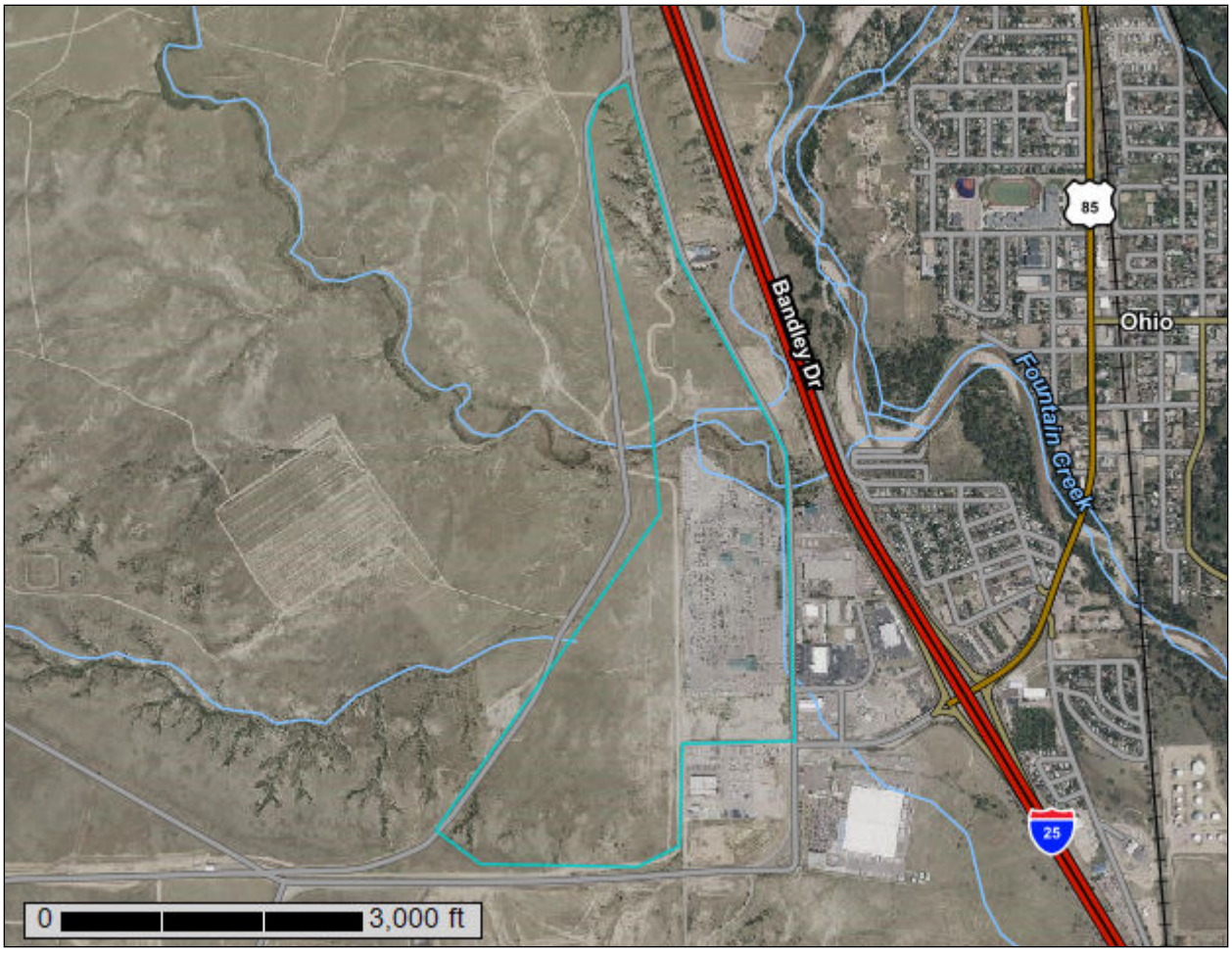
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for El Paso County Area, Colorado



May 8, 2026

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

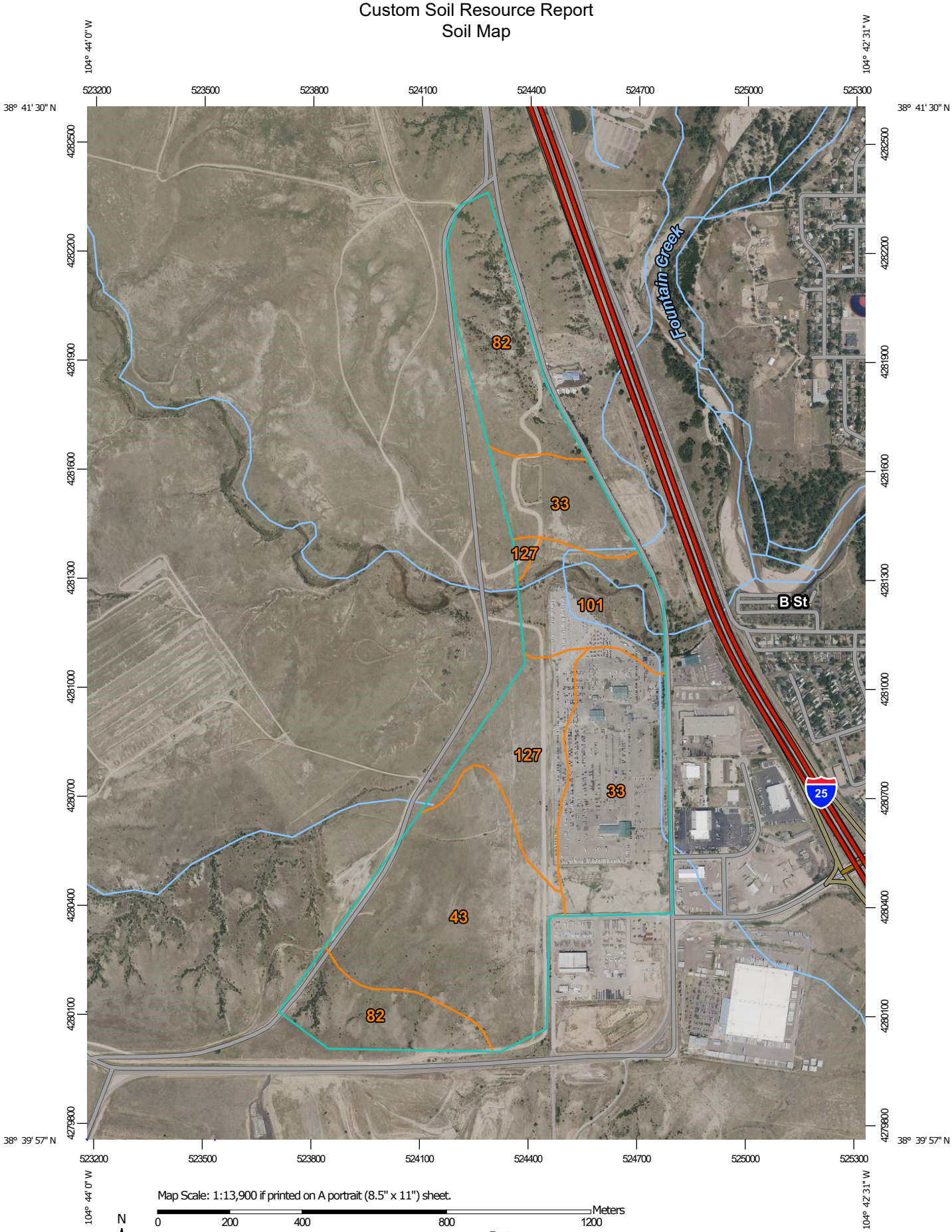
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map



MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
33	Heldt clay loam, 0 to 3 percent slopes	69.0	27.4%
43	Kimera loam, 0 to 5 percent slopes	71.8	28.5%
82	Schamber-Razor complex, 8 to 50 percent slopes	54.4	21.6%
101	Ustic Torrifluvents, loamy	26.9	10.7%
127	Midway-Razor clay loams, dry, 1 to 18 percent slopes	29.7	11.8%
Totals for Area of Interest		**251.9**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

33—Heldt clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3686
Elevation: 5,200 to 6,500 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Heldt

Setting

Landform: Stream terraces, Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium derived from shale

Typical profile

Ap - 0 to 8 inches: clay loam
Bw - 8 to 41 inches: silty clay
Bk - 41 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: R069XY047CO - Alkaline Plains
Other vegetative classification: ALKALINE PLAINS (069BY047CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

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

43—Kimera loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t51v
Landscape: Plains
Elevation: 3,700 to 6,400 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Kimera and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kimera

Setting

Landscape: Plains
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Old alluvium and/or eolian deposits

Typical profile

A - 0 to 6 inches: loam
Bw - 6 to 16 inches: loam
Bk1 - 16 to 28 inches: clay loam
Bk2 - 28 to 38 inches: loam
Bk3 - 38 to 79 inches: loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.21 to 0.71 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Very slightly saline (2.0 to 3.9 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R069XY006CO - Loamy Plains
Forage suitability group: Loamy (G069XW017CO)
Other vegetative classification: Loamy (G069XW017CO), Loamy Plains #6 (069XY006CO_2)
Hydric soil rating: No

Minor Components

Travessilla

Percent of map unit: 5 percent
Landscape: Plains
Landform: Scarps
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R069XY053CO - Sandstone Breaks
Other vegetative classification: Needs Field Review (G069XW050CO), Sandstone Breaks #53 (069XY053CO_2)
Hydric soil rating: No

Oterodry

Percent of map unit: 5 percent
Landscape: Plains
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY026CO - Sandy Plains
Hydric soil rating: No

Fort

Percent of map unit: 5 percent
Landscape: Plains
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains
Other vegetative classification: Loamy (G069XW017CO), Loamy Plains #6 (069XY006CO_2)

Hydric soil rating: No

Wilid

Percent of map unit: 5 percent
Landscape: Plains
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains
Other vegetative classification: Loamy (G069XW017CO), Loamy Plains #6 (069XY006CO_2)
Hydric soil rating: No

82—Schamber-Razor complex, 8 to 50 percent slopes

Map Unit Setting

National map unit symbol: 369y
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Schamber and similar soils: 55 percent
Razor and similar soils: 43 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Schamber

Setting

Landform: Breaks
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite and/or colluvium derived from granite and/or eolian deposits derived from granite

Typical profile

A - 0 to 5 inches: gravelly loam
AC - 5 to 15 inches: very gravelly loam
C - 15 to 60 inches: very gravelly sand

Properties and qualities

Slope: 8 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R069XY064CO - Gravel Breaks
Hydric soil rating: No

Description of Razor

Setting

Landform: Breaks
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 3 inches: clay loam
Bw - 3 to 9 inches: clay loam
Bk - 9 to 31 inches: clay
Cr - 31 to 35 inches: weathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R069XY047CO - Alkaline Plains
Other vegetative classification: ALKALINE PLAINS (069AY047CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

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

101—Ustic Torrifluvents, loamy

Map Unit Setting

National map unit symbol: 3673
Elevation: 5,500 to 7,000 feet
Mean annual precipitation: 13 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 125 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ustic torrifluvents and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ustic Torrifluvents

Setting

Landform: Stream terraces, Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy, clayey, stratified loamy

Typical profile

A - 0 to 6 inches: variable
C - 6 to 60 inches: stratified loamy sand to clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups
Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R069XY037CO - Saline Overflow
Other vegetative classification: OVERFLOW (069BY036CO)
Hydric soil rating: No

Minor Components

Other soils
Percent of map unit: 4 percent
Hydric soil rating: No

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

127—Midway-Razor clay loams, dry, 1 to 18 percent slopes

Map Unit Setting
National map unit symbol: 2t52f
Landscape: Plains
Elevation: 3,700 to 6,400 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition
Midway, dry, and similar soils: 46 percent
Razor, dry, and similar soils: 44 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Midway, Dry

Setting
Landscape: Plains
Landform: Hillslopes, Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Slope alluvium and/or residuum weathered from shale

Typical profile

A - 0 to 3 inches: clay loam
AC - 3 to 9 inches: clay
C - 9 to 16 inches: paragravelly clay
Cr - 16 to 79 inches: bedrock

Properties and qualities

Slope: 3 to 18 percent
Depth to restrictive feature: 11 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.00 to 0.21 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Very slightly saline to slightly saline (2.0 to 7.9 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R069XY046CO - Shaly Plains
Hydric soil rating: No

Description of Razor, Dry

Setting

Landscape: Plains
Landform: Hillslopes, Pediments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Slope alluvium and/or residuum weathered from shale

Typical profile

A - 0 to 4 inches: clay loam
Bw - 4 to 15 inches: silty clay
Bky - 15 to 30 inches: clay
Cr - 30 to 79 inches: bedrock

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.00 to 0.21 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Very slightly saline to slightly saline (2.0 to 7.9 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R069XY047CO - Alkaline Plains
Hydric soil rating: No

Minor Components

Manzanola

Percent of map unit: 9 percent
Landscape: Plains
Landform: Hillslopes, Fan remnants
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY042CO - Clayey Plains
Other vegetative classification: Loamy Plains #6 (069XY006CO_2)
Hydric soil rating: No

Rock outcrop

Percent of map unit: 1 percent
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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:

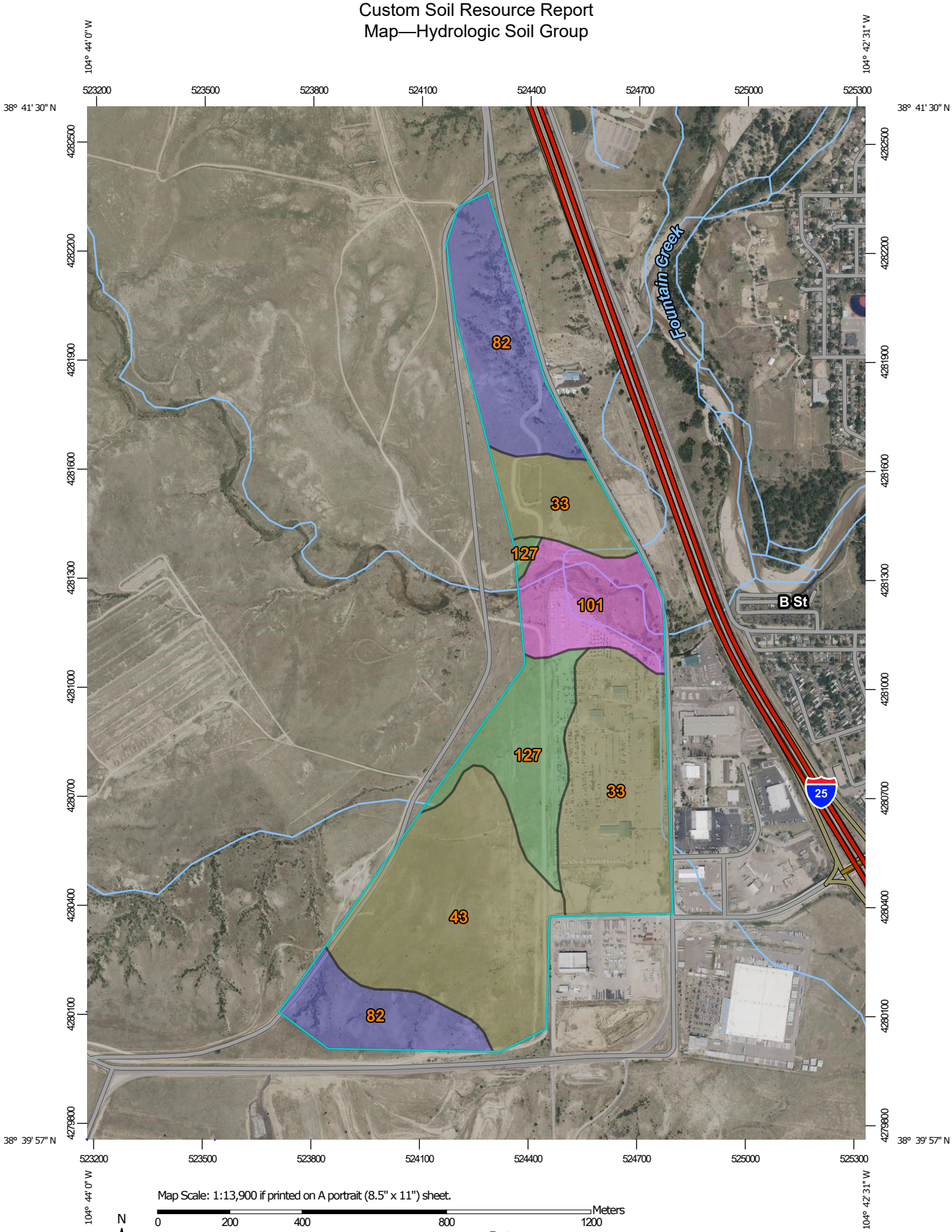
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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.


104° 44' 0" W
104° 42' 31" W
38° 41' 30" N
38° 39' 57" N
523200
523500
523800
524100
524400
524700
525000
525300
4282500
4282200
4281900
4281600
4281300
4281000
4280700
4280400
4280100
4279800
82
33
127
101
127
33
43
82
Fountain Creek
B St
25
Map Scale: 1:13,900 if printed on A portrait (8.5" x 11") sheet.
N
Meters
0
200
400
800
1200
Feet
0
500
1000
2000
3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
33	Heldt clay loam, 0 to 3 percent slopes	C	69.0	27.4%
43	Kimera loam, 0 to 5 percent slopes	C	71.8	28.5%
82	Schamber-Razor complex, 8 to 50 percent slopes	A	54.4	21.6%
101	Ustic Torrifluvents, loamy	B	26.9	10.7%
127	Midway-Razor clay loams, dry, 1 to 18 percent slopes	D	29.7	11.8%
Totals for Area of Interest			**251.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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APPENDIX C
HYDROLOGIC CALCULATIONS

Calculation of Peak Runoff using Rational Method

Designer: LMS
Company: Atwell, LLC
Date: 5/27/2026
Project: Existing Carvana/Adesa Expansion Lo
Location: Fountain, Colorado

MHFD-Rational, Version 3.00 (August 2025)

Cells of this color are for required user-input
Cells of this color are for optional override values

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

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

Computed $t_c = t_i + t_t$

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

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

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

Provide input for area, soil type, and imperviousness on the Runoff Coeffs worksheet.

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group(s)	Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time						
				WQE & 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)
A1	4.52	A	5.0%	0.02	0.02	0.02	0.03	0.07	0.15	0.29	500.00			0.100	20.42	210.00			0.030	2.5	0.43	8.08
B1	16.79	C/D	5.0%	0.03	0.08	0.17	0.35	0.42	0.50	0.60	500.00			0.100	19.34	1400.00			0.070	2.5	0.66	35.28
C1	6.43	B	5.0%	0.03	0.03	0.10	0.28	0.36	0.45	0.55	500.00			0.100	20.15	1750.00			0.010	15	1.50	19.44
D1	12.30	B	95.0%	0.79	0.81	0.82	0.85	0.86	0.87	0.88	500.00			0.020	9.30	0.00			0.020	20	2.83	0.00
E1	35.80	B	95.0%	0.79	0.81	0.82	0.85	0.86	0.87	0.88	500.00			0.020	9.30	0.00			0.020	20	2.83	0.00
F1	10.46	B	5.0%	0.03	0.03	0.10	0.28	0.36	0.45	0.55	20.00			0.250	2.98	3000.00			0.010	7	0.70	71.43
G1	0.91	A	5.0%	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00			0.070	17.79	150.00			0.100	2.5	0.79	3.16
OS1	23.24	A	5.0%	0.02	0.02	0.02	0.03	0.07	0.15	0.29	500.00			0.300	14.21	2000.00			0.030	2.5	0.43	76.98
OS2	3.48	C/D	5.0%	0.03	0.08	0.17	0.35	0.42	0.50	0.60	250.00			0.070	15.38	0.00			0.020	2.5	0.35	0.00
OS3	1.57	C/D	5.0%	0.03	0.08	0.17	0.35	0.42	0.50	0.60	500.00			0.070	21.76	0.00			0.020	2.5	0.35	0.00
OS4	63.66	C/D	5.0%	0.03	0.08	0.17	0.35	0.42	0.50	0.60	500.00			0.070	21.76	1200.00			0.020	2.5	0.35	56.57
H1	5.10	B	95.0%	0.79	0.81	0.82	0.85	0.86	0.87	0.88	400.00			0.020	8.32	0.00			0.020	20	2.83	0.00
I1	10.46	B	5.0%	0.03	0.03	0.10	0.28	0.36	0.45	0.55	100.00			0.060	10.67	0.00			0.020	2.5	0.35	0.00

Calculation of Peak Runoff using Rational Method

Designer:
Company:
Date:
Project:
Location:

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

	WQE	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.60		1.28				2.78	

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

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

$$Q(cfs) = CIA$$

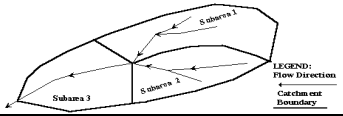
Subcatchment Name	Time of Concentration				Rainfall Intensity, I (in/hr)								Peak Flow, Q (cfs)							
	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	**(Optional)** Override t_c (min)	WQE	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	WQE	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A1	28.50	27.23	27.23		1.00		2.12				4.61		0.08		0.18				3.11	
B1	54.62	34.24	34.24		0.87		1.86				4.03		0.42		2.36				34.13	
C1	39.59	55.22	39.59		0.80		1.70				3.68		0.13		0.36				10.64	
D1	9.30	9.85	9.30		1.67		3.56				7.74		16.15		35.50				82.56	
E1	9.30	9.85	9.30		1.67		3.56				7.74		47.00		103.34				240.29	
F1	74.41	76.70	74.41		0.52		1.12				2.43		0.14		0.38				11.40	
G1	20.95	25.97	20.95		1.15		2.46				5.34		0.02		0.04				0.72	
OS1	91.19	44.99	44.99		0.73		1.56				3.40		0.29		0.68				11.76	
OS2	15.38	25.15	15.38		1.35		2.87				6.24		0.14		0.76				10.95	
OS3	21.76	25.15	21.76		1.13		2.41				5.23		0.05		0.29				4.14	
OS4	78.33	39.73	39.73		0.79		1.69				3.68		1.46		8.16				118.04	
H1	8.32	9.85	8.32		1.74		3.71				8.06		6.98		15.34				35.67	
I1	10.67	25.15	10.67		1.58		3.37				7.33		0.42		1.16				34.44	

Determination of Runoff Coefficients for Rational Method

Designer: LMS
Company: Atwell, LLC
Date: 5/27/2026
Project: Existing Carvana/Adesa Expansion Lot
Location: Fountain, Colorado

MHFD-Rational, Version 3.00 (August 2025)

Cells of this color are for required user-input
Cells of this color are for optional override values



Provide subcatchment names on the Rational Calcs worksheet to open up the table below.

Subcatchment Name	# of Subareas	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness				Runoff Coefficient, C							(Optional) Override Runoff Coefficient, C							Comments
				Imperviousness Source	Imperviousness Category	Calculated Imperviousness	(Optional) Override Imperviousness	WQE & 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	WQE & 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	
A1	**1**	**4.52**	**A**			**5.0%**	**5.0%**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	
		4.52	A	Land Use	Open Space, Undisturbed Native Grasses	5%		0.02	0.02	0.02	0.03	0.07	0.15	0.29								
B1	**1**	**16.79**	**C/D**			**5.0%**	**5.0%**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	
		16.79	C/D	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.08	0.17	0.35	0.42	0.50	0.60								
C1	**1**	**6.43**	**B**			**5.0%**	**5.0%**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	
		6.43	B	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.03	0.10	0.28	0.36	0.45	0.55								
D1	**1**	**12.30**	**B**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	
		12.30	B	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.82	0.85	0.86	0.87	0.88								
E1	**1**	**35.80**	**B**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	
		35.80	B	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.82	0.85	0.86	0.87	0.88								
F1	**1**	**10.46**	**B**			**5.0%**	**5.0%**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	
		10.46	B	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.03	0.10	0.28	0.36	0.45	0.55								
G1	**1**	**0.91**	**A**			**5.0%**	**5.0%**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	
		0.91	A	Land Use	Open Space, Undisturbed Native Grasses	5%		0.02	0.02	0.02	0.03	0.07	0.15	0.29								
OS1	**1**	**23.24**	**A**			**5.0%**	**5.0%**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	
		23.24	A	Land Use	Open Space, Undisturbed Native Grasses	5%		0.02	0.02	0.02	0.03	0.07	0.15	0.29								
OS2	**1**	**3.48**	**C/D**			**5.0%**	**5.0%**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	
		3.48	C/D	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.08	0.17	0.35	0.42	0.50	0.60								
OS3	**1**	**1.57**	**C/D**			**5.0%**	**5.0%**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	
		1.57	C/D	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.08	0.17	0.35	0.42	0.50	0.60								
OS4	**1**	**63.66**	**C/D**			**5.0%**	**5.0%**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	**0.03**	**0.08**	**0.17**	**0.35**	**0.42**	**0.50**	**0.60**	
		63.66	C/D	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.08	0.17	0.35	0.42	0.50	0.60								
H1	**1**	**5.10**	**B**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	
		5.10	B	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.82	0.85	0.86	0.87	0.88								
I1	**1**	**10.46**	**B**			**5.0%**	**5.0%**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	
		10.46	B	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.03	0.10	0.28	0.36	0.45	0.55								

Calculation of Peak Runoff using Rational Method

Designer: LMS
Company: ATWELL, LLC
Date: 5/29/2026
Project: Carvana
Location: Fountain, CO

MHFD-Rational, Version 3.00 (August 2025)

Cells of this color are for required user-input
Cells of this color are for optional override values

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

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

Computed $t_c = t_i + t_t$

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

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

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

Calculation of Peak Runoff using Rational Method

Provide input for area, soil type, and imperviousness on the Runoff Coeffs worksheet.

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group(s)	Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time						
				WQE & 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)
A-1	0.91	A	5.0%	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00			0.070	17.79	150.00			0.100	2.5	0.79	3.16
A-2	2.04	A,C/D	59.7%	0.49	0.50	0.51	0.53	0.55	0.59	0.65	250.00			0.030	11.93	260.00			0.010	20	2.00	2.17
A-3	3.18	C/D	95.0%	0.79	0.81	0.83	0.85	0.86	0.87	0.89	300.00			0.030	6.33	250.00			0.022	20	2.97	1.40
A-4	2.44	C/D	95.0%	0.79	0.81	0.83	0.85	0.86	0.87	0.89	200.00			0.030	5.17	300.00			0.025	20	3.16	1.58
A-5	1.61	C/D	95.0%	0.79	0.81	0.83	0.85	0.86	0.87	0.89	300.00			0.030	6.33	245.00			0.021	20	2.90	1.41
A-6	1.28	C/D	95.0%	0.79	0.81	0.83	0.85	0.86	0.87	0.89	250.00			0.033	5.60	100.00			0.007	20	1.61	1.03
A-7	1.33	C/D	95.0%	0.79	0.81	0.83	0.85	0.86	0.87	0.89	220.00			0.027	5.61	140.00			0.028	20	3.35	0.70
A-8	1.29	C/D	95.0%	0.79	0.81	0.83	0.85	0.86	0.87	0.89	300.00			0.025	6.72	360.00			0.015	20	2.45	2.45
A-9	0.59	C/D	95.0%	0.79	0.81	0.83	0.85	0.86	0.87	0.89	20.00			0.020	1.87	350.00			0.020	20	2.83	2.06
C1	12.30	B	5.0%	0.03	0.03	0.10	0.28	0.36	0.45	0.55	225.00			0.250	9.99	1500.00			0.010	15	1.50	16.67
D1	12.30	B	95.0%	0.79	0.81	0.82	0.85	0.86	0.87	0.88	500.00			0.020	9.30	0.00			0.010	20	2.00	0.00
E1	35.80	B	95.0%	0.79	0.81	0.82	0.85	0.86	0.87	0.88	500.00			0.020	9.30	0.00			0.100	20	6.32	0.00
F1	10.46	B	5.0%	0.03	0.03	0.10	0.28	0.36	0.45	0.55	20.00			0.250	2.98	3000.00			0.010	7	0.70	71.43
H1	5.10	B	95.0%	0.79	0.81	0.82	0.85	0.86	0.87	0.88	400.00			0.020	8.32	0.00			0.002	20	0.89	0.00
I1	10.46	B	5.0%	0.03	0.03	0.10	0.28	0.36	0.45	0.55	100.00			0.060	10.67	0.00			0.020	7	0.99	0.00

Calculation of Peak Runoff using Rational Method

Designer:
Company:
Date:
Project:
Location:

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

	WQE	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.60		1.28				2.78	

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

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

$$Q(cfs) = CIA$$

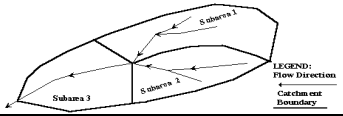
Subcatchment Name	Time of Concentration				Rainfall Intensity, I (in/hr)								Peak Flow, Q (cfs)							
	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	**(Optional)** Override t_c (min)	WQE	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	WQE	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A-1	20.95	25.97	20.95		1.15		2.46				5.34		0.02		0.04				0.72	
A-2	14.10	18.35	14.10		1.40		2.99				6.50		1.39		3.05				7.80	
A-3	7.73	11.11	7.73		1.78		3.81				8.27		4.47		9.80				22.94	
A-4	6.75	11.27	6.75		1.87		3.98				8.65		3.59		7.86				18.41	
A-5	7.74	11.11	7.74		1.78		3.81				8.27		2.26		4.96				11.61	
A-6	6.63	10.78	6.63		1.88		4.00				8.69		1.89		4.15				9.71	
A-7	6.31	10.48	6.31		1.91		4.07				8.83		2.00		4.38				10.25	
A-8	9.17	12.05	9.17		1.68		3.58				7.78		1.70		3.74				8.75	
A-9	3.93	11.70	5.00		2.04		4.34				9.43		0.95		2.07				4.85	
C1	26.66	50.92	26.66		1.01		2.15				4.67		0.31		0.87				25.81	
D1	9.30	9.85	9.30		1.67		3.56				7.74		16.15		35.50				82.56	
E1	9.30	9.85	9.30		1.67		3.56				7.74		47.00		103.34				240.29	
F1	74.41	76.70	74.41		0.52		1.12				2.43		0.14		0.38				11.40	
H1	8.32	9.85	8.32		1.74		3.71				8.06		6.98		15.34				35.67	
I1	10.67	25.15	10.67		1.58		3.37				7.33		0.42		1.16				34.44	

Determination of Runoff Coefficients for Rational Method

Designer: LMS
Company: ATWELL, LLC
Date: 5/29/2026
Project: Carvana
Location: Fountain, CO

MHFD-Rational, Version 3.00 (August 2025)

Cells of this color are for required user-input
Cells of this color are for optional override values



Provide subcatchment names on the Rational Calcs worksheet to open up the table below.

Subcatchment Name	# of Subareas	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness				Runoff Coefficient, C							(Optional) Override Runoff Coefficient, C							Comments
				Imperviousness Source	Imperviousness Category	Calculated Imperviousness	(Optional) Override Imperviousness	WQE & 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	WQE & 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	
A-1	**1**	**0.91**	**A**			**5.0%**	**5.0%**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	**0.02**	**0.02**	**0.02**	**0.03**	**0.07**	**0.15**	**0.29**	
		0.91	A	Land Use	Open Space, Undisturbed Native Grasses	5%		0.02	0.02	0.02	0.03	0.07	0.15	0.29								
A-2	**2**	**2.04**	**A,C/D**			**59.7%**	**59.7%**	**0.49**	**0.50**	**0.51**	**0.53**	**0.55**	**0.59**	**0.65**	**0.49**	**0.50**	**0.51**	**0.53**	**0.55**	**0.59**	**0.65**	
		1.24	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
		0.80	A	Land Use	Open Space, Undisturbed Native Grasses	5%		0.02	0.02	0.02	0.03	0.07	0.15	0.29								
A-3	**1**	**3.18**	**C/D**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	
		3.18	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
A-4	**1**	**2.44**	**C/D**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	
		2.44	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
A-5	**1**	**1.61**	**C/D**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	
		1.61	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
A-6	**1**	**1.28**	**C/D**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	
		1.28	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
A-7	**1**	**1.33**	**C/D**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	
		1.33	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
A-8	**1**	**1.29**	**C/D**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	
		1.29	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
A-9	**1**	**0.59**	**C/D**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	**0.79**	**0.81**	**0.83**	**0.85**	**0.86**	**0.87**	**0.89**	
		0.59	C/D	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.83	0.85	0.86	0.87	0.89								
C1	**1**	**12.30**	**B**			**5.0%**	**5.0%**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	
		12.30	B	Surface Type	Historic Flow Analysis	5%		0.03	0.03	0.10	0.28	0.36	0.45	0.55								
D1	**1**	**12.30**	**B**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	
		12.30	B	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.82	0.85	0.86	0.87	0.88								
E1	**1**	**35.80**	**B**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	
		35.80	B	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.82	0.85	0.86	0.87	0.88								
F1	**1**	**10.46**	**B**			**5.0%**	**5.0%**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	
		10.46	B	Land Use	Open Space, Undisturbed Native Grasses	5%		0.03	0.03	0.10	0.28	0.36	0.45	0.55								
H1	**1**	**5.10**	**B**			**95.0%**	**95.0%**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	**0.79**	**0.81**	**0.82**	**0.85**	**0.86**	**0.87**	**0.88**	
		5.10	B	Surface Type	Roadways and Paved Streets	95%		0.79	0.81	0.82	0.85	0.86	0.87	0.88								
I1	**1**	**10.46**	**B**			**5.0%**	**5.0%**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	**0.03**	**0.03**	**0.10**	**0.28**	**0.36**	**0.45**	**0.55**	
		10.46	B	Surface Type	Historic Flow Analysis	5%		0.03	0.03	0.10	0.28	0.36	0.45	0.55								

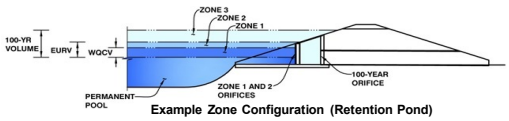
APPENDIX D
HYDRAULIC CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: Carvana - Fountain, CO

Basin ID: Basin A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	**EDB**	
Watershed Area =	13.17	acres
Watershed Length =	1,225	ft
Watershed Length to Centroid =	500	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	89.53%	percent
Percentage Hydrologic Soil Group A =	20.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	80.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.436	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.255	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1 in.) =	0.928	acre-feet	1.00	inches
5-yr Runoff Volume (P1 = 1.28 in.) =	1.233	acre-feet	1.28	inches
10-yr Runoff Volume (P1 = 1.56 in.) =	1.543	acre-feet	1.56	inches
25-yr Runoff Volume (P1 = 1.99 in.) =	2.040	acre-feet	1.99	inches
50-yr Runoff Volume (P1 = 2.36 in.) =	2.461	acre-feet	2.36	inches
100-yr Runoff Volume (P1 = 2.78 in.) =	2.949	acre-feet	2.78	inches
500-yr Runoff Volume (P1 = 3.91 in.) =	4.243	acre-feet	3.91	inches
Approximate 2-yr Detention Volume =	0.893	acre-feet		
Approximate 5-yr Detention Volume =	1.204	acre-feet		
Approximate 10-yr Detention Volume =	1.464	acre-feet		
Approximate 25-yr Detention Volume =	1.768	acre-feet		
Approximate 50-yr Detention Volume =	1.930	acre-feet		
Approximate 100-yr Detention Volume =	2.122	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.436	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.819	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.867	acre-feet
Total Detention Basin Volume =	2.122	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

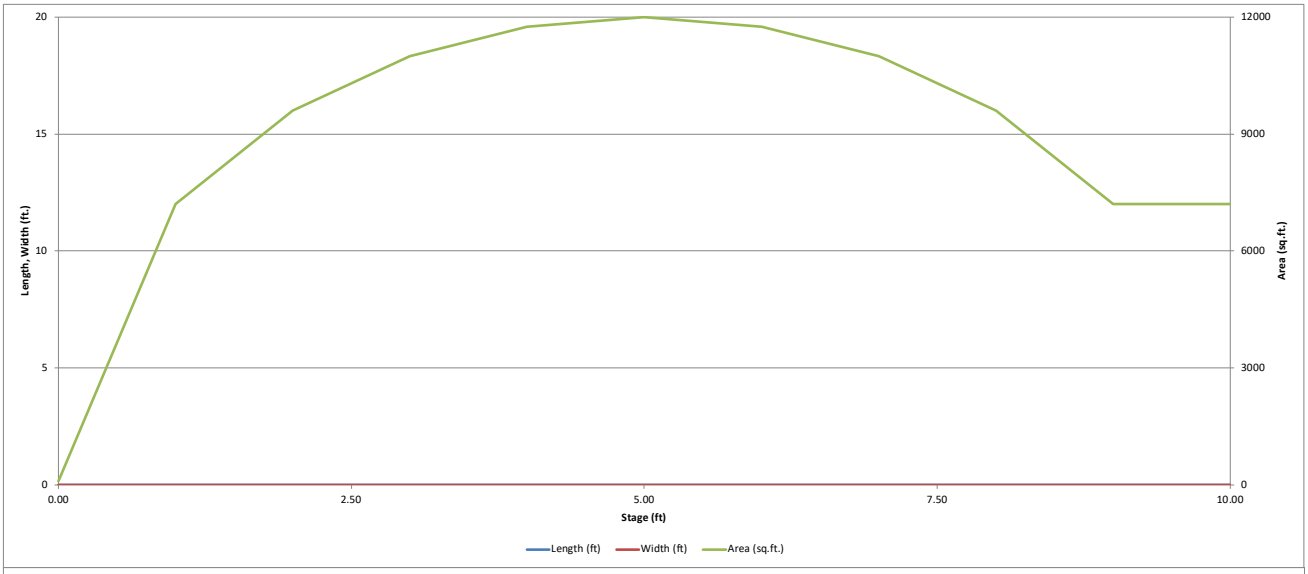
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

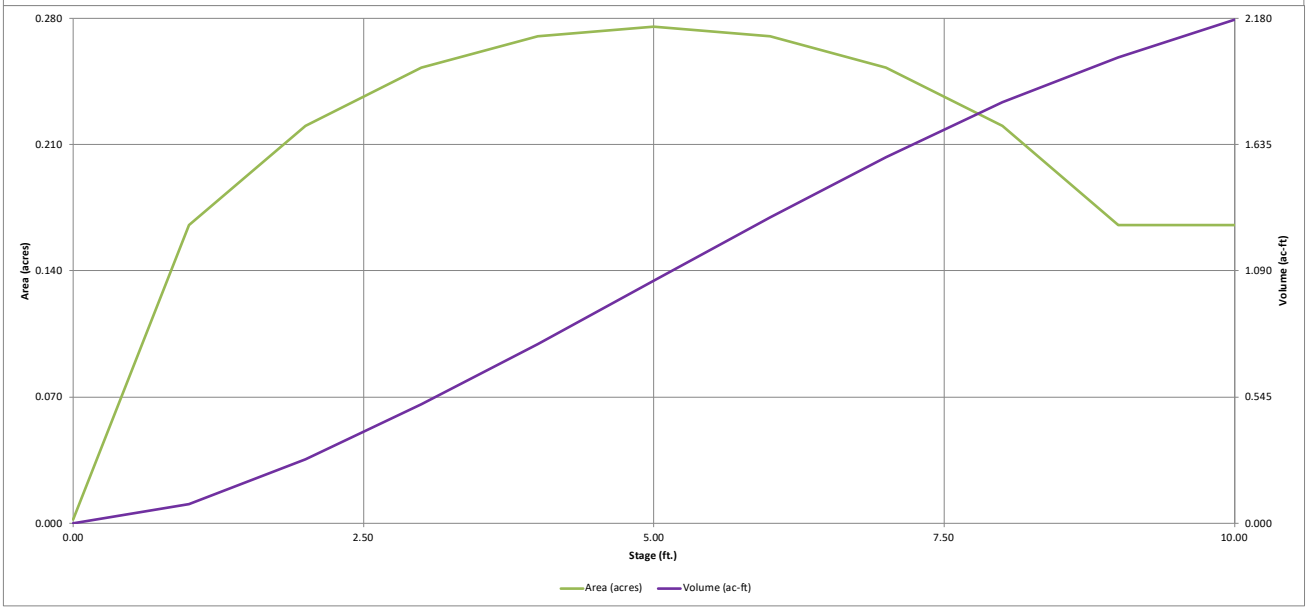
Depth Increment = 3.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
1	--	1.00	--	--	--	7,200	0.165	3,650	0.084
2	--	2.00	--	--	--	9,600	0.220	12,050	0.277
3	--	3.00	--	--	--	11,000	0.253	22,350	0.513
4	--	4.00	--	--	--	11,760	0.270	33,730	0.774
5	--	5.00	--	--	--	12,000	0.275	45,610	1.047
6	--	6.00	--	--	--	11,760	0.270	57,490	1.320
7	--	7.00	--	--	--	11,000	0.253	68,870	1.581
8	--	8.00	--	--	--	9,600	0.220	79,170	1.817
9	--	9.00	--	--	--	7,200	0.165	87,570	2.010
10	--	10.00	--	--	--	7,200	0.165	94,770	2.176

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



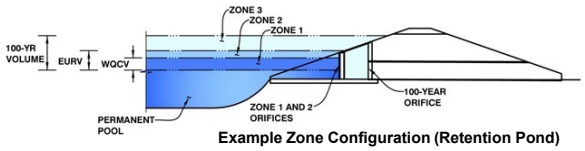


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: Carvana - Fountain, CO

Basin ID: Basin A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.69	0.436	Orifice Plate
Zone 2 (EURV)	5.77	0.819	Orifice Plate
Zone 3 (100-year)	9.68	0.867	Circular Orifice
Total (all zones)		2.122	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.111E-02	ft²
Depth at top of Zone using Orifice Plate =	6.80	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.04	sq. inches (diameter = 1-15/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.00	4.00					
Orifice Area (sq. inches)	3.04	3.04	3.04					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected	
Invert of Vertical Orifice =	6.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	2.18	N/A	ft²
Depth at top of Zone using Vertical Orifice =	6.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.83	N/A	feet
Vertical Orifice Diameter =	20.00	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	N/A	N/A	feet
Overflow Weir Front Edge Length =	N/A	N/A	feet	Overflow Weir Slope Length =	N/A	N/A	feet
Overflow Weir Grate Slope =	N/A	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	N/A	N/A	
Horiz. Length of Weir Sides =	N/A	N/A	feet	Overflow Grate Open Area w/o Debris =	N/A	N/A	ft²
Overflow Grate Type =	N/A	N/A		Overflow Grate Open Area w/ Debris =	N/A	N/A	ft²
Debris Clogging % =	N/A	N/A	%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A	ft²
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

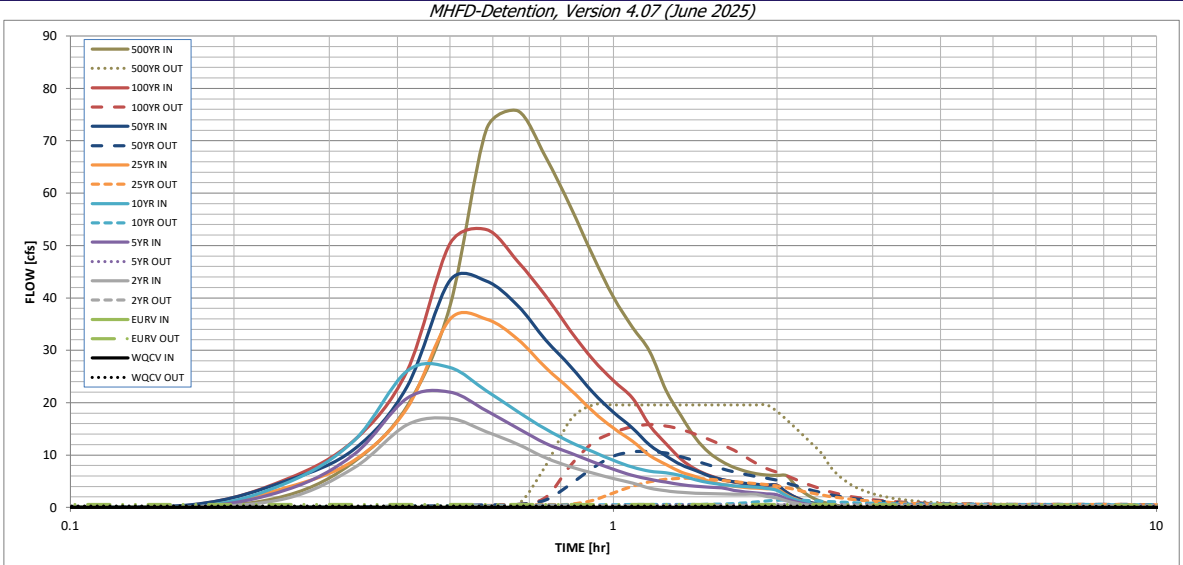
Routed Hydrograph Results

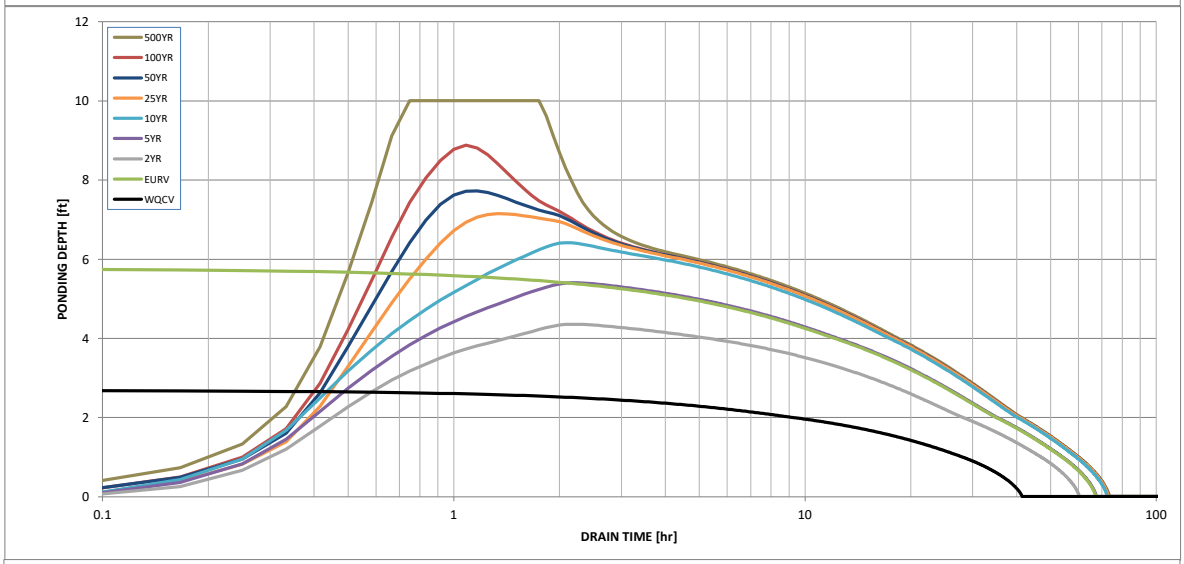
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

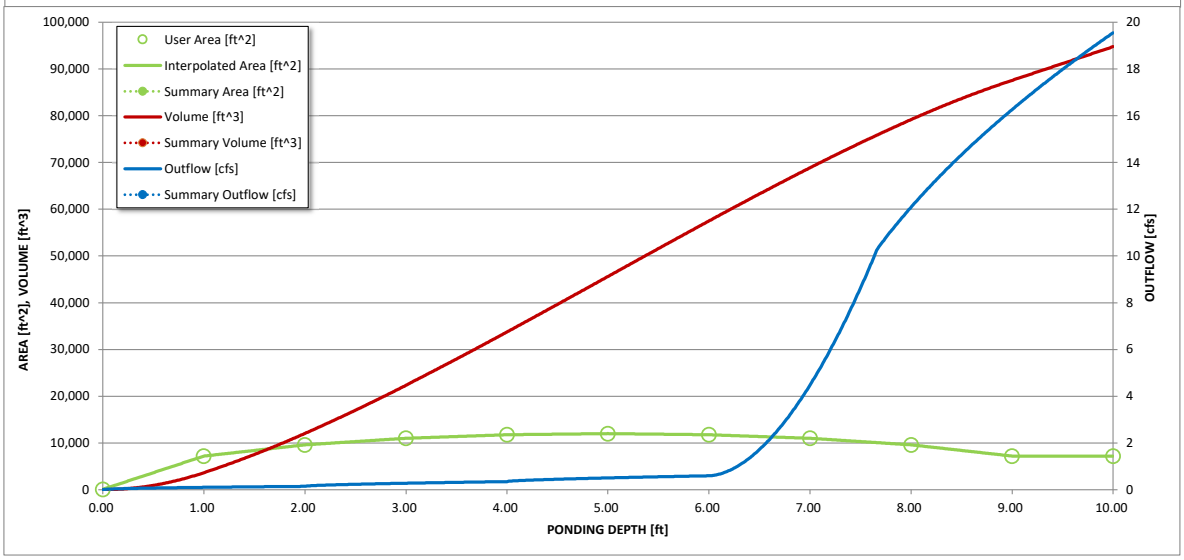
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.00	1.28	1.56	1.99	2.36	2.78	3.91
CUHP Runoff Volume (acre-ft) =	0.436	1.255	0.928	1.233	1.543	2.040	2.461	2.949	4.243
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.928	1.233	1.543	2.040	2.461	2.949	4.243
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	2.2	4.6	10.8	14.8	20.1	32.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.03	0.17	0.35	0.82	1.12	1.52	2.48
Peak Inflow Q (cfs) =	N/A	N/A	17.0	22.0	26.7	36.0	43.3	53.1	75.7
Peak Outflow Q (cfs) =	0.3	0.6	0.4	0.5	1.4	5.5	10.6	15.8	19.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.3	0.5	0.7	0.8	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	60	55	60	64	63	61	59	55
Time to Drain 99% of Inflow Volume (hours) =	**40**	64	58	64	69	68	68	67	66
Maximum Ponding Depth (ft) =	2.69	5.77	4.35	5.40	6.41	7.15	7.72	8.88	10.00
Area at Maximum Ponding Depth (acres) =	0.24	0.27	0.27	0.27	0.26	0.25	0.23	0.17	0.17
Maximum Volume Stored (acre-ft) =	0.436	1.258	0.869	1.157	1.429	1.616	1.755	1.988	2.176

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.53	0.45	2.24
	0:15:00	0	0.00	1.75	3.35	4.64	3.78	5.07	5.40	8.75
	0:20:00	0	0.00	7.58	10.15	12.79	9.00	11.12	12.85	19.30
	0:25:00	0	0.00	15.75	20.82	26.06	18.95	23.05	26.04	38.42
	0:30:00	0	0.00	16.99	22.01	26.70	35.94	43.34	50.33	72.16
	0:35:00	0	0.00	14.46	18.44	22.28	35.96	43.21	53.06	75.73
	0:40:00	0	0.00	12.07	15.13	18.30	32.10	38.52	46.94	66.90
	0:45:00	0	0.00	9.46	12.22	14.95	26.68	31.99	40.39	57.48
	0:50:00	0	0.00	7.76	10.38	12.46	22.53	26.98	33.76	48.02
	0:55:00	0	0.00	6.56	8.71	10.62	18.31	21.94	28.22	40.14
	1:00:00	0	0.00	5.50	7.27	9.01	15.15	18.16	24.20	34.43
	1:05:00	0	0.00	4.63	6.11	7.69	12.67	15.19	20.92	29.76
	1:10:00	0	0.00	3.68	5.37	6.89	9.91	11.90	15.67	22.35
	1:15:00	0	0.00	3.16	4.81	6.61	8.17	9.83	12.16	17.42
	1:20:00	0	0.00	2.89	4.35	6.04	6.75	8.12	9.19	13.18
	1:25:00	0	0.00	2.73	4.05	5.26	5.87	7.05	7.28	10.45
	1:30:00	0	0.00	2.64	3.85	4.74	5.01	6.01	6.12	8.79
	1:35:00	0	0.00	2.57	3.72	4.38	4.42	5.31	5.34	7.66
	1:40:00	0	0.00	2.53	3.28	4.13	4.06	4.88	4.83	6.94
	1:45:00	0	0.00	2.50	2.96	3.97	3.81	4.57	4.49	6.45
	1:50:00	0	0.00	2.49	2.75	3.85	3.66	4.39	4.32	6.20
	1:55:00	0	0.00	2.09	2.60	3.64	3.57	4.28	4.25	6.10
	2:00:00	0	0.00	1.81	2.42	3.25	3.51	4.22	4.23	6.06
	2:05:00	0	0.00	1.22	1.63	2.19	2.38	2.85	2.87	4.12
	2:10:00	0	0.00	0.80	1.07	1.46	1.58	1.90	1.91	2.75
	2:15:00	0	0.00	0.52	0.69	0.95	1.04	1.25	1.26	1.81
	2:20:00	0	0.00	0.32	0.43	0.59	0.65	0.78	0.79	1.13
	2:25:00	0	0.00	0.19	0.27	0.36	0.41	0.49	0.50	0.72
	2:30:00	0	0.00	0.09	0.15	0.20	0.23	0.28	0.28	0.40
	2:35:00	0	0.00	0.04	0.07	0.08	0.11	0.13	0.13	0.18
	2:40:00	0	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.05
	2:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Summary Stage-Area-Volume-Discharge Relationships

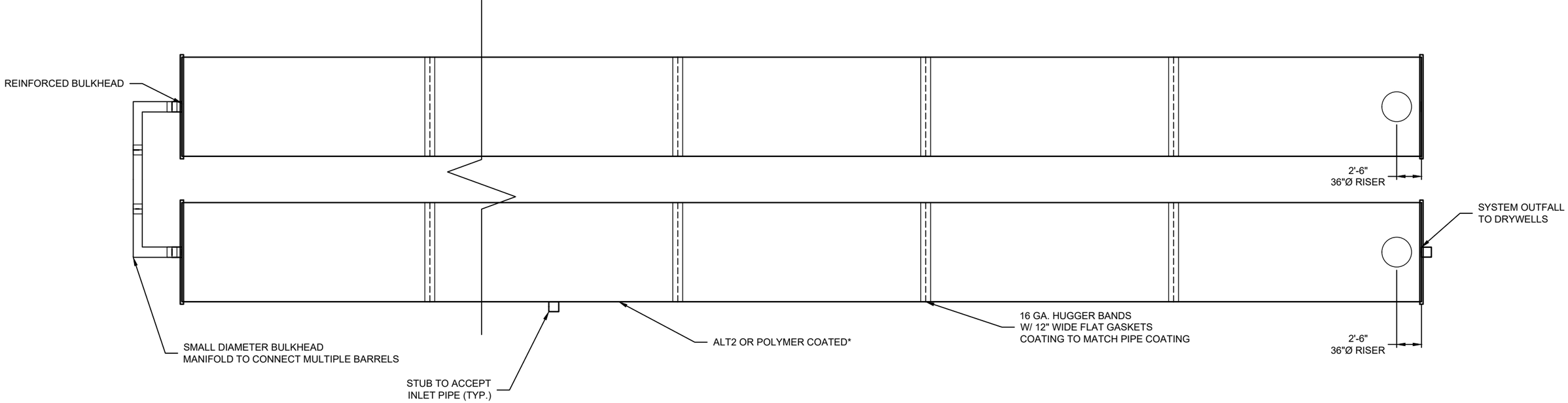
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

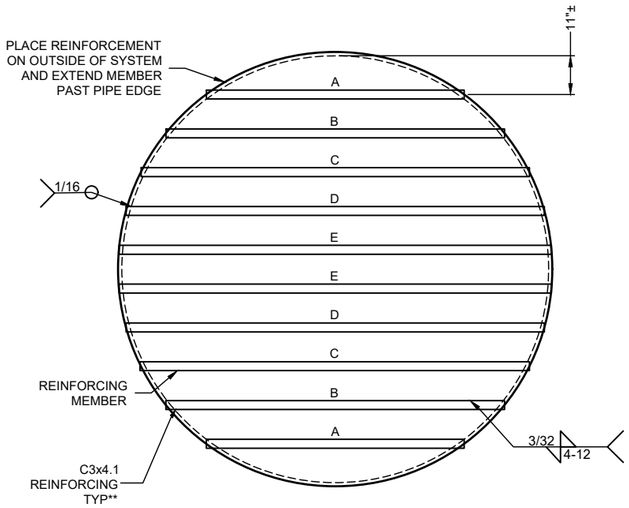
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

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

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





TYPICAL BULKHEAD REINFORCEMENT DETAIL

NOT TO SCALE

ALL INFORMATION ON THIS SHEET IS FOR A TYPICAL DETENTION SYSTEM AND IS SUBJECT TO CHANGE ON A PROJECT BASIS.
*COATING TO BE SELECTED BY EOR BASED ON SOIL TYPES THAT WILL BE IN CONTACT WITH THE PIPE. SEE TABLES ON SHEET 2 FOR DURABILITY RECOMMENDATIONS.
**BULKHEADS SHALL BE 12-GAGE OR HEAVIER WITH THE WATER SIDE AND SOIL SIDE COATING MATCHING THE SPECIFIED CMP COATING. BULKHEAD PLATES SHALL BE FULLY WELDED ONTO THE CMP. IF BULKHEAD PLATES REQUIRE REINFORCEMENTS, THE REINFORCEMENTS AND ATTACHMENT METHODS WILL BE DESIGNED IN ACCORDANCE WITH CHAPTER 8 OF THE NCSPA CSP DESIGN MANUAL. REINFORCING MEMBERS SHALL BE POST COATED WITH ZINC RICH PAINT PER AASHTO M 36 (FOR GALVANIZED OR ALUMINIZED SYSTEMS) OR PER AASHTO M 245 (FOR POLYMER COATED SYSTEMS).

5" x 1" or 3" x 1" Height of Cover Limits for Corrugated Steel Pipe

H 20 and H 25 Live Loads

Diameter (in.)	Minimum Cover (in.)	Maximum Cover (ft.) Specified Thickness (in.) and Gage (0.064) 16	(0.079) 14	(0.109) 12	(0.138) 10	(0.168) 8
54	12	56	70	98	127	155
60	12	50	63	88	114	139
66	12	46	57	80	103	127
72	12	42	52	74	95	116
78	12	39	48	68	87	107
84	12	36	45	63	81	99
90	12	33	42	59	76	93
96	12	31	39	55	71	87
102	18	29	37	52	67	82
108	18		35	49	63	77
114	18		32	45	58	72
120	18		30	42	54	66
126	18			39	50	61
132	18			36	46	58
138	18			33	43	53
144	18				39	49

Maximum cover heights shown are for 5" x 1".
To obtain maximum cover for 3" x 1", increase these values by 12%.

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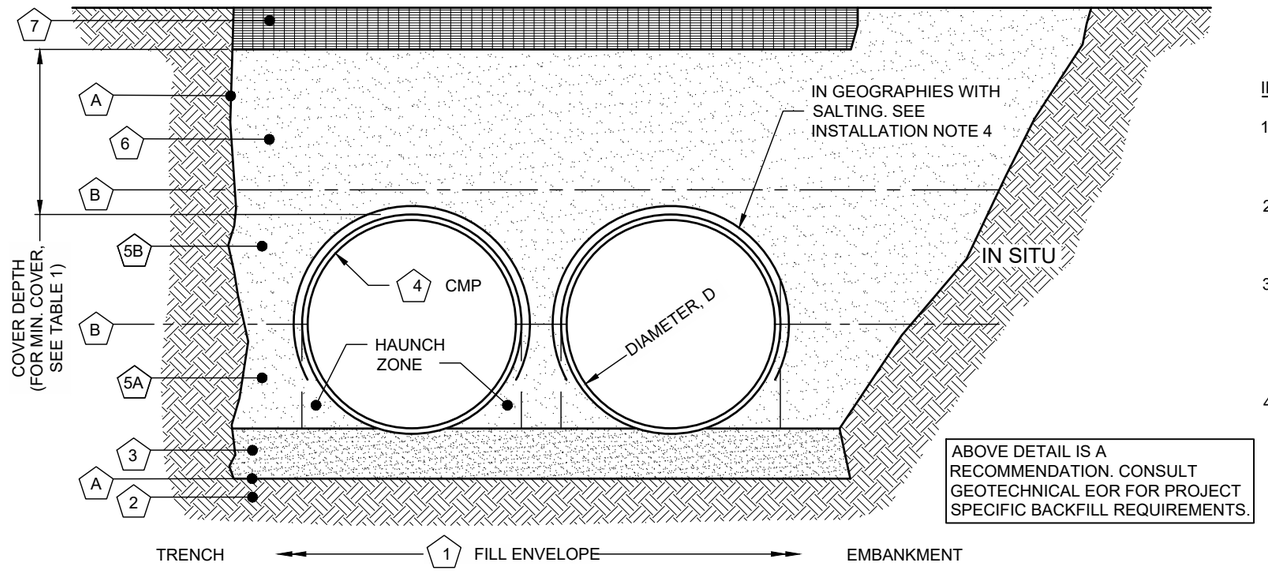
ARIZONA CMP DETENTION
STANDARD DETAIL

TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT
- ULTRAFLO ALSO AVAILABLE FOR SIZES 18" - 120" WITH 3/4"x 3/4"x 7 1/2" CORRUGATION



MINIMUM WIDTH DEPENDS ON SITE CONDITIONS AND ENGINEERING JUDGEMENT

ABOVE DETAIL IS A RECOMMENDATION. CONSULT GEOTECHNICAL EOR FOR PROJECT SPECIFIC BACKFILL REQUIREMENTS.

INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. BACKFILL USING CONTROLLED LOW-STRENGTH MATERIAL (CLSM, "FLASH FILL" OR "FLOWABLE FILL") MAY BE USED WHEN THE SPACING BETWEEN THE PIPES WILL NOT ALLOW FOR PLACEMENT AND ADEQUATE COMPACTION OF THE BACKFILL. CONTACT CONTECH FOR FURTHER EVALUATION.
4. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2:

	CMP DETENTION AND CMP DRAINAGE STANDARD BACKFILL SPECIFICATIONS			
	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	AASHTO 26.5.2 OR PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	AASHTO M 43: 3, 357, 4, 467, 5, 56, 57 (APPROVED REGIONAL EQUIVALENTS INCLUDE CA-7)	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE FOUNDATION SOILS CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5A	CRITICAL BACKFILL	AASHTO M 145: A-1, A-2, A-3 *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A THREE LIFT (24") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WELL GRADED GRANULAR MATERIAL WHICH MAY CONTAIN SMALL AMOUNTS OF SILT OR CLAY AND MAXIMUM PARTICLE SIZE OF 3" (PER AASHTO 26.3.8.1 AND 12.4-1.3).	
5B	BACKFILL	AASHTO M 145: A-1, A-2, A-3		
6	COVER MATERIAL	UP TO MIN. COVER - SEE 5A AND 5B ABOVE ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROAD BASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	OPTIONAL GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5A INCLUDE CA-7, CODOT #67, MIDOT 2G, 34G, OR 21AA STONE OR GRAVEL; #8; #57; MIDOT 6A, 2G, 3G, 34G.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

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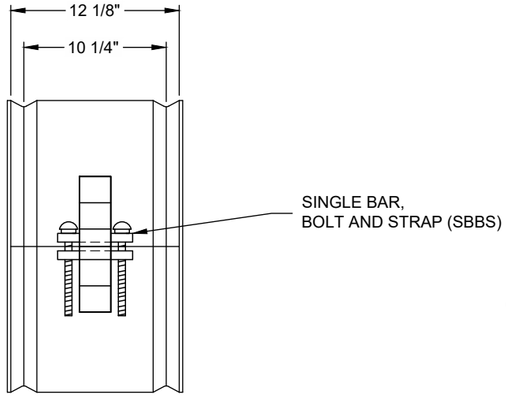
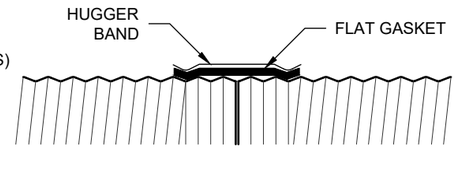
ARIZONA CMP DETENTION STANDARD DETAIL

ESTIMATED MATERIAL SERVICE LIFE FOR CSP

CSP MATERIAL	ESTIMATED SERVICE LIFE	SITE ENVIRONMENTAL CONDITIONS	MAXIMUM FHWA ABRASION LEVEL
ALUMINIZED TYPE 2 CSP	MINIMUM 100 YEARS	4.5 ≤ pH ≤ 9	LEVEL #2
		r ≥ 5,000 OHM-CM	
	MINIMUM 75 YEARS	5 ≤ pH ≤ 9	
		r ≥ 1,500 OHM-CM	
POLYMER COATED CSP	MINIMUM 100 YEARS	5 ≤ pH ≤ 9	LEVEL #3
		r ≥ 1,500 OHM-CM	
	MINIMUM 75 YEARS	4 ≤ pH ≤ 9	
		r ≥ 750 OHM-CM	
	MINIMUM 50 YEARS	3 ≤ pH ≤ 12	
		r ≥ 250 OHM-CM	



CONNECTION DETAIL
(SBBS)



FLAT GASKET

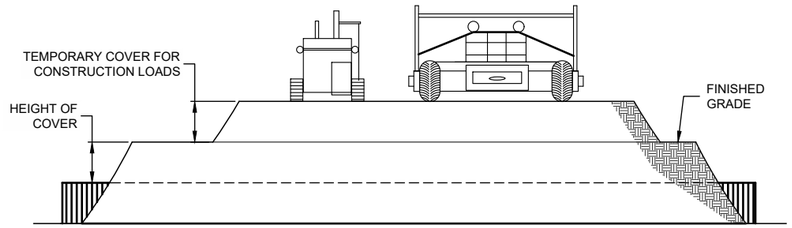
2 2/3"x1/2" RE-ROLLED END HEL-COR PIPE

GENERAL NOTES:

1. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
2. BAND MATERIALS AND/OR COATING CAN VARY BY LOCATION. CONTACT YOUR CONTECH REPRESENTATIVE FOR AVAILABILITY.
3. BANDS ARE SHAPED TO MATCH THE PIPE-ARCH WHEN APPLICABLE.
4. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" THRU 96" 2-PIECES
   - 102" THRU 144" 3-PIECES
5. BAND FASTENERS ARE ATTACHED WITH SPOT WELDS, RIVETS OR HAND WELDS.
6. ALL CMP IS REROLLED TO HAVE ANNULAR END CORRUGATIONS OF 2 2/3"x1/2"
7. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
8. ORDER SHALL DESIGNATE GASKET OPTION, IF REQUIRED (SEE DETAILS ABOVE).

H-12 HUGGER BAND DETAIL

NOT TO SCALE



CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

NOT TO SCALE

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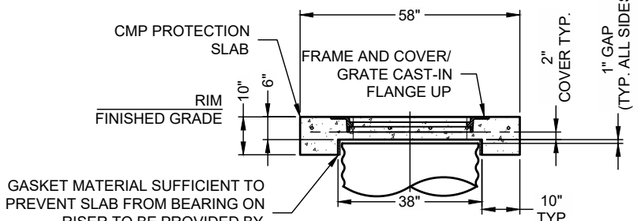
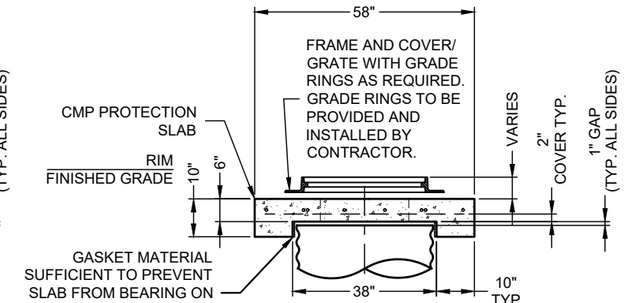
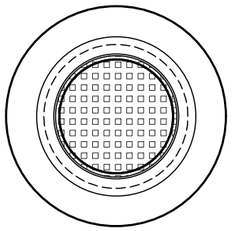
ARIZONA CMP DETENTION
STANDARD DETAIL



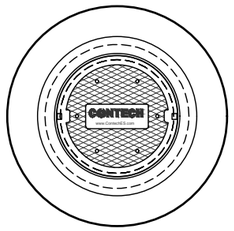
ELEVATION VIEW
(FLUSH MOUNTED)



ELEVATION VIEW



PLAN VIEW
(GRATED CASTING)
30"Ø HS25 LOAD RATED



PLAN VIEW
(SOLID CASTING)
24"Ø HS25 LOAD RATED
30"Ø HS25 LOAD RATED

CHECK ONE:

- ☐ CAST-IN COVER
- ☐ SEPARATE COVER

CHECK ONE:

- ☐ 24"Ø COVER
- ☐ 30"Ø COVER
- ☐ 30"Ø GRATE

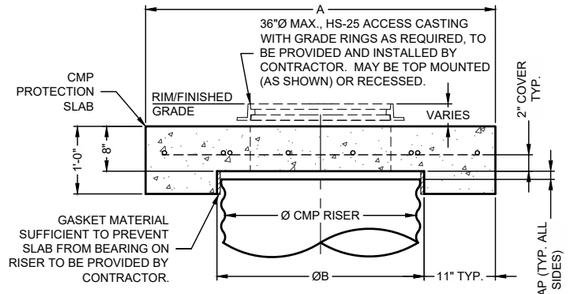
FABRICATION NOTES:

1. CONCRETE STRENGTH = 4,000 PSI
2. REINFORCING STEEL - ASTM A615, GRADE 60, OR EQUIVALENT WELDED WIRE FABRIC.
3. NICE LIGHT BROOM FINISH FOR UNITS W/ CAST-IN FRAME AND COVER
4. LIFTERS IN SIDE FOR UNITS W/ CAST-IN FRAME AND COVER AND LIFTERS IN TOP SLAB FOR UNITS W/ SEPARATE COVER

GENERAL NOTES:

1. DESIGN LOAD HS20/HS25
2. EARTH COVER = 1' MAX
3. RISER CAP MUST BE ADEQUATELY SUPPORTED WITH PROPER BEDDING AND BEARING PRESSURE OF 3350 PSF AS TO NOT TRANSFER LOADS ONTO RISER.
4. HEAVY PICK WEIGHT = 1,900 LBS

PRECAST 58" OD CMP RISER CAP
UP TO 36" RISERS
PRECASTER: SEALY, TX

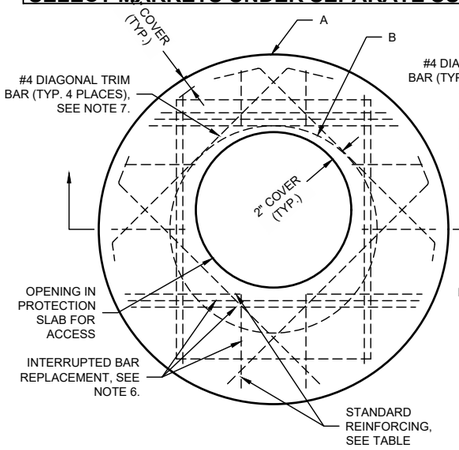


SECTION VIEW

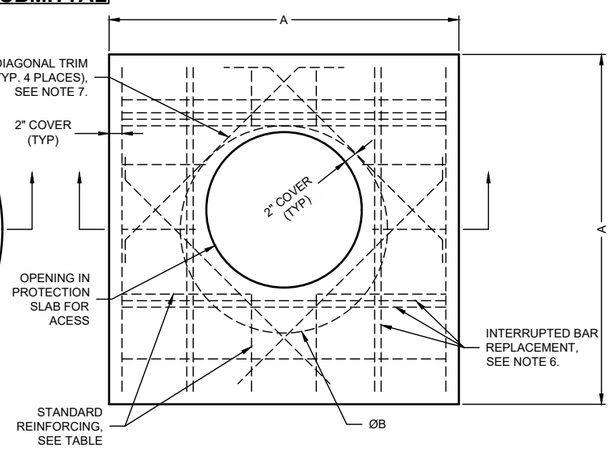
REINFORCING TABLE				
Ø CMP RISER	A	B Ø	REINFORCING	**BEARING PRESSURE (PSF)
24"	4'Ø 4'x4'	26"	#5 @ 10" OCEW #5 @ 10" OCEW	2,540 1,900
30"	4'-6"Ø 4'-6" x 4'-6"	32"	#5 @ 10" OCEW #5 @ 9" OCEW	2,260 1,670
36"	5'Ø 5' x 5'	38"	#5 @ 9" OCEW #5 @ 8" OCEW	2,060 1,500
42"	5'-6"Ø 5'-6" x 5'-6"	44"	#5 @ 8" OCEW #5 @ 8" OCEW	1,490 1,370
48"	6'Ø 6' x 6'	50"	#5 @ 7" OCEW #5 @ 7" OCEW	1,210 1,270

** ASSUMED SOIL BEARING CAPACITY

ACCESS CASTING SUPPLIED BY CONTECH IN SELECT MARKETS UNDER SEPARATE SUBMITTAL



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION AND ACI 350.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 4,000 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERS, ARCHITECTS AND LAND SURVEYORS, ENDWELL, NY.

CAST-IN PLACE MANHOLE CAP DETAIL

NOT TO SCALE

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ARIZONA CMP DETENTION
STANDARD DETAIL

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project: Carvana, Fountain CO
Minor: 5-year
Major: 100-year

Worksheet Protected

INLET NAME	Inlet A-1	Inlet A-2	Inlet A-3	Inlet A-4
Inlet Application (Street or Area)	STREET	STREET	AREA	STREET
Hydraulic Condition	In Sump	In Sump	Swale	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type C (Depressed)	CDOT Type R Curb Opening
Number of Inlet Units	1	1	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	3.05	9.80	7.86	4.96
Major Peak Flow, Q (cfs)	7.80	22.94	18.41	11.61

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:				
Bypass Flow Description (Optional):				
Minor Bypass Flow Received, Q_b (cfs)				
Major Bypass Flow Received, Q_b (cfs)				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	3.05	9.80	7.86	4.96
Major Total Design Peak Flow, Q (cfs)	7.80	22.94	18.41	11.61
Minor Inlet Interception Capacity, Q_a (cfs)	8.28	16.04	15.52	16.04
Major Inlet Interception Capacity, Q_a (cfs)	9.78	23.37	16.02	16.04
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	0.00	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	2.39	N/A
Minor Flow Capture Percentage, C%	100%	100%	100%	100%
Major Flow Capture Percentage, C%	100%	100%	87%	100%

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project: Carvana, Fountain CO
Minor: 5-year
Major: 100-year

Worksheet Protected

INLET NAME	Inlet A-5	Inlet A-6	Inlet A-7
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
Number of Inlet Units	1	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	4.15	4.38	3.74
Major Peak Flow, Q (cfs)	9.71	10.25	8.75

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	Inlet A-3		
Bypass Flow Description (Optional):			
Minor Bypass Flow Received, Q_b (cfs)	0.00		
Major Bypass Flow Received, Q_b (cfs)	2.39		

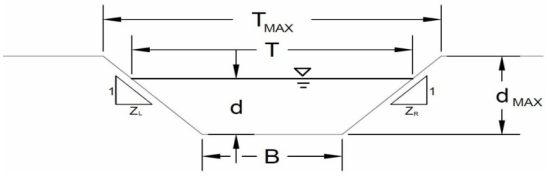
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	4.15	4.38	3.74
Major Total Design Peak Flow, Q (cfs)	12.10	10.25	8.75
Minor Inlet Interception Capacity, Q_a (cfs)	16.04	16.04	16.04
Major Inlet Interception Capacity, Q_a (cfs)	16.04	16.04	16.04
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	N/A
Minor Flow Capture Percentage, C%	100%	100%	100%
Major Flow Capture Percentage, C%	100%	100%	100%

AREA INLET IN A SWALE

Carvana, Fountain CO

Inlet A-3



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.013	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	50.00	ft/ft
Right Side Sloe	Z2 =	50.00	ft/ft

Check one of the following soil types:

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

Choose One:
- ○ Non-Cohesive
- ○ Cohesive
- ◉ Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**100.00**	**100.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**510.1**	**510.1**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**0.98**	**0.98**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**7.9**	**18.4**	**cfs**
Water Depth	d =	**0.19**	**0.27**	**ft**

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

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

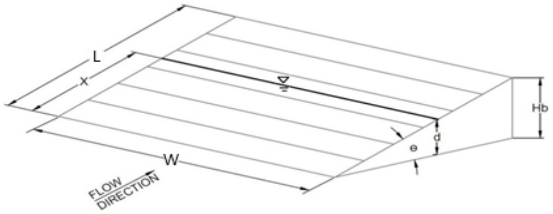
AREA INLET IN A SWALE

Carvana, Fountain CO

Inlet A-3

Inlet Design Information (Input)

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

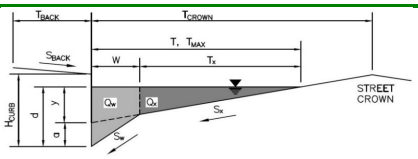


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.19	1.27	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**15.5**	**16.0**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**2.4**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**87**	**%**

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **Inlet A-4**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

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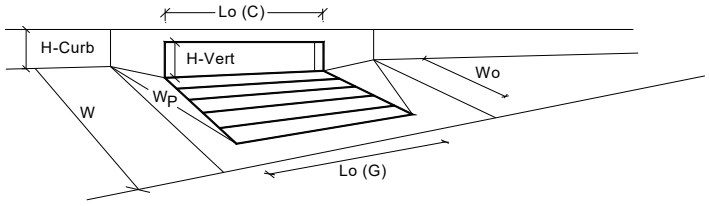
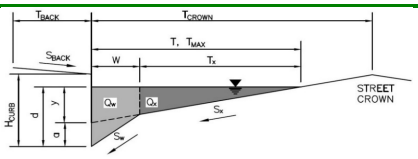


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	5.0	11.6	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **Inlet A-5**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

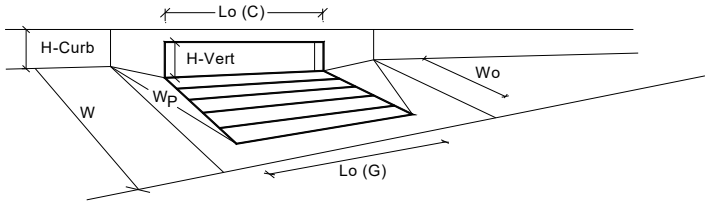
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

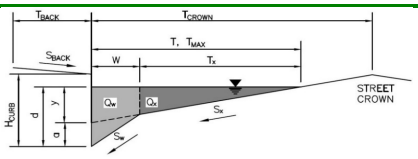


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.2	12.1	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **Inlet A-6**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

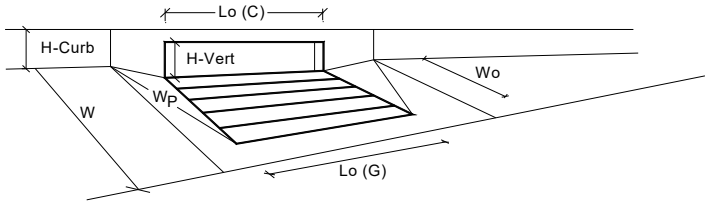
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

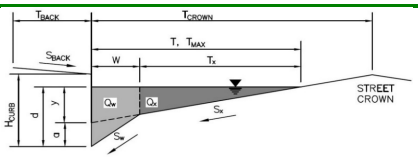


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.4	10.3	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **Inlet A-7**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

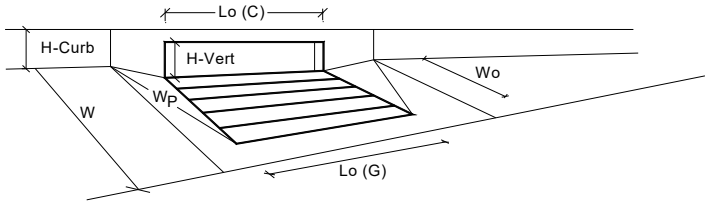
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

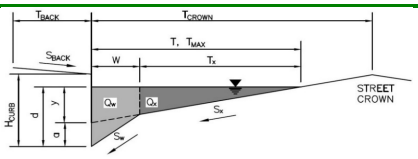


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.7	8.8	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **Inlet A-1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

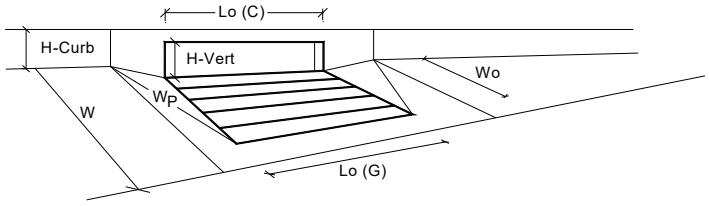
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.4	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

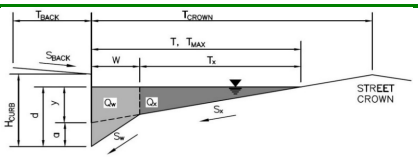


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.4	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.37	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} =	0.93	0.96	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**9.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.1	7.8	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **Inlet A-2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

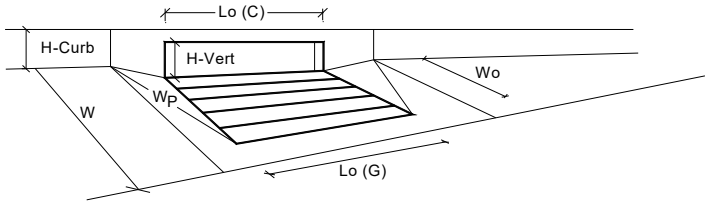
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.83	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**23.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	9.8	22.9	cfs

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project: Carvana, Fountain CO
Minor: 5-year
Major: 100-year

Worksheet Protected

INLET NAME	A-2	A-3	A-4	A-5
Inlet Application (Street or Area)	STREET	STREET	AREA	STREET
Hydraulic Condition	In Sump	In Sump	Swale	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type C (Depressed)	CDOT Type R Curb Opening
Number of Inlet Units	1	1	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	3.05	9.80	7.86	4.96
Major Peak Flow, Q (cfs)	7.80	22.94	18.41	11.61

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:				
Bypass Flow Description (Optional):				
Minor Bypass Flow Received, Q_b (cfs)				
Major Bypass Flow Received, Q_b (cfs)				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	3.05	9.80	7.86	4.96
Major Total Design Peak Flow, Q (cfs)	7.80	22.94	18.41	11.61
Minor Inlet Interception Capacity, Q_a (cfs)	8.28	16.04	15.52	16.04
Major Inlet Interception Capacity, Q_a (cfs)	9.78	23.37	16.02	16.04
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	0.00	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	2.39	N/A
Minor Flow Capture Percentage, C%	100%	100%	100%	100%
Major Flow Capture Percentage, C%	100%	100%	87%	100%

MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project: Carvana, Fountain CO
Minor: 5-year
Major: 100-year

Worksheet Protected

INLET NAME	A-6	A-7	A-8
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
Number of Inlet Units	1	1	1

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	4.15	4.38	3.74
Major Peak Flow, Q (cfs)	9.71	10.25	8.75

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	A-4		
Bypass Flow Description (Optional):			
Minor Bypass Flow Received, Q_b (cfs)	0.00		
Major Bypass Flow Received, Q_b (cfs)	2.39		

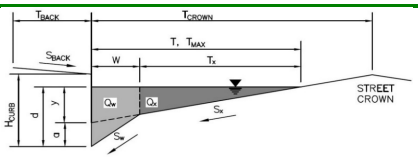
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	4.15	4.38	3.74
Major Total Design Peak Flow, Q (cfs)	12.10	10.25	8.75
Minor Inlet Interception Capacity, Q_a (cfs)	16.04	16.04	16.04
Major Inlet Interception Capacity, Q_a (cfs)	16.04	16.04	16.04
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	N/A
Minor Flow Capture Percentage, C%	100%	100%	100%
Major Flow Capture Percentage, C%	100%	100%	100%

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **A-2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

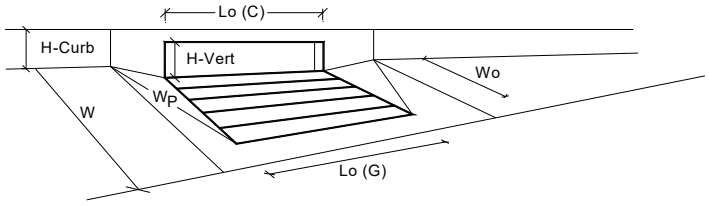
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.4	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

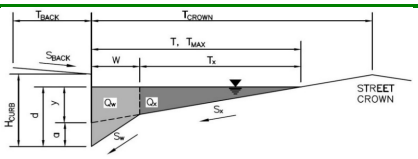


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.4	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.37	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} =	0.93	0.96	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.3**	**9.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.1	7.8	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **A-3**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

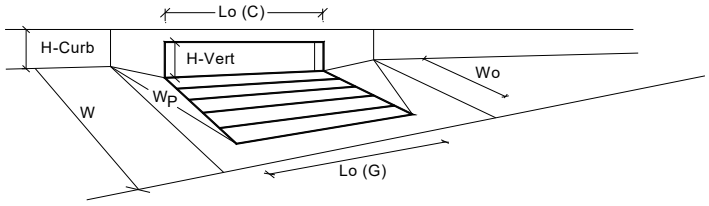
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

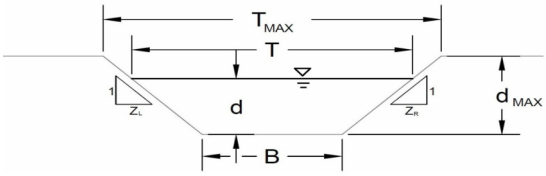


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.83	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**23.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	9.8	22.9	cfs

AREA INLET IN A SWALE

Carvana, Fountain CO

A-4



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.013	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	50.00	ft/ft
Right Side Sloe	Z2 =	50.00	ft/ft

Check one of the following soil types:

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

Choose One:
- ○ Non-Cohesive
- ○ Cohesive
- ◉ Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**100.00**	**100.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**510.1**	**510.1**	**cfs**
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	**0.98**	**0.98**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**7.9**	**18.4**	**cfs**
Water Depth	d =	**0.19**	**0.27**	**ft**

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

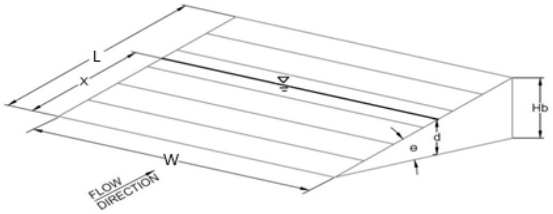
AREA INLET IN A SWALE

Carvana, Fountain CO

A-4

Inlet Design Information (Input)

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

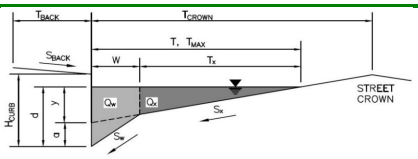


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.19	1.27	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**15.5**	**16.0**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**2.4**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**87**	**%**

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **A-5**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

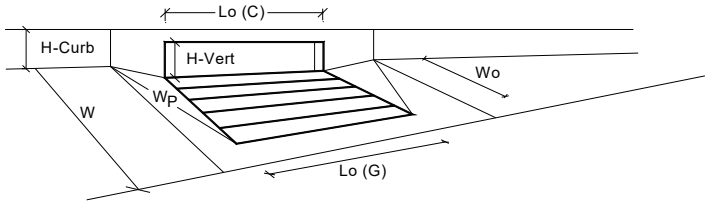
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

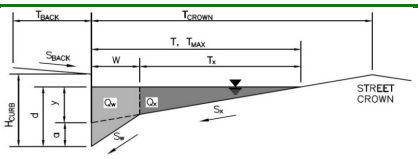


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	5.0	11.6	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **A-6**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

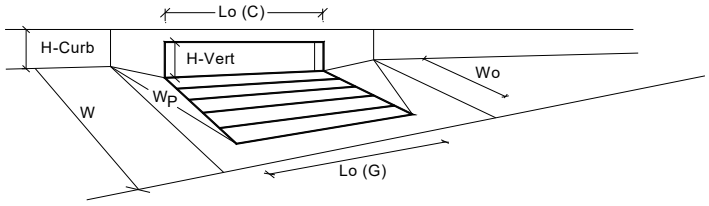
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

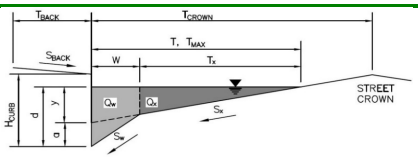


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.2	12.1	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **A-7**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

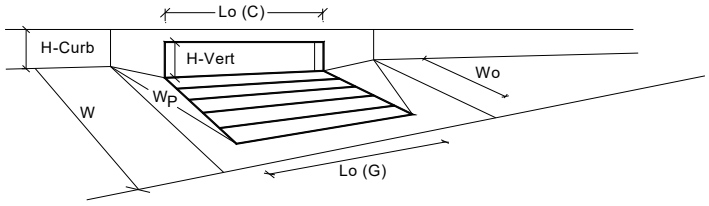
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)

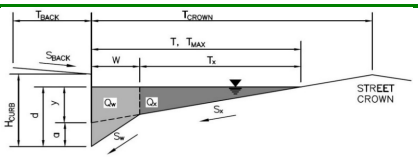


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.4	10.3	cfs

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

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

Project: **Carvana, Fountain CO**
Inlet ID: **A-8**



Gutter Geometry:

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Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

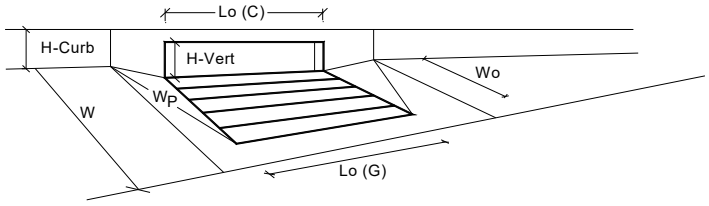
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	8.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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 6.00 (August 2025)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	1.00	1.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	8.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
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		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	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)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.50	0.50	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	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.0**	**16.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.7	8.8	cfs

River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Notes
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
2438	100_yr_Flow	EX_100yr_river_flow	4328.00	5536.94	5543.57	5540.91	5543.86	0.0026	4.30	1007.66	221.51	0.36	
2438	100_yr_Flow	PR_100Y	4328.00	5536.94	5543.57	5540.90	5543.86	0.0026	4.30	1007.66	221.51	0.36	
2243	100_yr_Flow	EX_100yr_river_flow	4328.00	5536.22	5542.14		5542.97	0.0082	7.37	603.74	182.37	0.63	
2243	100_yr_Flow	PR_100Y	4328.00	5536.22	5542.14		5542.97	0.0082	7.37	603.83	182.40	0.63	
2018	100_yr_Flow	EX_100yr_river_flow	4328.00	5533.22	5540.31		5541.14	0.0081	7.30	592.99	138.51	0.62	Upstream station from culverts
2018	100_yr_Flow	PR_100Y	4328.00	5533.22	5540.31		5541.14	0.0081	7.30	592.72	138.50	0.62	
1735	100_yr_Flow	EX_100yr_river_flow	4328.00	5531.31	5539.31		5539.69	0.0030	4.94	875.24	174.68	0.39	Downstream station from culverts
1735	100_yr_Flow	PR_100Y	4328.00	5531.31	5539.30	5536.46	5539.68	0.0030	4.95	874.14	174.62	0.39	
1633	100_yr_Flow	EX_100yr_river_flow	4328.00	5530.88	5538.86		5539.33	0.0039	5.47	791.76	165.76	0.44	
1633	100_yr_Flow	PR_100Y	4328.00	5530.88	5538.86		5539.33	0.0039	5.47	791.76	165.76	0.44	
1579	100_yr_Flow	EX_100yr_river_flow	4328.00	5531.44	5537.36	5537.07	5538.83	0.0182	9.73	444.60	124.07	0.91	
1579	100_yr_Flow	PR_100Y	4328.00	5531.44	5537.36	5537.07	5538.83	0.0182	9.73	444.60	124.07	0.91	
1373	100_yr_Flow	EX_100yr_river_flow	4328.00	5529.80	5536.94		5537.28	0.0029	4.64	932.27	197.52	0.38	
1373	100_yr_Flow	PR_100Y	4328.00	5529.80	5536.94		5537.28	0.0029	4.64	932.27	197.52	0.38	
715	100_yr_Flow	EX_100yr_river_flow	4328.00	5528.17	5532.55	5532.33	5533.20	0.0214	6.47	669.08	392.11	0.87	
715	100_yr_Flow	PR_100Y	4328.00	5528.17	5532.55	5532.33	5533.20	0.0214	6.47	669.08	392.11	0.87	
302	100_yr_Flow	EX_100yr_river_flow	4328.00	5526.47	5531.55		5531.63	0.0013	2.36	1832.95	599.36	0.24	
302	100_yr_Flow	PR_100Y	4328.00	5526.47	5531.55		5531.63	0.0013	2.36	1832.95	599.36	0.24	
22	100_yr_Flow	EX_100yr_river_flow	4328.00	5523.98	5530.03	5529.38	5530.43	0.0100	5.11	847.44	398.99	0.62	
22	100_yr_Flow	PR_100Y	4328.00	5523.98	5530.03	5529.38	5530.43	0.0100	5.11	847.44	398.99	0.62	

APPENDIX E
REFERENCE MATERIALS

FINAL DRAINAGE REPORT AND PLAN CHRISTIAN SUBDIVISION FILING NO. 2

August, 1999
Revised October, 1999

Project No. 99035

Prepared for:
ADT Automotive
435 Metroplex Drive
Nashville, Tennessee 37211

Prepared by:
Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado 80907
Phone: (719) 531-6200
Fax: (719) 531-6266

TABLE OF CONTENTS

APPENDIX

MAP POCKET

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

August, 1999
Revised October, 1999
Project No. 99035

City of Fountain
116 South Main Street
Fountain CO 80817

Attn: Mr. David Smedsrud

Re: Final Drainage Report and Plan
Christian Subdivision Filing No. 2

Gentlemen:

Attached for approval is the Preliminary and Final Drainage Report for the "Christian Subdivision Filing No. 2" project. The project is located within the area that was studied in the "Master Development Drainage Plan" (MDDP) prepared for the "Christian Annexation Phase I and Phase II" project. The MDDP was submitted to the City of Fountain for approval in August of 1999 (Revised October, 1999).

The scope of the MDDP was limited to a general analysis of the hydrologic and hydraulic conditions of the overall development. Drainage facility recommendations were limited to major facilities and general in scope. The attached drainage report further refines the analysis performed in the MDDP with recommendations made specific to the Christian Subdivision Filing No. 2 project.

The attached report was prepared in accordance with criteria presented in the latest edition of the City of Colorado Springs Drainage Criteria Manual and in general conformance with the criteria and recommendations set forth in the MDDP. The report has been revised to include Consultant, Staff, and Planning Department comments.

Please contact the undersigned if there are any questions or if additional information is required.

Very truly yours,
Obering, Wurth & Associates

Roland G. Obering

Roland G. Obering, P.E. & P.L.S.

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

CERTIFICATION STATEMENTS

Preliminary and Final Drainage
Report and Plan
Christian Subdivision Filing No. 2
Project No. 99035

ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are current to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria acceptable to the City of Fountain for drainage reports. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Roland G. Obering

Roland G. Obering, P.E. & P.L.S. Colorado 13226

Roland G. Obering 13226 11/12/99

DEVELOPER'S STATEMENT

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

Business Name

By

Title

c/o Michael J. Frederick
455 E. Pikes Peak Ave. #100
Address
Colorado Springs, CO 80903

CITY OF FOUNTAIN

David R. Lethbridge

11/14/99
Date

David R. Lethbridge, Review Consultant for the City of Fountain; I recommend this Drainage Report for acceptance by the City of Fountain

Date

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

Re: Preliminary and Final Drainage
Report and Plan
Christian Subdivision Filing No. 2
Project No. 99035

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, no portion of the Christian Subdivision Filing No. 2 development is located within a floodplain as designated by the Flood Insurance Rate Map Panel No. 962 of 1300 dated March 17, 1997 (see Appendix, FEMA Exhibit).

Roland G. Obering, P.E. & P.L.S. Colorado No. 13226

Note:
Based on discussions with the El Paso County Flood Plain Administrator, a Flood Plain Development Permit will not be required for this project since it is located outside the limits of the official regulated floodplain study. Jurisdiction lies with the City of Fountain.

PRELIMINARY AND FINAL DRAINAGE REPORT AND PLAN FOR CHRISTIAN SUBDIVISION FILING NO. 2

I. PURPOSE

The purpose of this drainage report is to provide a drainage analysis for the "Christian Subdivision Filing No. 2" tract (the Project) and to make recommendations regarding drainage facilities that will safely convey runoff to acceptable outfall facilities. The analysis and recommendations will be in accordance with the criteria and requirements set forth in the "Master Development Drainage Plan for Christian Annexation Phase I and Phase II" (MDDP). Any changes to the criteria or recommendations presented in the MDDP will be discussed in this report.

II. GENERAL

A. LOCATION

The "Project" is a portion of the 128 acre "Christian Addition No. 1" tract that was annexed into the City of Fountain in November of 1996. The "Project" is located West of I-25 in Sections 6 and 7, Township 16 South, Range 65 West of the Sixth Principal Meridian (See Vicinity Map, Appendix). The "Project" is bounded on the North by an un-named tributary to Fountain Creek sometimes referred to as "West Bank Tributary", on the East by Charter Oak Ranch Road, on the South by the Christian Subdivision Filing No. 1 tract, and on the West by the Fort Carson Military Reservation.

B. PROJECT DESCRIPTION

The "Project" consists of approximately 56 acres. The area generally slopes from West to East with an average cross slope of approximately 3 percent. Vegetation generally consists of native grass and weeds. Onsite soils consist primarily of Heldt clay loam, which is typically deep and well drained. The soil is included in the hydrologic soil group "C".

C. LAND USE

The "Project" consists of approximately 56 acres. It is to be developed as an automotive auction facility. The major portion of the site is to be paved with asphalt bituminous pavement. Six (6) buildings are to be constructed to provide for the needs of the sales and maintenance staff.

D. PROJECT PHASING

The entire 56 acre site will be graded as the initial step of site development. Approximately 31 acres is to be developed in the first phase of the project. All of the buildings are to be constructed during this phase and 23 acres will be paved. The remaining 8 acres will be temporarily graveled until the need for additional parking occurs at which time it will be paved. The deferral of paving was discussed and accepted during Planning Commission hearings for the Master Plan. The remaining 25 acres is proposed to be re-seeded as part of Phase I. It will eventually be paved as needed as the auction facility expands.

III. OVERVIEW OF EXISTING DRAINAGE CHARACTERISTICS

A. OFFSITE

The "Project" site is located South of and adjacent to the unnamed tributary to Fountain Creek, sometimes referred to as the West Bank Tributary. This tributary was studied as part of the MDDP. The study was performed to establish a 100-year flood plain along the Northerly property line of the "Project" site. The Northerly property line of the "Project" was established to not encroach into the 100-year flood plain and to allow an additional 25'± buffer back from the top of the bank.

Stormwater runoff also enters the "Project" site via overland flow from the Christian Subdivision Filing No. 1 tract and from the Fort Carson Military Reservation, located South and West of the "Project" site, respectively. A portion of the flow from Fort Carson is captured in a stock watering pond which will be removed as part of the site grading.

B. ONSITE

Stormwater runoff from the "Project" site currently flows over land East to an existing roadside ditch along the Westerly side of Charter Oak Ranch Road. The majority of the water flows East to the road ditch in a poor condition then to an existing culvert under Charter Oak Ranch Road, then in an uncontrolled manner, Easterly through the Champlin Industrial Park to the I-25 Right-of-way and then Northerly to the above referenced unnamed tributary. A small amount of stormwater is carried Northward to the existing creek and Southerly toward Santa Fe Avenue.

IV. HYDROLOGIC ANALYSIS SUMMARY

A. CRITERIA

The criteria used in this study was obtained from the current edition of the Drainage Criteria Manual for the City of Colorado Springs and El Paso County (DCM).

Methods

The Rational Method was used to estimate runoff amounts for both the 5-year and the 100-year storm events. Sub basins were determined based on locations of ridge lines and proposed outfall points.

Runoff Coefficients

Runoff coefficients were obtained from the DCM. Values of 0.90 and 0.95 were typically used for the 5-year and 100-year storms, respectively. These coefficients represent land use of commercial/retail development and are reasonable to expect for the auto auction development.

Times of Concentration

Times of concentration were determined by combining travel times for overland flow, channel flow, curb and gutter flow, and storm sever flow where applicable.

Rainfall Intensities

Rainfall intensities for specific times of concentration were obtained from pertinent charts found in the DCM.

B. OFFSITE CONSIDERATIONS

West Bank Tributary

The tributary to Fountain Creek, located along the "Project's" Northerly property line, was studied as part of the MDDP. The main purpose of the study was to establish a 100-year flood along the length of the tributary. Reference is made to the MDDP for information regarding this study.

West Offsite

Stormwater runoff from the Fort Carson Military Reservation enters the "Project" site via surface flow. The 5-year and 100-year discharge amounts were estimated to be 43.8 cfs and 102.9 cfs respectively. No increase in discharge from Fort Carson is anticipated in the foreseeable future.

South Offsite

The property, which is located South of the "Project", is platted as Christian Subdivision Filing No. 1. It is currently undeveloped. Stormwater from this site currently enters the "Project" site via surface flow.

In accordance with the MDDP, once the Christian Subdivision Filing No. 1 is developed, all runoff will be directed to a proposed detention pond at the Northeast corner of the that site. Discharge from the that site were estimated to be as follows:

Historic (Existing)	$Q_5 = 8.4$ cfs	$Q_{100} = 21.4$ cfs
Developed	$Q_5 = 32.1$ cfs	$Q_{100} = 63.3$ cfs

C. ONSITE CONSIDERATIONS

Stormwater runoff from the "Project" site was evaluated at four (4) locations that represent outfall points after the "Project" site is developed.

Point No. 1 is located at the proposed main detention pond (Detention Pond No. 1) located along the West side of Charter Oak Ranch Road. This pond is to be sized to accommodate the majority of the runoff from the "Project" site. Approximately 35.8 acres (Sub basin A) drains to this pond.

Point No. 2 is located at the Northeast corner of the site. Approximately 5.1 acres (Sub basin B) drains to this point and discharges directly into the existing creek without detention via the roadside overflow channel. The detention ponds, proposed at the other outfall points were sized to over-detain in order to compensate for this un-detained flow.

Point No. 3 is located at another proposed detention pond (Detention Pond #2) which is near the Northwest corner of the "Project" site. This pond will be sized to accommodate runoff from sub basin "C", consisting of approximately 12.3 acres and containing most of Phase II of the development.

Point No. 4 is located at the Northwest corner of the site. At this location stormwater runoff from the Fort Carson Military Reservation will be discharged directly into the existing creek. No detention is proposed at this location, as these are historic flows.

Stormwater runoff from each sub basin is summarized on the attached "Drainage Plan" (see Map Pocket).

V. HYDRAULIC ANALYSIS SUMMARY

A. OFFSITE FACILITIES

West Bank Tributary

It is proposed to install riprap channel lining along two sections of the existing channel where there is evidence of erosion. These two sections are located at bends in the main channel. The riprap was sized for the stream velocity as computed in the HEC 2 computer program. The length of the riprap is to extend on either side of the bends in order to prevent undercutting. A typical section and approximate extent is shown on the attached Drainage Plan. This proposed stabilization together with the 25'± buffer is proposed to result in the prudent long-term management of the portion of the naturally occurring channel adjacent to this subdivision. A private drainage easement will be provided for installation and maintenance in this area.

West Offsite

A channel is proposed to be constructed along the West side of the "Project" site. The channel will be sized to accommodate the anticipated 100-year discharge from the Fort Carson Military Reservation. Riprap channel lining with concrete cut-off walls are to be installed in steeper sections and at the outfall into the creek. Based on the current Site Plan, the developer is considering installing the Southerly portion of this system in an underground pipe to accommodate the test track with riprap at the North end. This area is subject to final design and will be shown in detail on the Site Plan application. A suitable easement will be provided.

South Offsite

In accordance with the MDDP, stormwater from the South is to be accommodated by detention ponds designed to discharge at the historic 5-year and 100-year storm rates. Reference is made to the MDDP for data regarding these ponds. Storm sewer facilities along the West side of Charter Oak Ranch Road are sized for the historic 100-year discharge amount, which is estimated to be 57.2 cfs. It is proposed to install a 42" RCP to the Southerly property line to accommodate this flow. It should be noted that this system will be extended Southerly along the Christian Subdivision Filing No. 1 frontage when required as an outfall for development on the South or when the road is improved.

B. ONSITE FACILITIES

The majority of the runoff from onsite is to be accommodated by two (2) detention pond facilities that are sized to release at the 5-year and 100-year historic rates.

Pond No. 1 accommodates runoff from Subbasin A. The pond was sized to over detain in order to compensate for the un-detained runoff from sub basin B discharging directly to the overflow channel. The pond's outlet structure is designed to discharge into the public storm sewer, which is to be constructed along the West side of Charter Oak Ranch Road. Should the outlet structure become non-functional or blocked, an emergency spillway in the form of an open overflow channel is to be constructed along the Westerly side of Charter Oak Ranch Road to carry the stormwater North to the existing creek.

Pond No. 2 accommodates runoff from Subbasin C. The pond's outlet is designed as a two (2)-stage structure that limits discharges to the historic rates for both the 5-year and 100-year storm events directly into the existing creek. Riprap erosion protection at the pipe outlet will be required to help reduce erosion at the outlet.

The ponds were sized based on the following:

Total Undeveloped Runoff from the Site:

Q5 = 35.2 cfs Q100 = 92.9 cfs

Developed Flow from Sub basin "B":

Q5 = 21.1 cfs Q100 = 38.3 cfs

Total Allowable Discharge from Both Ponds Combined:

Q5 = 14.1 cfs Q100 = 54.6 cfs

Discharge from Detention Pond No. 1:

Q5 = 7.7 cfs Q100 = 23.6 cfs

Discharge from Detention Pond No. 2:

Q5 = 5.5 cfs Q100 = 21.5 cfs

A public storm sewer is proposed along the West side of Charter Oak Ranch Road. The storm sewer is part of an overall system that will accommodate historic discharge rates from the entire Christian Annexation Phase I and Phase II area. Reference is made to the MDDP for data regarding the recommended alternate and the sizing of these storm sewer facilities.

Due to the amount and velocity of flow discharging from the storm sewer an energy dissipater is proposed at the Northerly end of the storm sewer. The Contra Costa Energy Dissipator type is recommended for this application. A schematic drawing of this structure was included in the MDDP.

A summary of the proposed public storm sewer and other drainage facilities is presented in tabular form on the "Drainage Plan". The private onsite systems are also shown on the Drainage Plan

VI. ENVIRONMENTAL CONSIDERATIONS

The corridor along the existing creek at the North end of the project has been deemed as an environmentally sensitive area. Wetland boundary limits were determined and a Preeble Mouse Habitat Study was conducted as part of the MDDP. The wetland boundary along the South side of the creek is shown on the attached "Drainage Plan". The "Preeble Mouse Habitat Study" revealed an unsuitable habitat for the mouse. Reference is made to the MDDP for supporting documentation regarding the above.

VII. ESTIMATE OF PROBABLE COST

Following Section VIII is an "Estimate of Probable Cost" for both the public and private recommended drainage facilities shown on the attached "Drainage Plan". The public facilities include the storm sewer along Charter Oak Ranch Road and the energy dissipation structure. The riprap improvements along the South side of the creek, the detention ponds, related outlet structures, and the onsite drainage facilities are considered to be private.

VIII. SUMMARY AND RECOMMENDATIONS

In summary, this drainage report establishes the following:

1. All offsite runoff is to be re-routed around the "Project" site via underground storm sewers and/or open swales.

2. Drainage facility recommendations made with this report are consistent with the plan presented in the MDDP.

3. Onsite stormwater runoff from development of this subdivision is to be accommodated by private onsite detention ponds that are sized to discharge at the historic 5-year and 100-year rates. These systems will be constructed and maintained by the Developer of Filing No. 2 including connection to the public systems.

4. The environmentally sensitive corridor, located along the Northerly property line, is to be protected from degradation with the installation of riprap erosion control

facilities along portions of the creek and with an energy dissipation structure at the North end of the storm sewer.

5. The systems in public rights-of-way or easements are publicly maintained and will require suitable assurances at the time of Building Permit. These systems will be constructed in association with improvements to Charter Oak Ranch Road by the entity (Developer or Local Improvement District) improving the road.

ESTIMATE OF PROBABLE COST

Christian Subdivision Filing No. 2
Public Drainage Facilities - Charter Oak Ranch Road

ITEM	DESCRIPTION	QNTY/UNIT	UNIT COST	ESTIMATE	COMMENTS
1	42" RCP Storm Sewer	1165 LF	$ 80	$ 93,200	
2	48" RCP Storm Sewer	770 LF	$ 95	$ 73,150	
3	Box Base Manhole	3 EA.	$ 5,000	$ 15,000	
4	CDOT Type C Inlet	2 EA.	$ 2,500	$ 5,000	
5	Concrete Energy Dissipator	1 EA	$ 5,000	$ 5,000	subject to final design
6	Rock Riprap Outlet Protection	100 CY	$ 35	$ 3,500	
7	Rock Riprap Swale	250 LF	$ 45	$ 11,250	
8	Concrete Cutoff Wall	2 EA.	$ 1,500	$ 3,000	
		Subtotal		$ 209,100	
	15% Engineering and Contingencies			$ 31,365	
	TOTAL PUBLIC DRAINAGE FACILITIES			**$ 240,465**	

Note: All construction shall be completed to El Paso County Department of Transportation Standards and Specifications

ESTIMATE OF PROBABLE COST

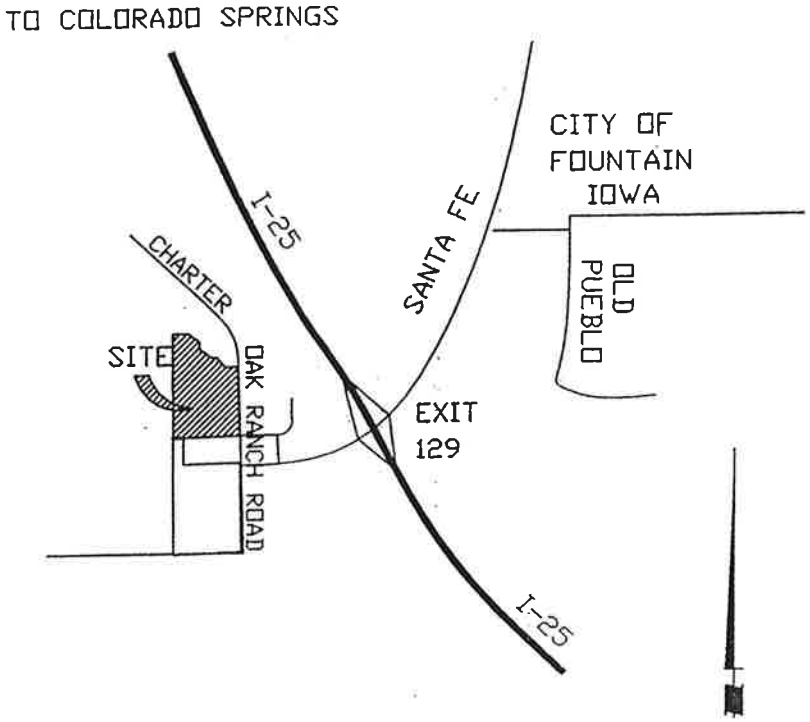
Christian Subdivision Filing No. 2
Private Drainage Facilities - ADT Automotive

Item #	Item Description	Approx Quantity	Units	Unit Cost	Total Cost	Comments
1	Detention Pond Outfall Structure	2	ea	$ 3,000	$ 6,000	
2	24" RCP Pond Storm Sewer	170	lf	$ 35	$ 5,950	
3	24" RCP Flared End Section	3	ea	$ 1,800	$ 5,400	
4	30" RCP Flared End Section	1	ea	$ 2,000	$ 2,000	
5	12" RCP Storm Sewer	240	lf	$ 25	$ 6,000	
6	15" RCP Storm Sewer	400	lf	$ 30	$ 12,000	
7	18" RCP Storm Sewer	550	lf	$ 35	$ 19,250	
8	24' RCP storm Sewer	340	lf	$ 40	$ 13,600	
9	30" RCP Storm Sewer	640	lf	$ 45	$ 28,800	
10	Storm Sewer Manhole	4	ea	$ 1,500	$ 6,000	
11	5' Curb Inlet	1	ea	$ 2,000	$ 2,000	
12	10' Cub Inlet	6	ea	$ 2,500	$ 15,000	
13	3' x 3' Area Inlet	4	ea	$ 1,500	$ 6,000	
14	Concrete Cut-off Walls	2	ea	$ 1,500	$ 3,000	
15	12" D50 Riprap Swale Lining on Granular Bedding and Filter Fabric	1300	cy	$ 38	$ 49,400	
	Subtotal Private Drainage Facilities				**$ 180,400**	
	15% Contingencies & Engineering				**$ 27,060**	
	Total Private Drainage Facilities				**$ 207,460**	

Note: Pond construction included in overlot grading cost

APPENDIX

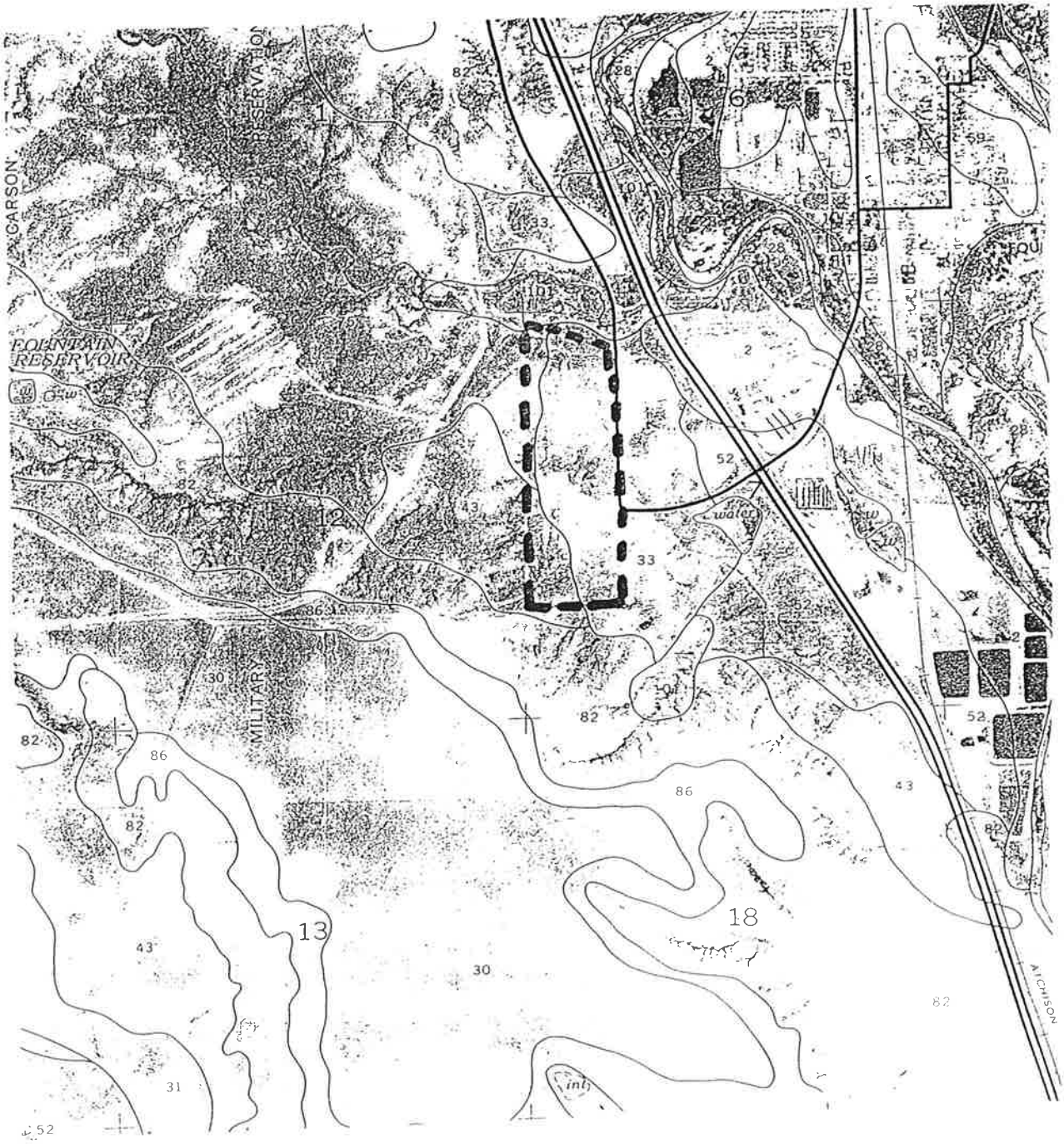
VICINITY MAP



VICINITY MAP

NOT TO SCALE

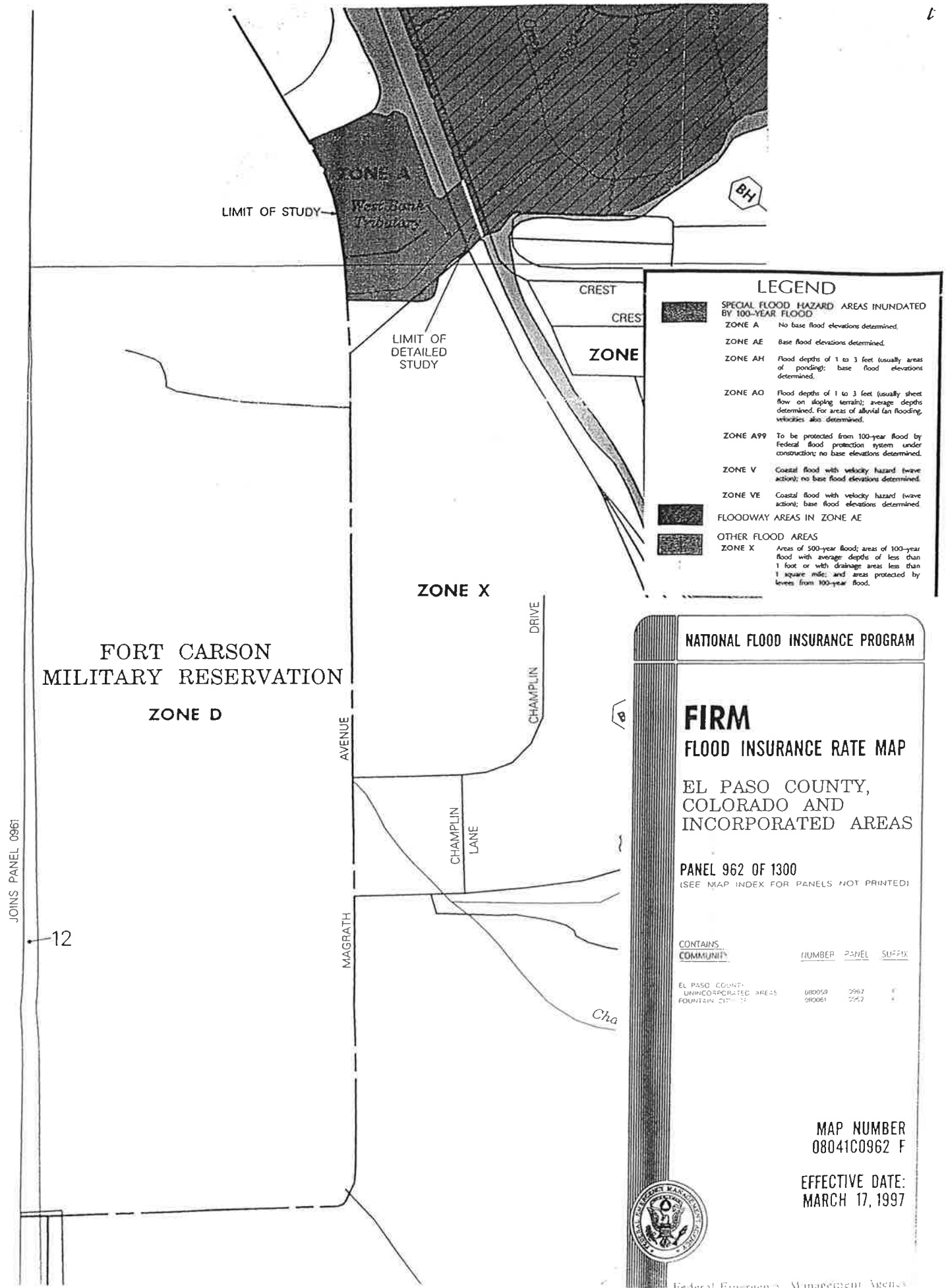
SCS SOILS
EXHIBIT



SHEET NO 24
EL PASO COUNTY AREA, COLORADO
(FOUNTAIN QUADRANGLE)

S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FEMA
EXHIBIT


ZONE A
West Bank Tributary
LIMIT OF STUDY
BH
CREST
CRES
ZONE
LIMIT OF DETAILED STUDY
ZONE X
FORT CARSON
MILITARY RESERVATION
ZONE D
CHAMPLIN DRIVE
AVENUE
CHAMPLIN LANE
MAGRATH
JOINS PANEL 0961
12
Cha
LEGEND
SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD
ZONE A No base flood elevations determined.
ZONE AE Base flood elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.
FLOODWAY AREAS IN ZONE AE
OTHER FLOOD AREAS
ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 962 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY UNINCORPORATED AREAS 080059 0962 F
FOUNTAIN CITY OF 080061 0962 F
MAP NUMBER
08041C0962 F
EFFECTIVE DATE:
MARCH 17, 1997
Federal Emergency Management Agency

HYDROLOGIC SUMMARY EXHIBIT

Hydrologic Summary

Christian Subdivision #2: ADT Automotive Center

Project # : 99035

Date: August, 1999

		Drainage Area					Rainfall Intensities		Discharge	
Point	Subbasin	Area (acres)	Land Use	C5	C100	Tc (min)	I5	I100	Q5 (cfs)	Q100 (cfs)
West Offsite	Fort Carson	70.0	Pasture	0.25	0.35	28.6	2.5	4.2	43.8	102.9
1	A	35.8	Commercial	0.90	0.95	7.0	4.6	7.9	148.2	268.7
2	B	5.1	Commercial	0.90	0.95	7.0	4.6	7.9	21.1	38.3
3	C	12.3	Commercial	0.90	0.95	7.0	4.6	7.9	50.9	92.3
4	D	4.1	Commercial	0.90	0.95	5.0	5.2	9.0	19.2	35.1
5	E	1.7	Roadway	0.90	0.95	5.0	5.2	9.0	8.0	14.5

HYDRAULIC SUMMARY EXHIBIT

Storm Sewer/ Drainage Facilities Summary

Project: Christian Subdivision Filing #2; ADT Automotive Center

Date: August, 1999

Project #: 99036

Design Flow				Proposed Drainage Facilities				
Summ Pnt	Upstream Q	Additional Q	Design Q	Diameter/Size	Slope	Capacity	Vel.	Comments
5-6	78.6	0	78.6	42	0.6	85	10	
6-2	78.6	23.6	102.2	48	0.5	110	9	
1-6	0	23.6	23.6	24	1	25	8	Detention Pond #1 Outfall
3-outfall	0	21.5	21.5	24	1	25	8	Detention Pond #2 Outfall

DETENTION POND EXHIBITS

Detention Pond Summary

ADT Automotive Center

Project # 99035

Date: August, 1999

						Outfall Facilities			
Q in (cfs)		Qout (cfs)		Water Surface Elev		Orifice		Stand Pipe	
Q5	Q100	Q5	Q100	5 year	100 year	Diameter	Invert	Diameter	Crest
Detention Pond #1									
148.2	268.7	7.7	23.6	39.1	42.4	10.0	30.0	18.0	39.5
Detention Pond #2									
50.9	92.3	5.5	21.5	38.5	40.1	9.0	31.5	24.0	39.0

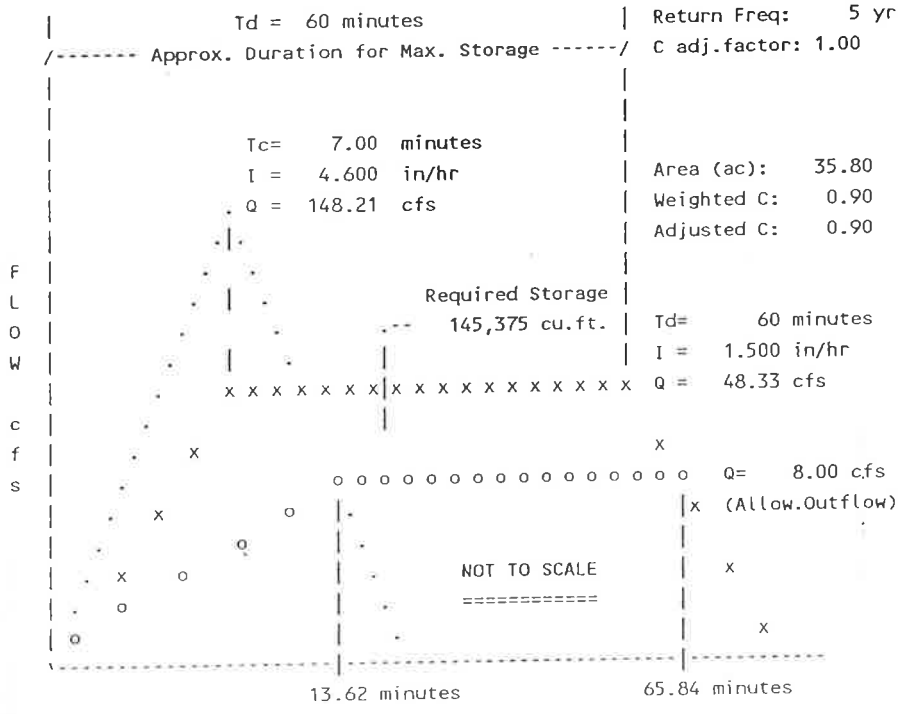
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 16:18:47 08-20-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Proposed Detention Pond along North Side of Charter Oak Ranch Road
ADT Automotive Center Proj # 99035; 5 year storm
Date: August 20, 1999

```
**************************************************************************
*  RETURN FREQUENCY:   5 yr    |  Allowable Outflow:     8.00 cfs     *
*  'C' Adjustment: 1.000       |  Required Storage:   145,375 cu.ft. *
*-------------------------------------------------------------------------*
*  Peak Inflow:   48.33 cfs       Inflow .HYD stored: POND15YR.HYD    *
**************************************************************************
```



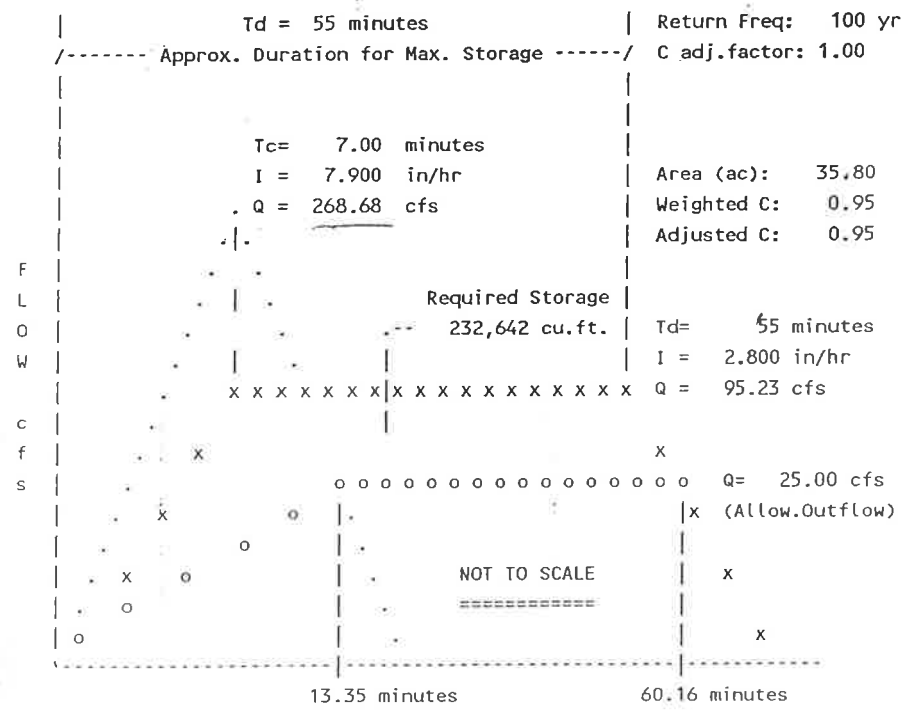
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 16:35:28 08-20-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Proposed Detention Pond along North Side of Charter Oak Ranch Road
ADT Automotive Center; Proj #99035; 100 year Storm
Date: August 20, 1999

```
**************************************************************************
*  RETURN FREQUENCY: 100 yr     |  Allowable Outflow:    25.00 cfs     *
*  'C' Adjustment: 1.000        |  Required Storage:   232,642 cu.ft. *
*-------------------------------------------------------------------------*
*  Peak Inflow:   95.23 cfs        Inflow .HYD stored: POND1100.HYD     *
**************************************************************************
```



****
*
* 100 year Storm Event *
* ADT- Alternate Grading (Pond in middle of site) *
* August23, 1999 Project No. 99035 *
* 10-inch orifice w/ 18" Stand Pipe *
*
****

Inflow Hydrograph: d:\drgdata\99035\POND1100.HYD
Rating Table file: d:\drgdata\99035\POND1 .PND

----INITIAL CONDITIONS----
Elevation = 30.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
30.00	0.0	0.000	0.0	0.0
30.50	0.0	0.003	4.0	4.0
31.00	0.0	0.022	31.8	31.8
31.50	0.0	0.074	107.3	107.3
32.00	0.0	0.175	254.4	254.4
32.50	0.0	0.313	454.7	454.7
33.00	4.2	0.465	674.4	678.6
33.50	4.6	0.630	914.4	919.0
34.00	5.0	0.810	1175.8	1180.8
34.50	5.3	1.004	1458.2	1463.5
35.00	5.6	1.213	1761.5	1767.1
35.50	5.9	1.437	2086.4	2092.3
36.00	6.2	1.676	2433.6	2439.8
36.50	6.5	1.931	2803.0	2809.5
37.00	6.7	2.201	3194.5	3201.2
37.50	7.0	2.486	3608.8	3615.8
38.00	7.2	2.787	4046.5	4053.7
38.50	7.5	3.107	4510.0	4517.5
39.00	7.7	3.446	5001.9	5009.6
39.50	7.9	3.805	5523.0	5530.9
40.00	13.3	4.184	6074.2	6087.5
40.50	16.8	4.583	6652.9	6669.7
41.00	19.0	4.998	7256.0	7275.0
41.50	20.8	5.431	7884.1	7904.9
42.00	22.4	5.881	8537.7	8560.1
42.50	23.9	6.354	9224.1	9248.0
43.00	25.2	6.855	9951.0	9976.2
43.50	26.5	7.384	10719.6	10746.1
44.00	27.7	7.943	11530.9	11558.6
44.50	28.9	8.531	12384.1	12413.0
45.00	30.0	9.146	13278.0	13308.0

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File: d:\drgdata\99035\POND1 .PND
Inflow Hydrograph: d:\drgdata\99035\POND1100.HYD
Outflow Hydrograph: d:\drgdata\99035\OUT .HYD

Starting Pond W.S. Elevation = 30.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	95.23 cfs
Peak Outflow	=	23.62 cfs
Peak Elevation	=	42.41 ft

***** Summary of Approximate Peak Storage *****

Initial Storage	=	0.00 ac-ft
Peak Storage From Storm	=	6.27 ac-ft
Total Storage in Pond	=	6.27 ac-ft

****
*
* 5 Year Storm Event *
* ADT- Alternate Grading (Pond in middle of site) *
* August23, 1999 Project No. 99035 *
* 10-inch orifice w/ 18" Stand Pipe *
*
****

Inflow Hydrograph: d:\drgdata\99035\POND15YR.HYD
Rating Table file: d:\drgdata\99035\POND1 .PND

----INITIAL CONDITIONS----
Elevation = 30.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
30.00	0.0	0.000	0.0	0.0
30.50	0.0	0.003	4.0	4.0
31.00	0.0	0.022	31.8	31.8
31.50	0.0	0.074	107.3	107.3
32.00	0.0	0.175	254.4	254.4
32.50	0.0	0.313	454.7	454.7
33.00	4.2	0.465	674.4	678.6
33.50	4.6	0.630	914.4	919.0
34.00	5.0	0.810	1175.8	1180.8
34.50	5.3	1.004	1458.2	1463.5
35.00	5.6	1.213	1761.5	1767.1
35.50	5.9	1.437	2086.4	2092.3
36.00	6.2	1.676	2433.6	2439.8
36.50	6.5	1.931	2803.0	2809.5
37.00	6.7	2.201	3194.5	3201.2
37.50	7.0	2.486	3608.8	3615.8
38.00	7.2	2.787	4046.5	4053.7
38.50	7.5	3.107	4510.0	4517.5
39.00	7.7	3.446	5001.9	5009.6
39.50	7.9	3.805	5523.0	5530.9
40.00	13.3	4.184	6074.2	6087.5
40.50	16.8	4.583	6652.9	6669.7
41.00	19.0	4.998	7256.0	7275.0
41.50	20.8	5.431	7884.1	7904.9
42.00	22.4	5.881	8537.7	8560.1
42.50	23.9	6.354	9224.1	9248.0
43.00	25.2	6.855	9951.0	9976.2
43.50	26.5	7.384	10719.6	10746.1
44.00	27.7	7.943	11530.9	11558.6
44.50	28.9	8.531	12384.1	12413.0
45.00	30.0	9.146	13278.0	13308.0

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: d:\drgdata\99035\POND1 .PND
Inflow Hydrograph: d:\drgdata\99035\POND15YR.HYD
Outflow Hydrograph: d:\drgdata\99035\OUT .HYD

Starting Pond W.S. Elevation = 30.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	48.33 cfs
Peak Outflow	=	7.73 cfs
Peak Elevation	=	39.06 ft

***** Summary of Approximate Peak Storage *****

Initial Storage	=	0.00 ac-ft
Peak Storage From Storm	=	3.49 ac-ft
Total Storage in Pond	=	3.49 ac-ft

POND-2 Version: 5.17
S/N: 1295130331

Alternate Grading (Pond in Middle of site, Pond No. 1)

CALCULATED 08-20-1999 16:44:00
DISK FILE: d:\drgdata\99035\POND-1 .VOL

Planimeter scale: 1 inch = 100 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	* Volume (acre-ft)	Volume Sum (acre-ft)
30.00	0.00	0.00	0.00	0.00	0.00
32.00	1.15	0.26	0.26	0.18	0.18
34.00	1.63	0.38	0.95	0.63	0.81
36.00	2.15	0.49	1.30	0.87	1.68
38.00	2.70	0.62	1.67	1.11	2.79
40.00	3.40	0.78	2.10	1.40	4.18
42.00	4.00	0.92	2.55	1.70	5.88
44.00	5.00	1.15	3.09	2.06	7.94
46.00	6.00	1.38	3.78	2.52	10.46
48.00	8.00	1.84	4.80	3.20	13.67

$$IA = (sq.rt(Area1) + ((Ei-E1)/(E2-E1))*(sq.rt(Area2)-sq.rt(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* Incremental volume computed by the Conic Method for Reservoir Volumes.

$$Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))$$

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Outlet Structure File: POND1 .STR

POND-2 Version: 5.17 S/N: 1295130331
Date Executed: Time Executed:

****

ADT- Alternate Grading (Pond in middle of site)
August20, 1999 Project No. 99035
10-inch orifice

****

***** COMPOSITE OUTFLOW SUMMARY ****

Elevation (ft)	Q (cfs)	Contributing Structures
30.00	0.0	
30.50	0.0	
31.00	0.0	
31.50	0.0	
32.00	0.0	
32.50	0.0	
33.00	4.2	1
33.50	4.6	1
34.00	5.0	1
34.50	5.3	1
35.00	5.6	1
35.50	5.9	1
36.00	6.2	1
36.50	6.5	1
37.00	6.7	1
37.50	7.0	1
38.00	7.2	1
38.50	7.5	1
39.00	7.7	1
39.50	7.9	1 +2
40.00	15.0	1 +2
40.50	23.5	1 +2
41.00	27.1	1 +2
41.50	30.1	1 +2
42.00	32.9	1 +2
42.50	35.3	1 +2
43.00	37.6	1 +2
43.50	39.8	1 +2
44.00	41.8	1 +2
44.50	43.7	1 +2
45.00	45.5	1 +2
45.50	47.3	1 +2
46.00	0.0	

Outlet Structure File: POND1 .STR

POND-2 Version: 5.17 S/N: 1295130331
Date Executed: Time Executed:

****

ADT- Alternate Grading (Pond in middle of site)
August20, 1999 Project No. 99035
10-inch orifice
****

>>>>>> Structure No. 1 <<<<<<
(Input Data)

ORIFICE
Orifice - Based on Area and Datum Elevation

E1 elev.(ft)?	32.8333
E2 elev.(ft)?	46
Orifice coeff.?	.6
Invert elev.(ft)?	30
Datum elev.(ft) ?	30.42
Orifice area (sq ft)?	.5454

Outlet Structure File: POND1 .STR

POND-2 Version: 5.17 S/N: 1295130331
Date Executed: Time Executed:

****

ADT- Alternate Grading (Pond in middle of site)
August20, 1999 Project No. 99035
10-inch orifice

****

>>>>>> Structure No. 2 <<<<<<
(Input Data)

STAND PIPE
Stand Pipe with weir or orifice flow

E1 elev.(ft)?	39.5
E2 elev.(ft)?	46
Crest elev.(ft)?	39.5
Diameter (ft)?	2.0
Weir coefficient?	3.1
Orifice coefficient?	.6
Start transition elev.(ft) @ ?	
Transition height (ft)?	

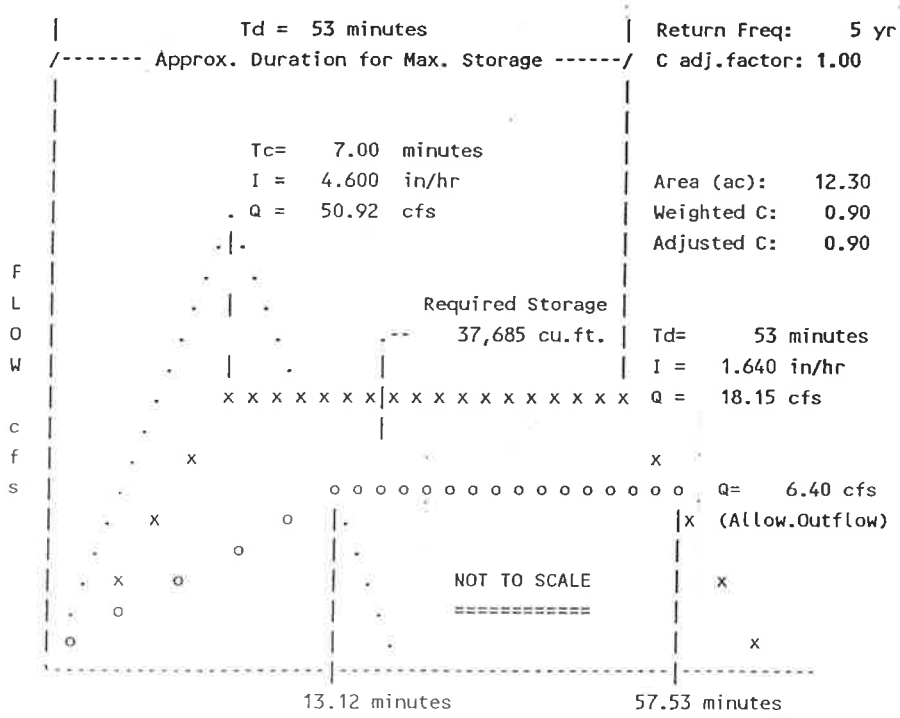
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 10:16:53 08-23-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Proposed Detention Pond Along Existing Creek: Pond #2
ADT Automotive Center; Proj # 99035; 5 year Storm
Date: August 23, 1999

RETURN FREQUENCY: 5 yr	Allowable Outflow: 6.40 cfs
'C' Adjustment: 1.000	Required Storage: 37,685 cu.ft.
Peak Inflow: 18.15 cfs	Inflow .HYD stored: POND25YR.HYD



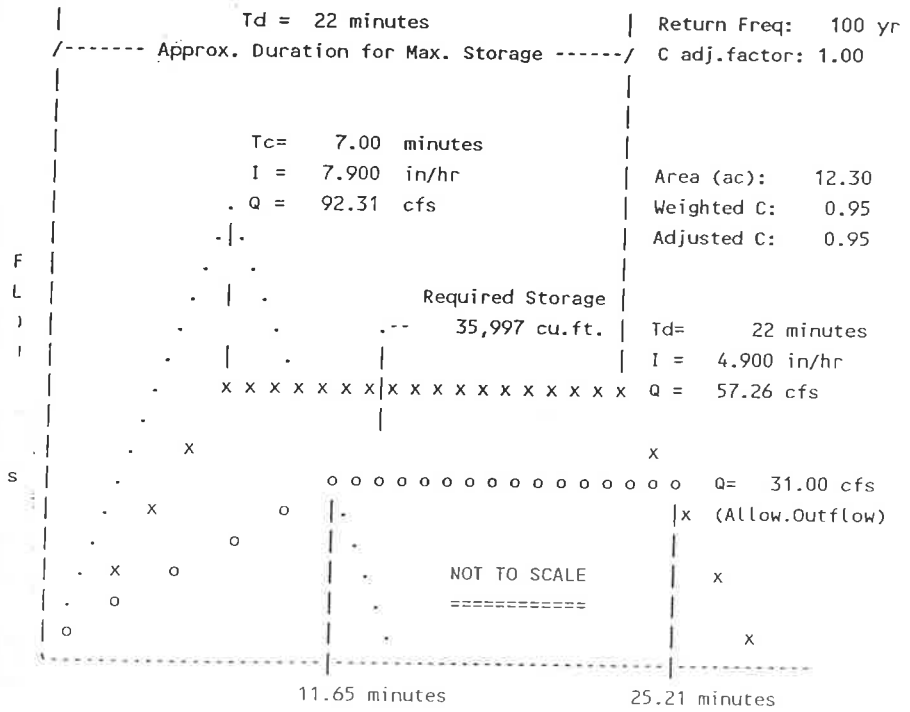
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 10:16:08 08-23-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Proposed Detention Pond Along Existing Creek: Detention Pond #2
ADT Automotive Center; Project # 99035; 100 Year Storm
Date: August 23, 1999

* RETURN FREQUENCY: 100 yr	Allowable Outflow: 31.00 cfs *
* 'C' Adjustment: 1.000	Required Storage: 35,997 cu.ft. *
* Peak Inflow: 57.26 cfs	Inflow .HYD stored: NONE STORED *



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**************************************************
*                                                *
*                                                *
*            5 Year Storm Event                  *
*  ADT- Alternate Grading ( Pond in middle of site) *
*          August 9, 1999  Project No. 99035     *
*          9 Inch Oricice w/ 24" Stand Pipe      *
*                                                *
**************************************************
```

Inflow Hydrograph: d:\drgdata\99035\POND25YR.HYD
Rating Table file: d:\drgdata\99035\POND2 .PND

----INITIAL CONDITIONS----
Elevation = 31.50 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
31.50	0.0	0.000	0.0	0.0
32.00	0.0	0.011	15.6	15.6
32.50	1.7	0.045	66.0	67.7
33.00	2.3	0.085	124.0	126.3
33.50	2.7	0.131	190.0	192.7
34.00	3.1	0.182	264.6	267.7
34.50	3.4	0.240	348.8	352.2
35.00	3.8	0.306	443.8	447.6
35.50	4.0	0.379	550.3	554.3
36.00	4.3	0.461	668.8	673.1
36.50	4.6	0.551	799.4	804.0
37.00	4.8	0.649	941.7	946.5
37.50	5.0	0.755	1096.2	1101.2
38.00	5.3	0.870	1263.6	1268.9
38.50	5.5	0.995	1443.8	1449.3
39.00	5.7	1.127	1636.7	1642.4
39.50	12.8	1.269	1842.9	1855.7
40.00	21.2	1.421	2062.8	2084.0
40.50	24.8	1.581	2295.3	2320.1
41.00	27.8	1.749	2539.4	2567.2
41.50	30.5	1.928	2799.5	2830.0
42.00	33.0	2.122	3080.4	3113.4
42.50	35.2	2.325	3375.1	3410.3
43.00	37.3	2.532	3675.9	3713.2
43.50	39.3	2.744	3983.0	4022.3

Time increment (t) = 1.0 min.

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: d:\drgdata\99035\POND2 .PND
Inflow Hydrograph: d:\drgdata\99035\POND25YR.HYD
Outflow Hydrograph: d:\drgdata\99035\OUT .HYD

Starting Pond W.S. Elevation = 31.50 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	18.15 cfs
Peak Outflow	=	5.50 cfs
Peak Elevation	=	38.51 ft

***** Summary of Approximate Peak Storage *****

Initial Storage	=	0.00 ac-ft
Peak Storage From Storm	=	1.00 ac-ft
Total Storage in Pond	=	1.00 ac-ft

****
*
* 100 Year Storm Event *
* ADT- Alternate Grading (Pond in middle of site) *
* August23, 1999 Project No. 99035 *
* 9 Inch Oricice w/ 24" Stand Pipe *
*
****

Inflow Hydrograph: d:\drgdata\99035\POND2100.HYD
Rating Table file: d:\drgdata\99035\POND2 .PND

----INITIAL CONDITIONS----
Elevation = 31.50 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
31.50	0.0	0.000	0.0	0.0
32.00	0.0	0.011	15.6	15.6
32.50	1.7	0.045	66.0	67.7
33.00	2.3	0.085	124.0	126.3
33.50	2.7	0.131	190.0	192.7
34.00	3.1	0.182	264.6	267.7
34.50	3.4	0.240	348.8	352.2
35.00	3.8	0.306	443.8	447.6
35.50	4.0	0.379	550.3	554.3
36.00	4.3	0.461	668.8	673.1
36.50	4.6	0.551	799.4	804.0
37.00	4.8	0.649	941.7	946.5
37.50	5.0	0.755	1096.2	1101.2
38.00	5.3	0.870	1263.6	1268.9
38.50	5.5	0.995	1443.8	1449.3
39.00	5.7	1.127	1636.7	1642.4
39.50	12.8	1.269	1842.9	1855.7
40.00	21.2	1.421	2062.8	2084.0
40.50	24.8	1.581	2295.3	2320.1
41.00	27.8	1.749	2539.4	2567.2
41.50	30.5	1.928	2799.5	2830.0
42.00	33.0	2.122	3080.4	3113.4
42.50	35.2	2.325	3375.1	3410.3
43.00	37.3	2.532	3675.9	3713.2
43.50	39.3	2.744	3983.0	4022.3

Time increment (t) = 1.0 min.

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: d:\drgdata\99035\POND2 .PND
Inflow Hydrograph: d:\drgdata\99035\POND2100.HYD
Outflow Hydrograph: d:\drgdata\99035\OUT .HYD

Starting Pond W.S. Elevation = 31.50 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	57.26 cfs
Peak Outflow	=	21.54 cfs
Peak Elevation	=	40.05 ft

***** Summary of Approximate Peak Storage *****

Initial Storage	=	0.00 ac-ft
Peak Storage From Storm	=	1.44 ac-ft
Total Storage in Pond	=	1.44 ac-ft

POND-2 Version: 5.17
S/N: 1295130331

Alternate Grading (Pond 1in Middle of site, Pond No. 2 north end of site)
ADP Automotive Center: Project # 99035
Date: August 23, 1999

CALCULATED 08-23-1999 10:26:32
DISK FILE: d:\drgdata\99035\POND-2 .VOL

Planimeter scale: 1 inch = 100 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume * (acre-ft)	Volume Sum (acre-ft)
31.50	0.00	0.00	0.00	0.00	0.00
32.00	0.28	0.06	0.06	0.01	0.01
34.00	0.47	0.11	0.26	0.17	0.18
36.00	0.75	0.17	0.42	0.28	0.46
38.00	1.04	0.24	0.61	0.41	0.87
40.00	1.36	0.31	0.83	0.55	1.42
41.00	1.50	0.34	0.98	0.33	1.75
42.00	1.75	0.40	1.12	0.37	2.12
44.00	1.90	0.44	1.26	0.84	2.96

$$IA = (\text{sq.rt}(Area1) + ((Ei-E1)/(E2-E1))*(\text{sq.rt}(Area2)-\text{sq.rt}(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* Incremental volume computed by the Conic Method for Reservoir Volumes.

$$Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + \text{sq.rt.}(Area1*Area2))$$

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Outlet Structure File: POND2 .STR

POND-2 Version: 5.17 S/N: 1295130331
Date Executed: Time Executed:

****

ADT- Alternate Grading (Pond in middle of site)
August 9, 1999 Project No. 99035
9 Inch Oricice w/ 24" Stand Pipe

****

>>>>>> Structure No. 2 <<<<<<
(Input Data)

STAND PIPE
Stand Pipe with weir or orifice flow

E1 elev.(ft)?	39.00
E2 elev.(ft)?	44
Crest elev.(ft)?	39.00
Diameter (ft)?	2.0
Weir coefficient?	3.1
Orifice coefficient?	.6
Start transition elev.(ft) @ ?	
Transition height (ft)?	

Outlet Structure File: POND2 .STR

POND-2 Version: 5.17 S/N: 1295130331
Date Executed: Time Executed:

****

ADT- Alternate Grading (Pond in middle of site)
August 9, 1999 Project No. 99035
9 Inch Oricice w/ 24" Stand Pipe
****

>>>>>> Structure No. 1 <<<<<<
(Input Data)

ORIFICE
Orifice - Based on Area and Datum Elevation

E1 elev.(ft)?	32.25
E2 elev.(ft)?	44
Orifice coeff.?	.6
Invert elev.(ft)?	31.5
Datum elev.(ft) ?	31.88
Orifice area (sq ft)?	.4418

Outlet Structure File: POND2 .STR

POND-2 Version: 5.17 S/N: 1295130331
Date Executed: Time Executed:

****

ADT- Alternate Grading (Pond in middle of site)
August 9, 1999 Project No. 99035
9 Inch Oricice w/ 24" Stand Pipe

****

Outlet Structure File: d:\drgdata\99035\POND2 .STR
Planimeter Input File: d:\drgdata\99035\POND-2 .VOL
Rating Table Output File: d:\drgdata\99035\POND2 .PND

Min. Elev.(ft) = 31.5 Max. Elev.(ft) = 44 Incr.(ft) = .5

Additional elevations (ft) to be included in table:
* *

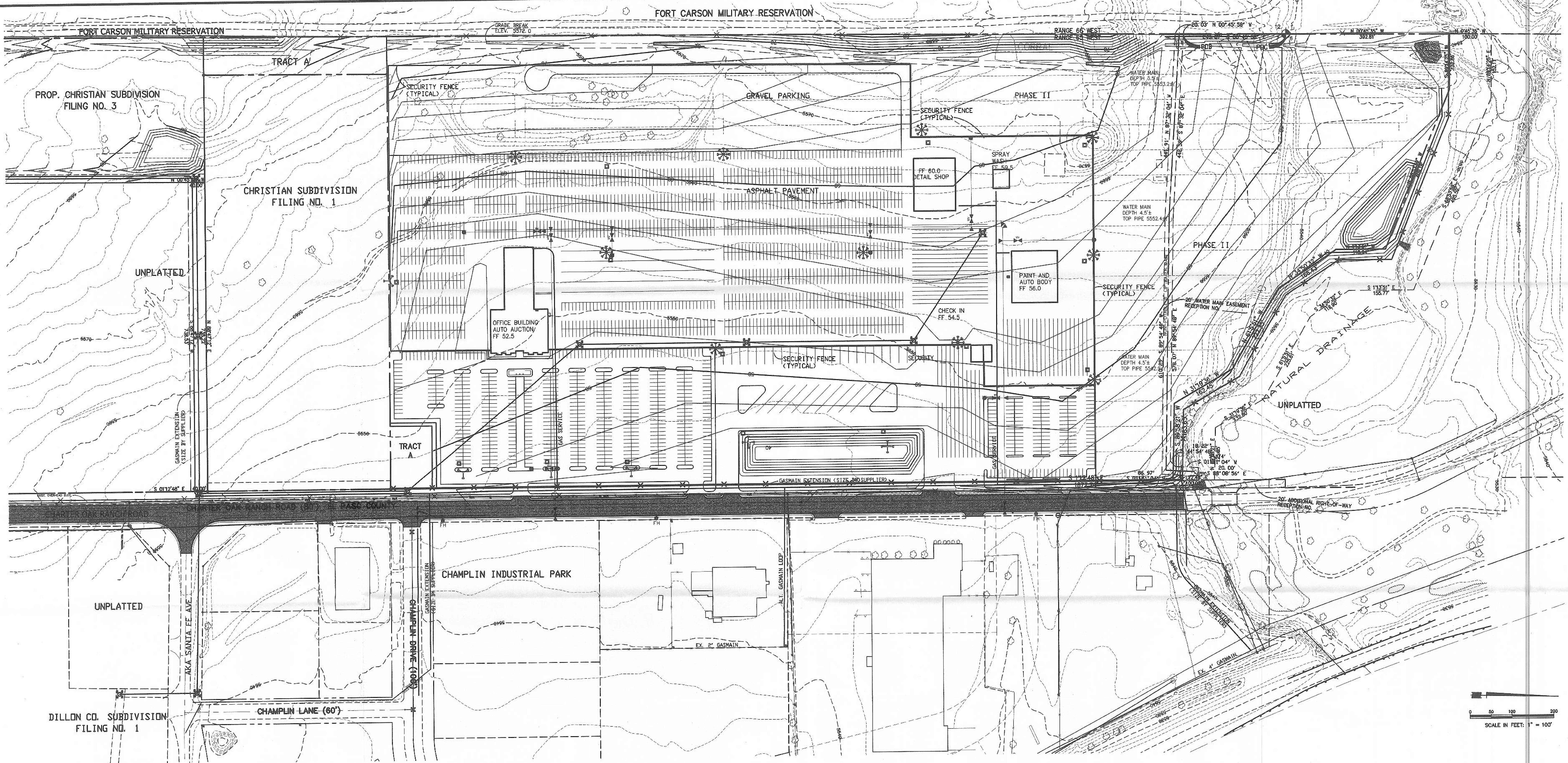
****

SYSTEM CONNECTIVITY

****

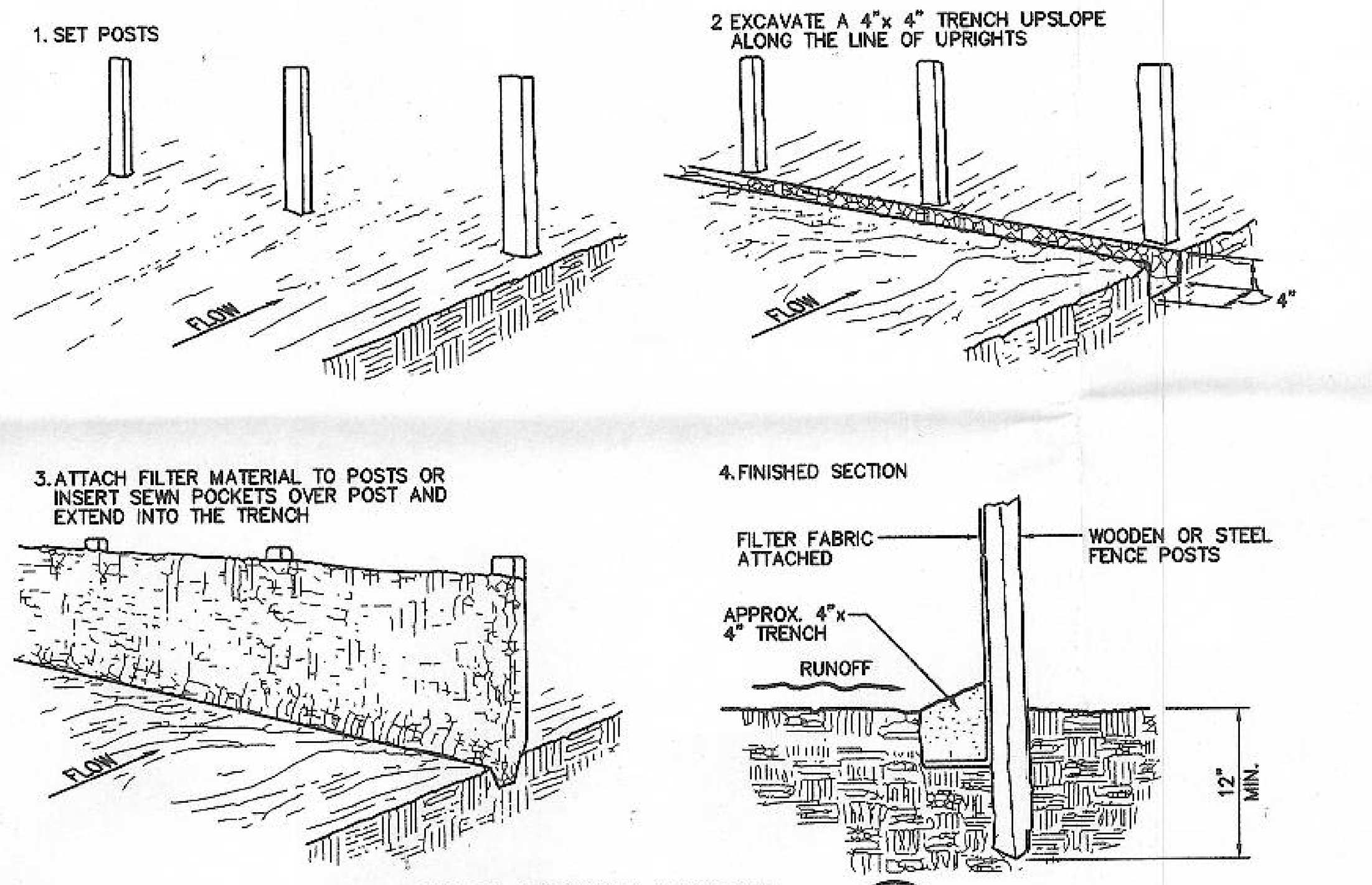
Structure	No.	Q Table		Q Table
ORIFICE	1		->	1
STAND PIPE	2		->	2

Outflow rating table summary was stored in file:
d:\drgdata\99035\POND2 .PND



LEGEND

—6470—	EXISTING INDEX CONTOURS (5' INTERVAL)	A/C 00.00	SPOT ELEVATION ON ASPHALTIC CONCRETE
	EXISTING INTERMEDIATE CONTOURS (1' INTERVAL)	TG 00.00	TIP OF CONCRETE GUTTER ELEVATION
70	PROPOSED INDEX CONTOURS (5' INTERVAL)	FL 00.00	FLOWLINE OF CONCRETE GUTTER ELEVATION
	PROPOSED INTERMEDIATE CONTOURS (1' INTERVAL)	T/C 00.00	TOP OF CONCRETE CURB ELEVATION
	EXISTING STORM SEWER FACILITIES	TOC 00.00	TOP OF CONCRETE ELEVATION
	PROPOSED STORM SEWER FACILITIES	TOG 00.00	TOP OF GRATE ELEVATION
	PROPOSED RETAINING WALLS	BOW 00.00	BACK OF SIDEWALK ELEVATION
(SF)	PROPOSED SILT FENCE	(STB)	PROPOSED STAKED STRAW BALE
(VTC)	PROPOSED VEHICLE TRACKING CONTROL		



SILT FENCE DETAIL – (SF)
SCALE: NTS

GRADING/EROSION CONTROL NOTES

1. THE EXISTING GROUND CONTOURS SHOWN HEREON ARE BASED ON AERIAL TOPOGRAPHIC MAPPING PREPARED BY DATAMAP, INC. FROM AERIAL PHOTOGRAPHY TAKEN IN JUNE, 1996. THE CONTOUR INTERVAL IS 2 FOOT. THE PROJECT BENCH MARK IS NORTHWEST TOP BOLT OF EXISTING FIRE HYDRANT AT WEATHERCRAFT ON THE EAST SIDE OF CHARTER OAK RANCH ROAD. ELEVATION: 5547.50. DATUM, U.S.G.S.

2. THE EXISTING UTILITIES SHOWN HEREON ARE FROM BEST AVAILABLE RECORD INFORMATION SUPPLEMENTED BY FIELD SURVEY OF VISIBLE SURFACE APPURTENANCES. THE EXISTING 8-INCH WATER LINE ALONG THE NORTHERLY PROPERTY LINE HAS BEEN POTHOLED AND FIELD LOCATED. THE CONTRACTOR SHALL BE RESPONSIBLE TO LOCATE ALL UTILITIES PRIOR TO COMMENCING CONSTRUCTION AND SHALL PROTECT SAME DURING CONSTRUCTION. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO (UNCC) AT 1-800-922-1987 A MINIMUM OF 72 HOURS PRIOR TO REQUIRING LOCATES. ANY UTILITIES DAMAGED DURING CONSTRUCTION SHALL BE IMMEDIATELY REPAIRED OR REPLACED AT THE CONTRACTOR'S EXPENSE.

3. THE OWNER HAS HAD COMPLETED A "PRELIMINARY GEOTECHNICAL ENGINEERING STUDY - PROPOSED AUCTION FACILITIES - CHARTER OAK RANCH ROAD - FOUNTAIN, COLORADO" PREPARED BY KUMAR & ASSOCIATES, INC. (PROJECT NO. 99-2-177A) DATED AUGUST, 1999 WHICH REPORT AND ALL SUPPLEMENTS THERETO SHALL BECOME A PART OF THESE PLANS BY REFERENCE. THE REPORT IS AVAILABLE FOR INSPECTION AT THE OFFICE OF THE ENGINEER, OBERING, WURTH & ASSOCIATES - 1015 ELKTON DRIVE - COLORADO SPRINGS, COLORADO - 719-531-6200. THE REFERENCED PRELIMINARY REPORT INDICATES "VERY HARD CLAYSTONE BEDROCK" AT DEPTHS OF BETWEEN TWO FEET (2') AND SEVENTEEN FEET (17') BELOW THE SURFACE.

4. THE CONTRACTOR SHALL BE RESPONSIBLE TO OBTAIN APPROVAL FROM THE EL PASO COUNTY DEPARTMENT OF TRANSPORTATION FOR ALL CONSTRUCTION ACCESS FROM THE EXISTING COUNTY ROAD (CHARTER OAK RANCH ROAD) INTO THE SITE.

5. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL LOCAL, STATE AND FEDERAL PERMITS REQUIRED TO PERFORM THE WORK AND SHALL COMPLY WITH THE CONDITIONS OF APPROVAL OF SAME.

6. PRIOR TO COMMENCEMENT OF GRADING, THE SITE SHALL BE STRIPPED OF ALL VEGETATIVE MATERIALS TO A MINIMUM DEPTH OF FOUR INCHES (4"). THE STRIPPINGS SHALL BE STOCKPILED IN AN ON-SITE LOCATION FOR LATER DISTRIBUTION OVER PROPOSED LANDSCAPE AREAS. SILT FENCE SHALL BE PLACED AROUND THE STRIPPING STOCKPILE IN A MANNER THAN MINIMIZES SEDIMENT FROM LEAVING THE SITE AND ENTERING PUBLIC RIGHTS-OF-WAY, ADJACENT PRIVATE PROPERTY OR PUBLIC DRAINAGEWAYS. STRIPPINGS MAY BE PLACED IN THE BOTTOMS OF DEEP FILLS AND/OR IN LANDSCAPE AREAS ONLY AT THE DIRECTION OF THE GEOTECHNICAL CONSULTANT.

7. COMPACTION REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE RECOMMENDATIONS CONTAINED IN THE REFERENCED GEOTECHNICAL INVESTIGATION.

8. IN THE AREA OF THE BUILDINGS,, THE CONTRACTOR MAY BE REQUIRED TO OVEREXCAVATE TO A DEPTH OF EIGHT FEET (8') BELOW PROPOSED BOTTOM OF FOOTING ELEVATIONS FOR A DISTANCE OF AT LEAST FIVE FEET (5') OUTSIDE OF THE BUILDING ENVELOPE AND REPLACE WITH AN APPROVED STRUCTURAL FILL LAYER FOUR FEET (4') DEEP PLACED OVER A FOUR FEET (4') DEEP LAYER OF COMPACTED ONSITE SOILS WHICH ARE MOISTURE CONDITIONED, ALL AT THE DIRECTION OF THE GEOTECHNICAL CONSULTANT.

9. THE CONTRACTOR SHALL SATISFY HIMSELF AS TO THE VOLUME OF MATERIAL REQUIRED TO BE MOVED TO COMPLETE THE GRADING TO THE FINISHED SUBGRADES AS SHOWN/INDICATED HEREON AND SHALL BE RESPONSIBLE TO PROVIDE ANY IMPORT REQUIRED TO COMPLETE THE WORK OR PROVIDE FOR ANY EXPORT REQUIRED TO COMPLETE THE WORK. IMPORTED MATERIALS SHALL BE APPROVED AT THE SOURCE BY THE GEOTECHNICAL CONSULTANT PRIOR TO PLACEMENT ON THE SITE. ALL EXPORTED MATERIALS SHALL BE REMOVED TO AN APPROVED OFF-SITE LOCATION. NO SEPARATE MEASUREMENT OR PAYMENT FOR IMPORT OR EXPORT SHALL BE MADE.

10. PRIOR TO CLEARING AND GRUBBING OF THE SITE, THE CONTRACTOR SHALL INSTALL EROSION CONTROL MEASURES AS INDICATED HEREON GENERALLY TO INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING:

    THE CONTRACTOR SHALL INSTALL A SILT FENCE ALONG THE PERIMETER OF THE SITE ADJACENT TO BOTH CHARTER OAK RANCH ROAD AND THE EXISTING DRAINAGEWAY ALONG THE NORTHERLY PROPERTY LINE. A SILT FENCE SHALL ALSO BE INSTALLED ALONG THE WESTERLY PERIMETER OF THE EASTERLY DETENTION FACILITY (PROPOSED TO BE UTILIZED AS A TEMPORARY SEDIMENT CONTROL BASIN THROUGHOUT CONSTRUCTION).

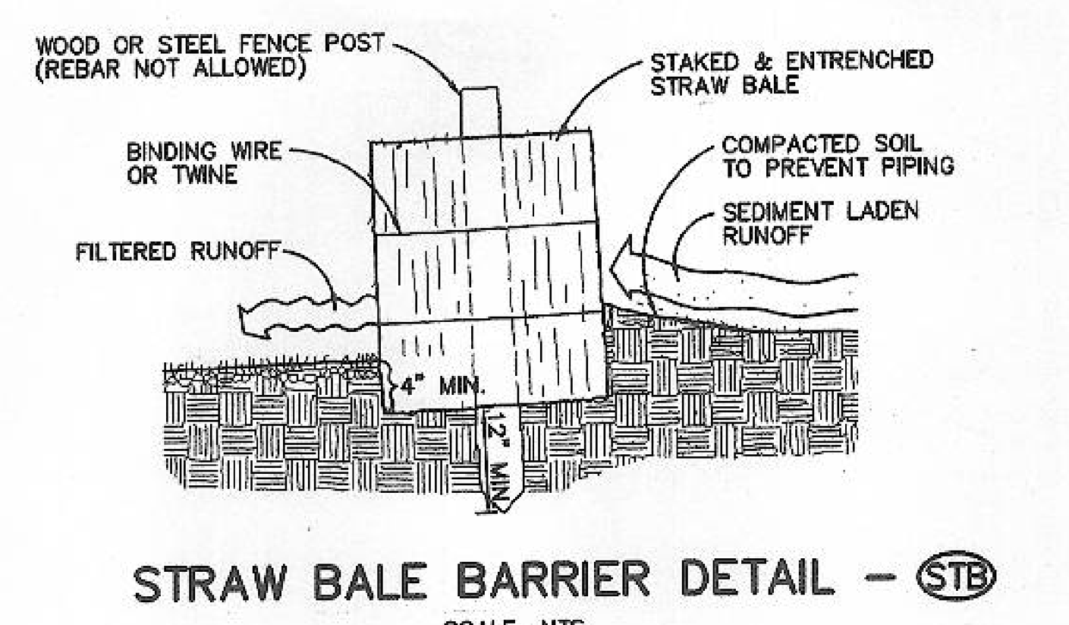
    THE CONTRACTOR SHALL CONSTRUCT THE EASTERLY DETENTION FACILITY PRIOR TO GRADING OTHER PORTIONS OF THE SITE. THE EASTERLY DETENTION FACILITY IS PROPOSED TO BE USED AS A TEMPORARY SEDIMENT CONTROL BASIN THROUGHOUT THE EARTHWORK OPERATION UNTIL SUCH TIME AS THE SITE IS PAVED AND VEGETATION HAS BEEN ESTABLISHED ON LANDSCAPE AREAS. THE CONTRACTOR SHALL DIRECT ALL RUNOFF FROM THE SITE INTO THE TEMPORARY SEDIMENT CONTROL BASIN BY MEANS OF DIVERSION DITCHES WITH STRAW BALE DITCH CHECKS AT 100 FOOT INTERVALS. THE PROPOSED STORM SEWER PIPE RUNNING NORTHERLY ALONG THE WESTERLY EDGE OF CHARTER OAK RANCH ROAD FROM THE DETENTION FACILITY TO THE EXISTING DRAINAGEWAY ON THE NORTH SHALL BE INSTALLED AS A PART OF THE EARTHWORK AND SHALL BE USED AS AN OUTLET FACILITY FOR THE TEMPORARY SEDIMENT CONTROL BASIN. ROCK RIPRAP SHALL BE PLACED AT THE NORTH END OF THE OUTLET PIPE AT THE POINT WHERE IT ENTERS THE EXISTING DRAINAGEWAY TO A THICKNESS, DEPTH AND EXTENT AS DIRECTED BY THE ENGINEER IN THE FIELD.

    THE CONTRACTOR SHALL INSPECT THE SEDIMENT CONTROL BASIN AFTER EACH HEAVY RAINFALL EVENT FOR SEDIMENT AND SHALL CLEAN THE BASIN OF SEDIMENT ON A REGULAR BASIS AS REQUIRED.

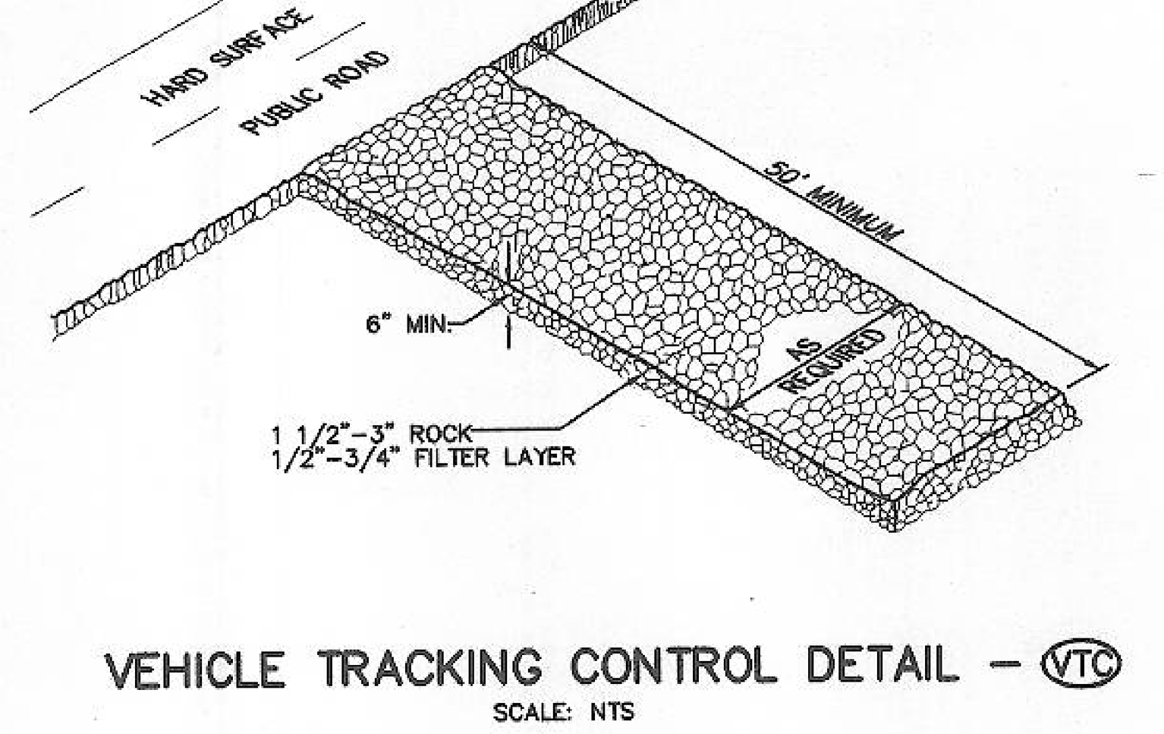
    THE CONTRACTOR SHALL INSTALL VEHICLE TRACKING CONTROL AT THE CONSTRUCTION ACCESS(S) INTO THE SITE IN ACCORDANCE WITH THE DETAILS INCLUDED HEREON.

    THE CONTRACTOR SHALL INSTALL STAKED STRAW BALES AT EACH STORM SEWER INLET.

ALL EROSION CONTROL FACILITIES SHALL BE MAINTAINED THROUGHOUT THE COURSE OF CONSTRUCTION UNTIL SUCH TIME AS THE SITE IMPROVEMENTS HAVE BEEN INSTALLED, THE SITE HAS BEEN PAVED, AND THE VEGETATION HAS BEEN ESTABLISHED IN ALL LANDSCAPE AREAS.



STRAW BALE BARRIER DETAIL – (STB)
SCALE: NTS



VEHICLE TRACKING CONTROL DETAIL – (VTC)
SCALE: NTS

ACCEPTED
CITY OF FOUNTAIN:

BY: ______________

TITLE: ______________

DATE: ______________

ISSUED FOR APPROVAL 11-12-99

NO.	DATE	REVISION	BY
2	11/12/99	REVISED FOR APPROVAL	VPT
1	10/29/99	REVISED PER ARCHITECT	VPT

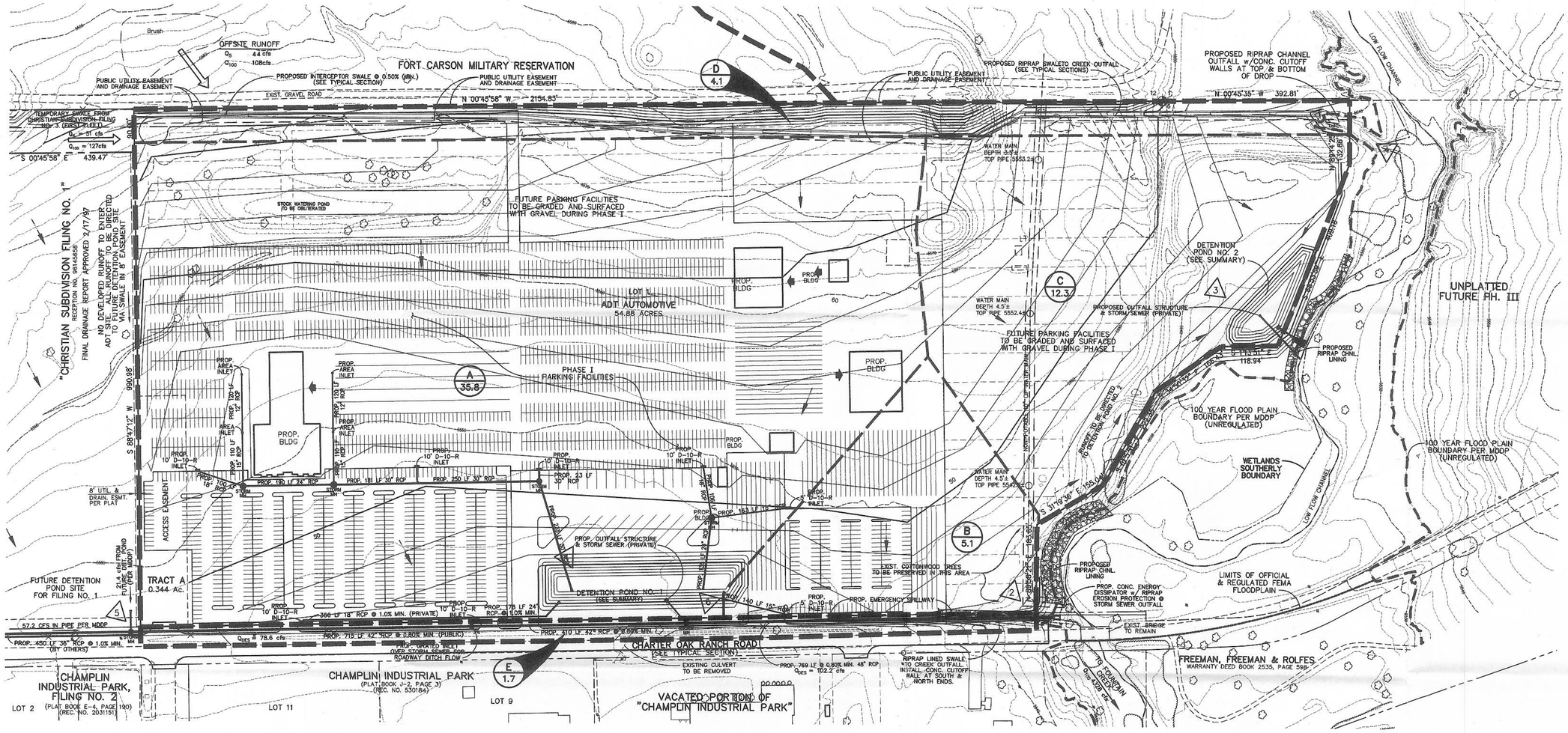
SHEET TITLE: GRADING AND EROSION CONTROL CHRISTIAN SUB. FIL. NO. 2

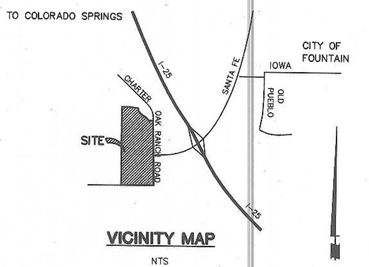
PROJECT: CHARTER OAK RANCH RD. COLORADO SPRINGS, COLORADO

PREPARED BY: Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-6200

FIELD BOOK NO. N/A
SCALE: 1" = 100'
DATE: 08/13/99
DESIGNED BY: RS/VPT
CHECKED BY: TLW/RGO
DRAWN BY: VPT/RS
PROJECT NO. 99035
SHEET NO. 2 OF 2 SHEETS

PROJECT NAME: COMPOSITE FACILITIES CHRISTIAN FILING NO. 2





VICINITY MAP
NTS

LEGEND

- EXISTING CONTOURS (6100)
- PROPOSED CONTOURS (90)
- EXISTING INLET, STORM SEWER, MANHOLE
- PROPOSED INLET, STORM SEWER, MANHOLE
- DRAINAGE SUBBASIN DESIGNATION (A) / DRAINAGE SUBBASIN AREA (ACRES) (1.3)
- SUMMARY POINT (1)
- PROPERTY LINE
- DRAINAGE SUBBASIN BOUNDARY

NOTES:

1. FINAL SIZING AND CONFIGURATION OF THE DETENTION PONDS AND OUTLET FACILITIES WILL BE ACCOMPLISHED WITH COMPLETION OF TEH FINAL GRADING PLAN FOR THE SITE.
2. ARMY CORPS OF ENGINEERS 404 PERMIT WILL BE REQUIRED WHERE INSTALLING CHANNEL IMPROVEMENTS WITHIN EXISTING WETLANDS AREAS.
3. WETLAND BOUNDARY WAS DETERMINED ONLY ALONG THE NORTH SIDE OF THE ADT TRACT.
4. ALL STORMWATER RUNOFF FROM THE SITE SHALL BE DIRECTED TO EXISTING CREEK ALONG THE NORTH SIDE OF THE PROPERTY. NO STORMWATER IS TO CROSS CHARTER CHARTER OAK RANCH ROAD IN AN EASTERLY DIRECTION.
5. SITE IMPROVEMENTS AND GRADING SHOWN ARE PRELIMINARY. REFER TO GRADING AND EROSION CONTROL PLAN FOR ADDITIONAL SITE AND GRADING DETAILS.

DETENTION POND SUMMARY

Detention Pond	Q_{in}(cfs)		Q_{out}(cfs)		Water Surface Elev.		Outfall Facilities			
							Orifice		Stand Pipe	
	Q_5	Q_{100}	Q_5	Q_{100}	5 year	100 year	Diameter	Invert	Diameter	Crest
1	148.2	268.7	7.7	23.8	39.1	42.4	12.0	30.0	18.0	39.5
2	50.9	92.3	5.5	21.5	36.5	40.1	9.0	31.5	24.0	39.0

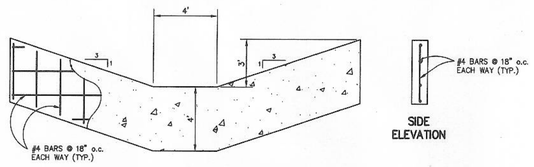
Notes:
Final configuration to be determined with the final grading plan.

HYDROLOGIC SUMMARY

Point	Subbasin	Drainage Area: Area (acres)	Land Use	C_5	C_{100}	T_c (min.)	Rainfall Intensities: I5	I100	Discharge: Q_5 (cfs)	Q_{100} (cfs)
Used Offsite	Fort Carson	70.0	Pasture	0.25	0.35	28.6	2.5	4.2	43.8	102.9
1	A	35.8	Commercial	0.90	0.95	7.0	4.8	7.9	148.2	268.7
2	B	5.1	Commercial	0.90	0.95	7.0	4.6	7.9	21.1	38.3
3	C	12.3	Commercial	0.90	0.95	7.0	4.6	7.9	50.9	92.3
4	D	4.1	Commercial	0.90	0.95	5.0	5.2	9.0	19.2	35.1
EAST OFFSITE	E	1.7	1/2 Roadway	0.90	0.95	5.0	5.2	9.0	8.0	14.5

STORM SEWER / DRAINAGE FACILITIES SUMMARY

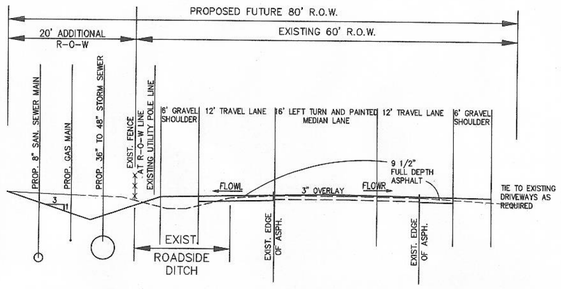
Design Flow: Summ. Pnt.	Upstream Q	Additional Q	Design Q	Proposed Drainage Facilities: Diameter/ Size	Slope (% min.)	Capacity (cfs)	Velocity (fps)	Comments
5-6	78.6	0	78.6	42	0.80	85	10	
6-2	78.6	23.6	102.2	48	0.50	110	9	
1-6	0	23.6	23.6	24	1	25	8	Detention Pond #1 Outfall
3-outfall	0	21.5	21.5	24	1	25	8	Detention Pond #2 Outfall



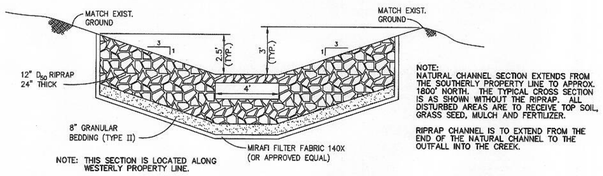
FRONT ELEVATION

SIDE ELEVATION

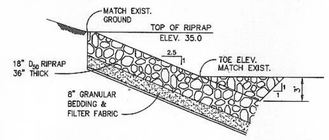
TYPICAL SECTION CONCRETE CUT-OFF WALL
SCALE: 1" = 4'



CHARTER OAK RANCH ROAD TYPICAL SECTION LOOKING NORTH
N.T.S.



TYPICAL INTERIM CHANNEL SECTION FOR NATURAL AND RIPRAP LINED CHANNEL
SCALE: 1" = 4'



TYPICAL RIPRAP LINED CHANNEL SECTION
N.T.S.

0 50 100 200
SCALE IN FEET: 1" = 100'

REVISIONS: NO.	DATE	DESCRIPTION	BY
1	11/12/99	REVISED FOR APPROVAL	RLC

ISSUED FOR APPROVAL NOV. 12, 1999

SHEET TITLE: DRAINAGE PLAN
FIELD BOOK NO.: N/A
SCALE: 1" = 100'
DATE: SEPT. 1999
PROJECT: CHRISTIAN SUBDIVISION FILING NO. 2 ADT AUTOMOTIVE CENTER
DESIGNED BY: RGO
CHECKED BY: TLW/RGO
DRAWN BY: RLC
PREPARED BY:
Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-8200
PROJECT NO. 99035
SHEET NO. DR-1
OF 1 SHEETS

PROJECT NO: 99035 UPDATED VERSION: 11-12-99

MASTER DEVELOPMENT DRAINAGE PLAN
for
CHRISTIAN ANNEXATION PHASE I AND PHASE II

July, 1999
Revised August, 1999
Revised October, 1999

Project No. 99035

Prepared for:
Gene Ray and Donald Christian
c/o Michael Frederick
455 East Pikes Peak, #100
Colorado Springs, CO 80903

TABLE OF CONTENTS

APPENDIX

MAP POCKET

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

August, 1999
Revised October 15, 1999
Project No. 99035

City of Fountain
116 South Main Street
Fountain, CO 80817

Attn: Mr. David Smedsrud, Deputy City Director
Mr. Dave Lethbridge, Consultant

Re: Master Development Drainage Plan
Christian Ranch Annexation Phase I and Phase II

Gentlemen:

Attached for acceptance is the revised Master Development Drainage Plan (MDDP) prepared for the referenced development. This plan has been revised in accordance with City Staff, Planning and City Council comments. The purpose of the MDDP is to provide the following:

- Hydrologic analysis of both existing offsite and onsite stormwater runoff conditions.
- Hydraulic analysis of both existing and proposed drainage facilities that will be utilized to safely convey stormwater to acceptable outfall facilities.
- Analysis of stormwater facility alternates.
- A review of any apparent environmental issues.

The attached report was prepared in accordance with the criteria set forth in the City of Fountain Subdivision Ordinance and in accordance with the most current addition of the "City of Colorado Springs and El Paso County Drainage Criteria Manual" (DCM).

It is the desire of the Owner/Developer to obtain approval of the MDDP as soon as possible in order that they may proceed with the development of the tract and with the installation of the required public drainage facilities.

If you need additional information or have any questions, please do not hesitate to contact the undersigned.

Very truly yours,
Obering, Wurth & Associates

Roland G. Obering

Roland G. Obering, P.E. & P.L.S.

RGO
msword\99035mdp.doc\jd

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

CERTIFICATION STATEMENTS

Master Development Drainage Plan
Christian Annexation Phase I & II
Project No. 99035

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 acceptable to the City of Fountain for drainage reports. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Roland G. Obering

Roland G. Obering, P.E. & P.L.S. Colorado 13226

DEVELOPER'S STATEMENT

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

Business Name

By

Owner

Title

c/o Michael J. Frederick
455 E. Pikes Peak Ave. #100

Address

Colorado Springs, CO 80903

CITY OF FOUNTAIN

David R. Lethbridge 11/14/99

David R. Lethbridge, Review Consultant for the City of Fountain; I recommend this Drainage Report for acceptance by the City of Fountain

Date

Date

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

Re: Master Development Drainage Plan
Christian Annexation Phase I & II
Project No. 99035

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, no portion of the Christian Annexation Phase II development is located within a floodplain as designated by the Flood Insurance Rate Map Panel No. 962 of 1300 dated March 17, 1997 (see Appendix, FEMA Exhibit).

Roland G. Obering

Roland G. Obering, P.E. & P.L.S. Colorado No. 13226

Note:
Based on conversations with the El Paso County Flood Plain Administration, a Flood Plain Development Permit will not be required for this project since it is located outside the limits of the official regulated floodplain study.

AUG 2 6 1999

STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION

Region 2 - Access
P.O. Box 536
Pueblo, Colorado 81002
(719) 546-5403
FAX - (719) 546-5414

August 24, 1999

I-25 FR
City of Fountain

Kenneth C. Harrison
Obering, Wurth & Associates
1015 Elkton Drive
Colorado Springs, CO 80907

RE: Master Development Drainage Plan – Christian Annexation Phase I and II

Dear Mr. Harrison:

Paul Reinsma, CDOT Regional Hydraulics engineer has reviewed the information submitted to this office on July 30, 1999 regarding the Master Development Drainage Plan for the Christian Annexation Phase I and Phase II. His comments are:

- This study proposes alternative approaches to handling stormwater. The proposal that would be acceptable to CDOT is referred to as the "detention pond" alternative.

If you have any questions, please contact Paul in Colorado Springs at (719) 634-2323 or me in Pueblo at (719) 546-5707.

Sincerely,

Jackie Hall

Jackie Hall
Access Manager

Xc: Michael Frederick, The Christian Trust
Dave Smedsrud, City of Fountain
Poling
Reinsma
Watkins/file

I. PURPOSE

The purpose of the following study is to provide an analysis of the drainage characteristics of the portion of the Christian Annexation tract known as Phase I and Phase II (Study Area). Phase I is currently platted as "Christian Subdivision Filing No. 1" and remains undeveloped. Phase II is currently unplatted and undeveloped. The intent of this study is to provide the following:

- A review of the existing hydrologic characteristics of the "Study Area" and upstream drainage characteristics that impact the "Study Area".
- A review of the hydraulic characteristics of the existing drainage facilities and the receiving natural stream located along the Northerly property line of the "Study Area".
- An analysis of potential impacts the proposed development will have on existing facilities.
- A presentation of alternative solutions for accommodating the proposed increased runoff in order to safely convey the runoff to acceptable outfall facilities.
- Recommendation of proposed drainage facilities, erosion control measures, and construction phasing.

The analysis was performed with the use of pertinent information obtained from field reconnaissance, photographs, field survey, and available floodplain and drainage studies.

II. GENERAL

A. LOCATION

The "Study Area" is comprised of the Southerly 98 acres of the overall 128.44 acre Christian Addition No. 1 tract that was annexed into the City of Fountain in November of 1996. The "Study Area" is located just West of Interstate 25 at the Fountain Exit in Sections 6 and 7, Township 16 South, Range 65 West of the Sixth Principal Meridian (see Vicinity Map, Appendix). The "Study Area" is bounded on the North by a tributary to Fountain Creek that crosses the Christian Addition No. 1 tract in an West/East direction, on the East and South by Charter Oak Ranch Road, and on the West by the Fort Carson Military Reservation. Included in the boundary of the "Study Area" is the platted site of "Christian Subdivision Filing No. 1" (CSF#1).

B. PROJECT DESCRIPTION

The "Study Area" consists of approximately 98 acres. Included in the "Study Area" is the platted "CSF#1" site consisting of approximately 10 acres and the remaining unplatted and undeveloped 88 acre site. The "Study Area" generally slopes from West to East with an average cross slope of approximately 3.5 percent. Vegetation generally consists of native grasses and weeds. Onsite soils consist predominately of Heldt clay loam which is typically deep and well drained and found on terraces, alluvial fans, and valley side slopes (see SCS Soils Map Exhibit). This soil type is included in the hydrologic soil group "C". There is a man-made stock pond located near the West central portion of the "Study Area".

C. LAND USE

The "Study Area" consists of the Southerly 98 acres of the overall 128 acre Christian Addition No. 1 tract. Ten (10) acres of the "Study Area" is currently platted as "Christian Subdivision Filing No. 1" and is referred to as Phase I in this report. This area was the subject of a Final Drainage Report (FDR) as part of the subdivision process and reference is made to that study. Phase II consists of approximately 88 acres and is currently undeveloped and unplatted. A land use Master Plan for Phase II was submitted to the City of Fountain in June of 1999. Phase II is divided into three (3) tracts (see Drainage Plan - Map Pocket). The fifty-six (56) acre tract is to be developed by the ADT Corporation as an automotive auction facility. The ten (10) acre tract is to be developed by First Fleet Trucking as a truck service facility and the remaining twenty-one (21) acre tract is to be developed as a commercial facility with undetermined ownership or specific use at this time. The majority of the 98 acre area will likely ultimately be paved with asphalt bituminous pavement with landscaping as required by the City of Fountain Subdivision Ordinance.

D. PROJECT PHASING

Phase I of the "Study Area" consists of the 10 acre "CSF No. 1" parcel. It is currently planned to be developed as a warehouse facility. Phase II consists of the remaining 88 acres and is to be developed as described above. The ADT and First Fleet tracts are to be developed as soon as the required approvals are obtained. No timetable for the development of the 21 acre tract has been established but it is anticipated that this tract will be developed in the next 3-5 years.

III. OVERVIEW OF EXISTING DRAINAGE CHARACTERISTICS

III. OVERVIEW OF EXISTING DRAINAGE CHARACTERISTICS

A. OFFSITE

The "Study Area" is located at the Easterly end of an unstudied drainage basin located West of Interstate 25. The basin is approximately 9625 acres in size and extends approximately 7.5 miles to the West of Interstate 25. The majority of the basin is occupied by Fort Carson Military Reservation. The channel that drains this basin is tributary to Fountain Creek and is labeled as the "West Bank Tributary" on the applicable FIRM Map (see FEMA Exhibit - Appendix). A study of this tributary was not included in the most recent FEMA study and therefore no official regulated floodplain has been established. A limited hydrologic study was performed as part of this study to estimate a flow at Charter Oak Ranch Road and to establish a floodplain boundary along the Northerly boundary of the project site. The results of this study will be discussed in subsequent sections of this report. See also Overall Drainage Basin Exhibits-Appendix for this offsite area.

Runoff also enters the "Study Area" from offsite sources adjacent to the Westerly property line from the Fort Carson Military Reservation and from an area on the South side of Charter Oak Ranch Road. It was estimated that approximately 175 acres drains to the Westerly property line of the site. There are two points of concentration of these offsite flows. The most Northerly point of concentration is into an existing "stock pond". This pond is currently being used for watering the grazing operations.

The second point of concentration is at the Southwest corner of the "Study Area" where a culvert under Charter Oak Ranch Road directs flows into the "Study Area". In addition, sheet flows crossing the road enter the "Study Area" due to lack of roadside ditches and an inadequate or non existent driveway culvert at the gravel pit access road. The adjacent offsite contributing areas are included in an Adjacent Offsite Basin Exhibit-Appendix together with Hydrologic computations. These areas also showns on the Historic Drainage Basin Map in the Map Pocket.

B. ONSITE

The majority of the stormwater runoff from the "Study Area" is directed to an existing culvert that crosses Charter Oak Ranch Road approximately 1100 feet North of the Santa Fe Avenue intersection. The culvert in theory was intended to discharge into a roadside ditch along the East side of Charter Oak Ranch Road. The stormwater was then carried in a Southerly direction to another culvert under Santa Fe Drive. The

culvert ultimately discharged on the South side of Santa Fe Drive. It is evident from field reconnaissance and information obtained from adjacent landowners, that the existing ditches and culverts described above do not have the capacity to accommodate the existing historic stormwater runoff. This is evidenced by the reports of frequent flooding and ditch overtopping that has been observed along this route in the past. This condition was a major factor in the decision to not utilize this outfall for the "Study Area". Reasons will be discussed in subsequent sections of this report.

IV. HYDROLOGY

A. CRITERIA

The hydrologic criteria used for this analysis was based on criteria set forth in the "DCM" for an MDDP level of effort.

B. METHODS

The Soil Conservation Method (SCS) was used to evaluate storm flows in the existing natural channel located along the northerly side of the "Study Area" since the contributing drainage area is greater than 100 acres. The Rational Method was used to evaluate storm runoff amounts generated by the "Study Area" since the contributing drainage subbasins are less than 100 acres.

C. RUNOFF COEFFICIENTS

Runoff coefficients for both hydrological methods were obtained from charts found in the DCM.

D. TIME OF CONCENTRATION

Times of concentration were determined by combining travel times for overland flow, channel flow, curb and gutter flow, and storm sewer flow where applicable. Specific charts and formulas, as presented in the DCM, were used to determine the appropriate travel time for each of the above components.

E. RAINFALL

The rainfall distribution used for the SCS method was the 24 hour SCS Type II A storm as described in the DCM. Rainfall intensities for specific times of concentration for both the 5-year and 100-year storm

events for the Rational Method were obtained from the charts included in the DCM.

V. HYDROLOGICAL ANALYSIS SUMMARY

A. OFFSITE – WEST BANK TRIBUTARY

As previously discussed, the drainage basin in which the "Study Area" is located has not been officially studied and therefore a 100-year floodplain has not been established. According to current Flood Insurance Rate Maps, the most current FEMA study limit is located at the East side of the Charter Oak Ranch Road Bridge. The tributary that drains the basin is referred to as the West Bank Tributary (see Appendix - FEMA Exhibit). In order to establish a floodplain boundary, a limited hydrological study was accomplished. Drainage basin limits, areas, stream routing, and times of concentration were determined from pertinent USGS mapping. Soils types were obtained from the SCS mapping of El Paso County. Existing land use was assumed. The HEC 1 stormwater water runoff computer model was used to estimate flows at the Charter Oak Ranch Road Bridge. The following is a summary of the results:

CONTRIBUTING DRAINAGE AREA

The area of the contributing drainage basin was estimated to be a total of 9,625 acres in size with 5,255 acres and 4,370 acres consisting of Hydrologic Soils Group A/B and C/D respectively (See Overall Drainage Basin Exhibits - Appendix). These soils groups were used to determine runoff coefficients for the individual sub basins.

AVERAGE RUNOFF CURVE NUMBER (CN)

The average "CN" for the basin, based on existing condition, was estimated to be 70, which reflects a pasture/range (for hydrologic condition) level of development within the basin. This value is anticipated to not change substantially in the near future since the majority of the basin is occupied by the Fort Carson Military Reservation. An average "CN" for the basin was increased to 70.2 to reflect the impact of the development of the "Study Area".

TIME OF CONCENTRATION

The time of concentration for the basin was estimated to be approximately 2.6 hours.

This is based on approximately 52,000 feet of natural stream channel with an overall vertical drop of 960 feet.

STORMWATER RUNOFF

Based on the above, the 100-year stormwater runoff at the Charter Oak Ranch Road crossing was estimated as follows:

Existing Conditions	4,328 cfs
Existing Conditions with Developed Project Condition (No Detention)	4,375 cfs

As a result of the relatively large basin area, and long time of concentration, development of the "Study Area" has minimal impact on the flow anticipated at the Charter Oak Ranch Road crossing. Included in the "Overall Drainage Basin Exhibits" section of the Appendix is a map of the overall drainage basin and copies of the associated HEC-1 runs.

B. ONSITE

The Rational Method was used to estimate stormwater runoff from onsite sources. Existing and developed conditions were both analyzed for each tract located within the "Study Area". Summaries of these flows are presented in table form on the attached Project Drainage Plan. Flows were based on a change in the routing of the stormwater from the culvert under Charter Oak Ranch Road to an outfall directly into the existing stream located at the Northeast Corner of the "Study Area". The outfall point was modified for the following reasons:

- Lack of capacity in the existing outfall facilities on the East side of Charter Oak Ranch Road
- Cost of Improvements to make the facilities adequate
- Lack of right-of-way and/or easements for the improvements
- Documented flooding conditions of the area located East of Charter Oak Ranch Road

- Proximity of the existing channel (West Bank Tributary) to the "Study Area"

In summary, the total historic discharge from the site, when all of the stormwater is diverted to the Northwest corner, is 66.2 cfs and 171.5 cfs for the 5-year and 100-year storms, respectively. The total developed and undetained discharge at this point would be increased to 343 cfs and 630.6 cfs for the 5-year and 100-year storms, respectively. It is proposed to reduce the developed discharges to historic levels with the use of detention ponds outfall facilities restricted to release the historic 5-year and 100-year rates.

VI. HYDRAULIC ANALYSIS SUMMARY

A. OFFSITE

In order to establish a 100-year floodplain boundary along the Northerly side of the "Study Area", a water surface profile was determined utilizing the HEC 2 computer model. Stream cross sections were obtained from the topographic mapping prepared for the "Study Area". A bridge cross section at Charter Oak Ranch Road was assumed based on information obtained from the mapping. Only the anticipated 100-year discharge was routed in the HEC 2 program with the results shown on the attached drainage plan. The beginning downstream water surface elevation in Fountain Creek was obtained from the current FEMA floodplain map and was assumed to be at elevation 5,532. At this elevation the existing bridge at Charter Oak Ranch Road, at elevation 5,527, is overtopped. In summary, the water surface elevation at the bridge is 5,532 and 5,538 at the Westerly side of the "Study Area". Included on the drainage plan for the "Study Area" is the floodplain as established by this study.

Adjacent runoff from the Fort Carson Military Reservation enters the "Study Area" along the Westerly property line via surface flow. A portion of the stormwater is intercepted by a large "stock pond" which is currently being used as part of an on-site ranching operation. Ultimately this pond will be eliminated as part of the development of the "Study Area". The balance of the runoff enters near the Southwest corner of the "Study Area". In order to accommodate the runoff from the West, it is proposed to construct a channel that will divert the water to the North where it will outfall directly into the existing creek. Riprap erosion protection will be required in steeper portions of the channel and at the outfall point in order to protect the channel from erosion. The estimated combined diverted offsite runoff from the Fort Carson property was determined to be 86 cfs and 216 cfs for the

5-year and 100-year storm events, respectively. The recommended channel cross section is shown on the "Drainage Plan" included in the map pocket of this report. The channel was sized for the100-year storm event.

B. ONSITE

In accordance with the requirements set forth in the DCM for MDDP's several alternates were evaluated as to proposed facilities required to accommodate developed runoff from the "Study Area". These alternates included the following:

1. Open channel, lined and natural, along the West side of Charter Oak Ranch Road.

2. Storm Sewer facilities along the West side of Charter Oak Ranch Road with no onsite detention facilities.

3. Storm Sewer facilities along the West side of Charter Oak Ranch Road with onsite detention facilities.

Of the three (3) above alternates, a discussion of only alternates 2 and 3 follow. It was determined that the "open channel" alternate rendered an excessive amount of property unusable for development purposes.

STORM SEWER WITH NO ONSITE DETENTION

As previously discussed, it was decided that due to the inadequate downstream facilities that all the developed runoff from the "Study Area" would be directed to the North to outfall into the existing natural stream. In order to accomplish this, this alternate proposes to construct public storm sewer facilities along the West side of Charter Oak Ranch Road from approximately the Santa Fe Avenue intersection to an outfall point located just upstream of the existing bridge. The storm sewer facilities would be sized to accommodate runoff from the minor storm (5-year) event. Grading of the "Study Area" would be accomplished so that any runoff greater than the minor storm event would be accommodated by surface swales and be directed North to the natural channel. No developed flow would be allowed to cross Charter Oak Ranch Road during either the minor or major storm event. The storm system is summarized in the Storm Sewer Summary -Non-Detention alternate.

Due to the environmentally sensitive area that encompasses the receiving stream, an energy dissipation structure is required at each storm sewer outfall and parking lot discharge point. It is anticipated that the following fixed energy dissipaters can be used in this situation:

- Impact Energy Dissipater
- Contra Costa Type
- Straight Drop Spillway Stilling Basin
- C.S.U. Ridged Boundary Basin

Example of each of these basins are included in the Appendix of this report. The selection of the appropriate structure is to be accomplished during the preliminary design phase when specific parameters (i.e. design discharge, velocity, depth, receiving stream configurator) can be more clearly defined.

It is our opinion that the fully developed runoff from the "Study Area" can be discharged into the receiving stream with minimal increased negative impact to downstream property and environmentally sensitive areas for the following reasons:

- The existing stream has a constant base flow.
- The point of discharge for the proposed storm sewer would be into the base flow section and not onto adjacent wetland areas.
- Sufficient energy dissipation with a combination of structures and stilling basins can be accomplished at the proposed storm sewer outlet to greatly reduce the erosive and damaging potential of the existing storm water.
- The majority of the downstream property is already located in an official regulated 100-year floodplain and therefore will experience minimal impact from the increased flows from the "Study Area".

STORM SEWER ALTERNATE WITH ONSITE DETENTION

This alternate was evaluated in accordance with the requirements set forth in the City of Fountain Subdivision Ordinance. The alternate includes storm sewer facilities to be installed at the same locations as described in the previous alternate. Each site would be required to install a pond to limit discharge to historic levels for the minor (5-year) and major (100-year) storm event. Outfall storm sewer pipes would be constructed off the main storm sewer line located along the West side of Charter Oak Ranch Road. No developed flow would be permitted to overtop Charter Oak Ranch Road. The storm system is summarized in the Storm Sewer Summary-Detention alternate.

Even though the discharge into the existing stream is reduced to historic levels, energy dissipation will still be required at the outlet to help protect the environmentally sensitive nature of the receiving stream. Energy dissipaters, as described in the previous alternate,are recommended depending on the design conditions and parameters. The proposed ponds for each tract are shown at approximate locations only. The ponds were sized utilizing the Pond Pac computer program as supplied by Haestad methods. Preliminary pond sizes are indicated in table form on the attached drainage plan. Final locations and sizes will be determined upon preparation of the grading plan and final drainage report for each site.

C. CHANNEL IMPROVEMENTS

Riprap slope protection is proposed along segments of the South side of the existing creek. These locations are shown on the "Drainage Plan". It appears that these sections are subject to erosion during high flows as evidenced by the steepness of the banks and exposed tree roots. It is recommended that the riprap extend three (3') feet above the 100-year flood elevation and be "toed" into the channel a minimum of 3 feet.

D. CHARTER OAKS RANCH ROAD DRAINAGE IMPROVEMENTS

Charter Oak Ranch Road is currently a two-lane paved County road with borrow ditches on either side to accommodate stormwater runoff. It is proposed to improve the roadway to a 12 foot through lane in each direction plus a 16 foot center turn lane. In addition, a 6' foot gravel shoulder is proposed for both sides of the roadway section. This section is subject to approval by both City of Fountain and El Paso County. Stormwater runoff is to be accommodated by roadside ditches, grate inlets, and a public storm sewer. Stormwater will be discharged into the existing

channel located along the North boundary of the ADT tract. Specific design parameters for the proposed drainage facilities will be discussed in the "Final Drainage Reports (FDRs)" for each tract as they are platted.

VII. ENVIRONMENTAL ISSUES

The only environmentally sensitive area that will be impacted by this project is located beyond the Northerly limits of the "Study Area". The area consists of a meandering perennial stream with adjacent wetlands. According to the land use

Master Plan for the City of Fountain, this area is designated as an open space corridor. In order to properly define the limits of this area, a 100-year floodplain study and wetland inspection was accomplished as part of this MDDP. The proposed property line was also staked for visual inspection. As a result of this inspection a buffer setback has been proposed and is discussed at the end of this section. The approximate limits of the existing wetlands were identified with the assistance of a representative from the Army Corps of Engineers (ACOE) on August 10, 1999. The wetland boundary is readily identifiable with the evidence of wetland plant species which include sedges, bullrush, and cat-tails. The limits were staked, surveyed, and are shown on the attached "Drainage Plan".

In accordance with current regulatory requirements, a "Preeble Mouse Habitat Study" was performed for the entire length of the existing channel on August 13, 1999. The study was performed by Greystone, an environmental firm located in Denver. It was determined that the existing habitat was not conducive to the Preeble Mouse. A "letter report" with pictures has been sent to the Division of Fish and Wildlife for further processing, review, and approval. It is anticipated that the "letter report" will meet all requirements concerning the Preeble Mouse. A copy of the letter as submitted is included in the Appendix.

Erosion control facilities are proposed at several locations along the existing channel. A concrete dissipation device and riprap erosion control is proposed at the storm sewer discharge point. Riprap erosion control facilities are also to be placed along specified sections of the Southerly stream bank where periodic erosion has taken place. The approximate locations are shown on the drainage plan.

The referenced buffer setback has been proposed as an area of no development immediately adjacent to the top of the South bank of the "West Bank Tributary" located North of the "Study Area". This setback is

being proposed in response to the portion of the City's Comprehensive Plan regarding open space, preservation of natural areas, and the "prudent line" theory. The setback distance is proposed to be 25' from the line that was initially established as defining the Floodplain as computed in this study. This MDDP also proposes rock riprap bank protection in two critical areas of erosion within the drainage on the North in order to stabilize the bank erosion that is occurring.

We have reviewed a topographic map from the 1960's compared to our 1996 topography and found no noticeable bank migration over that period of time. With Fort Carson as the only significant land user upstream and the likelihood of little if any urban type development occurring in the upstream watershed, we believe these will be no significant increase in flows in the drainage in the future.

The prudent line theory apparently attempts to predict impacts of urbanization in a watershed on unprotected bank degradation within a certain segment of the stream. We have no evidence of natural degradation over the last 30 years, no significant urbanization opportunity upstream in the foreseeable future, and are proposing bank stabilization in erosion prone areas adjacent to the "Study Area". It is our opinion that the 25' setback is a prudent distance for protection of the proposed development.

VIII. SUMMARY AND RECOMMENDATIONS

In summary, the MDDP has established the following:

1. The "Study Area" is located within a large drainage basin and its development will create minimal impact on the anticipated flows from the basin.

2. The natural channel along the Northerly side of the "Study Area" is to remain natural and is proposed to be preserved for open space purposes. Energy dissipation will be required at the storm sewer outfall in order to minimize the impact for both alternates that the proposed discharge from the site will have on the area. A setback from the streambank is recommended as a buffer area of no development.

3. The proposed outfall point for the "Study Area" and contributing area on the West is recommended to be relocated from the existing culvert under Charter Oak Ranch Road to directly into the natural stream channel located along the Northerly property line in order to alleviate existing flooding conditions of property located East of Charter Oak Ranch Road.

4. Both alternates require the installation of storm sewer facilities that will discharge into the natural stream located along the North side of the "Study

Area". Both alternates will alter existing conditions with respect to discharge amounts, frequency, and concentrations. It is proposed to minimize impacts of these alterations to the immediate receiving stream and wetland area with the installation of energy dissipation structures and riprap erosion control facilities. Since the majority of the floodplain is of substantial depth, very little impact to downstream properties are anticipated as a result of the development of the "Study Area".

5. Based on conversations with the City's consultants, the implementation of the "no detention facilities" alternate will require a variance from the City of Fountain Subdivision Ordinance. This could potentially take a lengthy amount of time in additional analysis and agency reviews with no guarantee that this alternate would be approved. It has been stated by the City's consultant that the "detention pond" alternate would be the more favorably received alternate due to the alignment with current City Subdivision Ordinances and growing positive public opinion regarding detention facilities. Toward this end, we believe the onsite detention facility approach is the appropriate alternate to recommend in this MDDP.

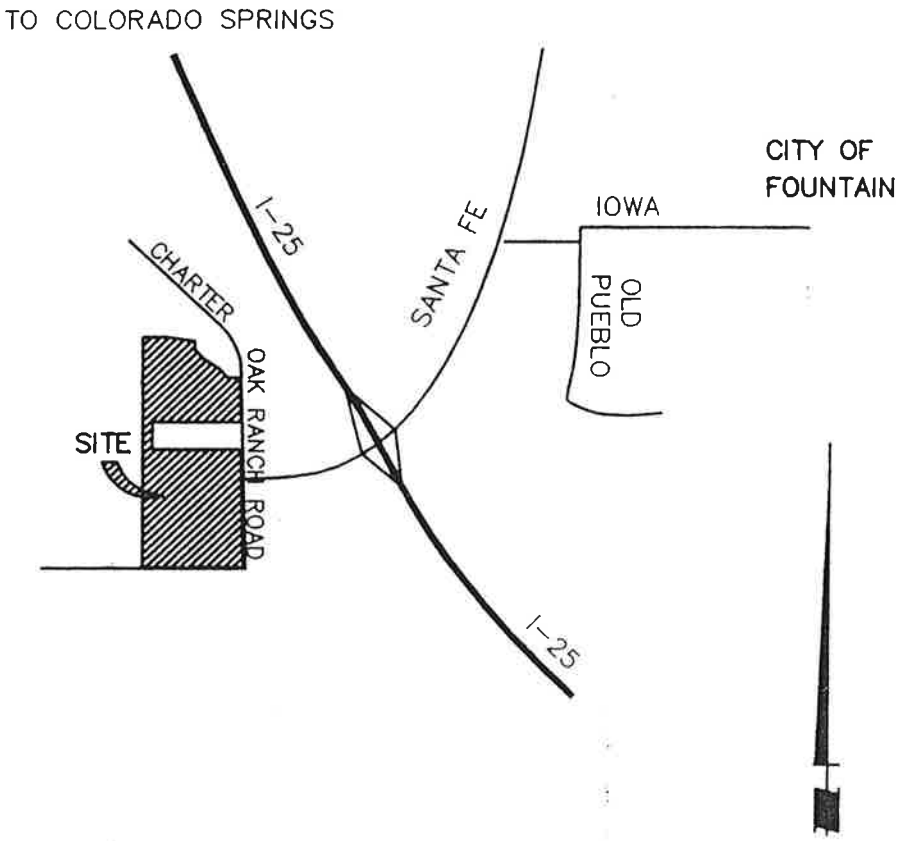
6. Storm sewer facilities functioning as an outfall and constructed in public rights-of-way and/or easements are proposed to be publicly owned and maintained. It is anticipated that the onsite facilities will be constructed as needed by each individual tract. The detention ponds and onsite outfall facilities would be privately constructed, owned, operated, and maintained.

This MDDP recommends the stormwater management approach for the Christian Annexation Phase I and II be one of individual user onsite detention of the 5 and 100 year design storms, installation of a 100-year underground system to accommodate historic runoff, and redirection of the runoff from its historic discharge location to the East to the natural drainage on the North. It is further recommended that as individual users are identified and parcels are subdivided, that this MDDP, in the approval format be utilized as a guide for the various Final Drainage Reports (FDRs).

This study is subject to the limits set forth herein.

APPENDIX

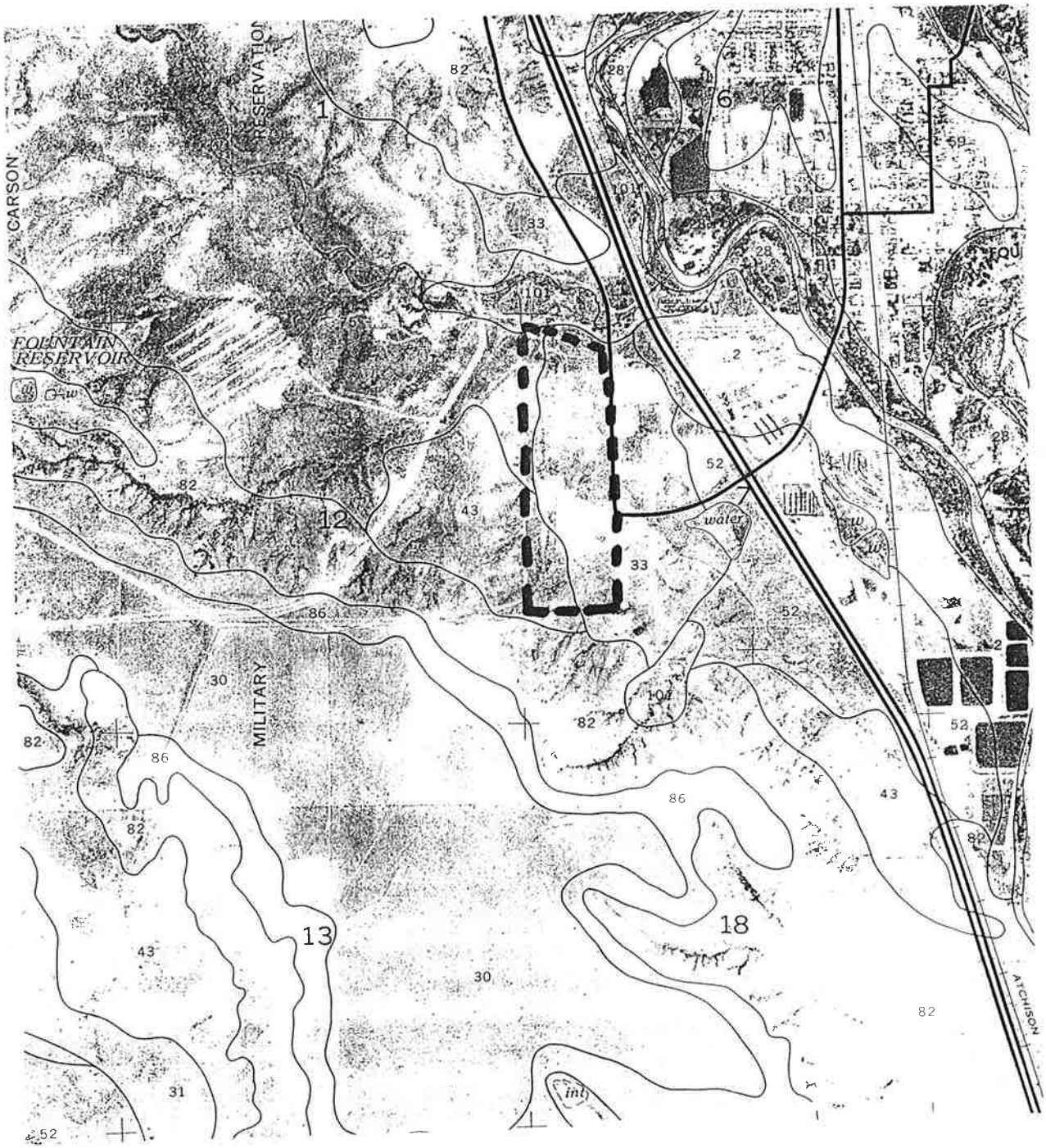
VICINITY MAP



VICINITY MAP

NTS

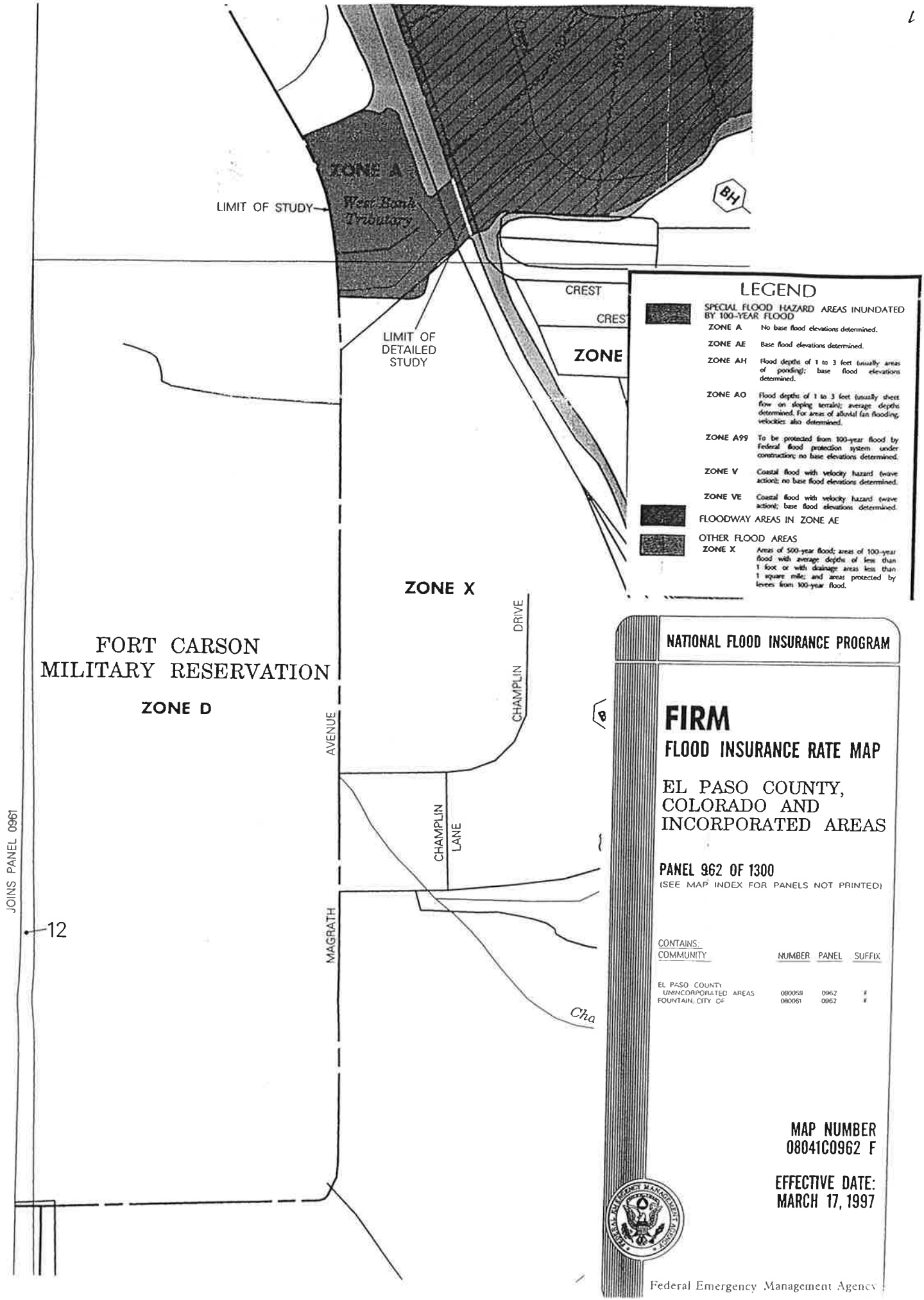
SCS SOILS
MAP



SHEET NO. 24
EL PASO COUNTY AREA, COLORADO
(FOUNTAIN QUADRANGLE)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FEMA EXHIBITS


ZONE A
West Bank Tributary
LIMIT OF STUDY
LIMIT OF DETAILED STUDY
CREST
CREST
ZONE
ZONE X
FORT CARSON
MILITARY RESERVATION
ZONE D
JOINS PANEL 0961
12
CHAMPLIN DRIVE
CHAMPLIN LANE
AVENUE
MAGRATH
BH
LEGEND
SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD
ZONE A No base flood elevations determined.
ZONE AE Base flood elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.
FLOODWAY AREAS IN ZONE AE
OTHER FLOOD AREAS
ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 962 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0962 F
FOUNTAIN, CITY OF 080061 0962 F
MAP NUMBER
08041C0962 F
EFFECTIVE DATE:
MARCH 17, 1997
Federal Emergency Management Agency

OVERALL DRAINAGE BASIN EXHIBITS

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Fountain Creek (Cont'd)								
BA	75,825	728	11,056	6.6	5,498.4	5,498.4	5,498.4	0.0
BB	77,030	700	7,999	8.4	5,500.1	5,500.1	5,500.1	0.0
BC	77,620	451	4,815	13.9	5,500.1	5,500.1	5,500.7	0.6
BD	78,260	550	5,008	13.4	5,505.6	5,505.6	5,505.6	0.0
BE	78,410	510	8,733	7.7	5,514.4	5,514.4	5,514.4	0.0
BF	79,480	476	7,575	8.8	5,514.9	5,514.9	5,515.9	1.0
BG	79,600	480	7,931	8.5	5,515.9	5,515.9	5,516.7	0.8
BH	80,520	400	6,016	11.1	5,519.0	5,519.0	5,519.0	0.0
BI	84,480	686	7,772	8.5	5,536.5	5,536.5	5,536.5	0.0
BJ	86,065	760	7,697	8.6	5,540.8	5,540.8	5,540.8	0.0
BK	87,710	937	7,871	8.4	5,546.0	5,546.0	5,546.3	0.3
BL	89,435	1,300	8,688	7.6	5,551.8	5,551.8	5,552.5	0.7
BM	90,485	1,500	10,764	6.1	5,558.9	5,558.9	5,559.0	0.1
BN	92,605	1,760	11,133	5.9	5,565.3	5,565.3	5,566.2	0.9
BO	94,500	1,000	7,605	8.7	5,578.1	5,578.1	5,579.1	1.0
BP	95,530	887	6,243	10.6	5,587.3	5,587.3	5,587.4	0.1
BQ	96,590	982	10,366	6.4	5,593.5	5,593.5	5,594.5	1.0
BR	97,830	1,450	8,341	7.9	5,598.6	5,598.6	5,598.9	0.3
BS	99,100	1,310	8,303	7.9	5,608.2	5,608.2	5,609.0	0.8
BT	100,450	1,087	6,898	9.6	5,616.9	5,616.9	5,617.9	1.0
BU	101,200	900	7,180	8.9	5,623.2	5,623.2	5,623.2	0.0
BV	101,900	1,060	8,179	7.8	5,625.9	5,625.9	5,626.3	0.4
BW	103,645	316	3,411	18.8	5,638.5	5,638.5	5,638.5	0.0
BX	103,735	320	3,838	16.7	5,639.8	5,639.8	5,639.8	0.0
BY	104,070	600	7,683	8.4	5,644.4	5,644.4	5,644.4	0.0
BZ	105,100	252	3,170	20.3	6,645.4	5,645.4	5,645.6	0.2

[1]Feet Above Fountain Creek Mile 21.0

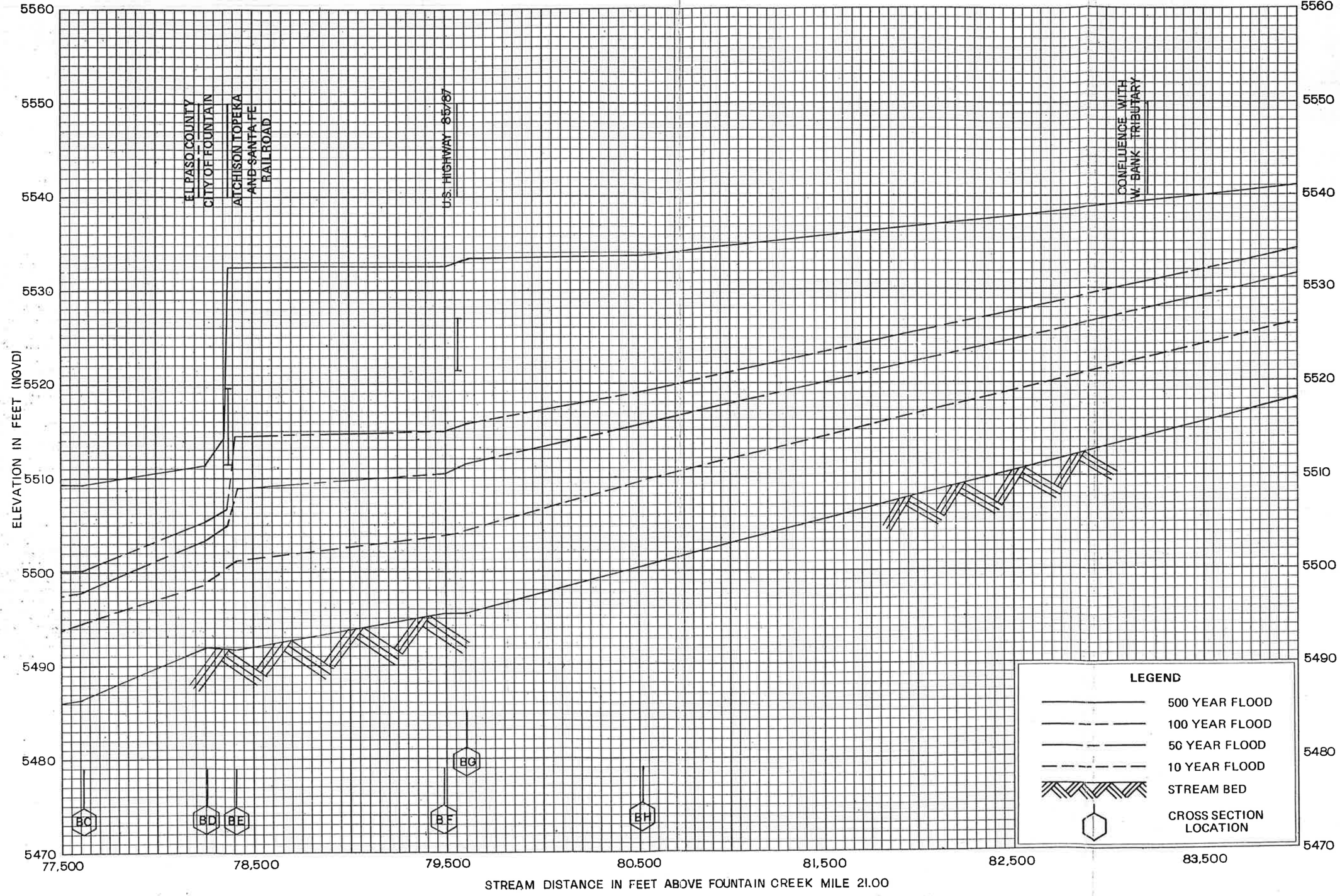
TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

FOUNTAIN CREEK



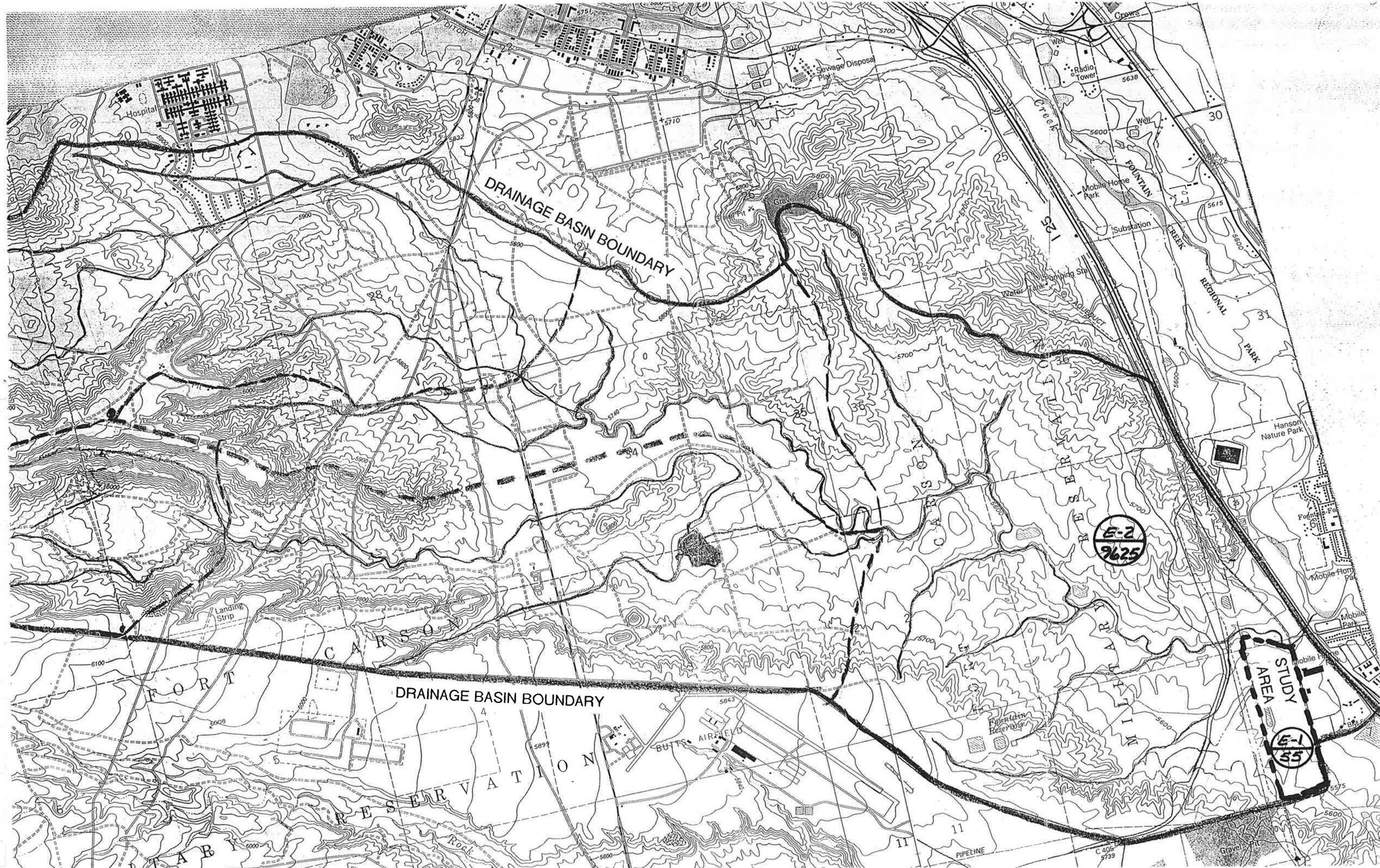
FLOOD PROFILES

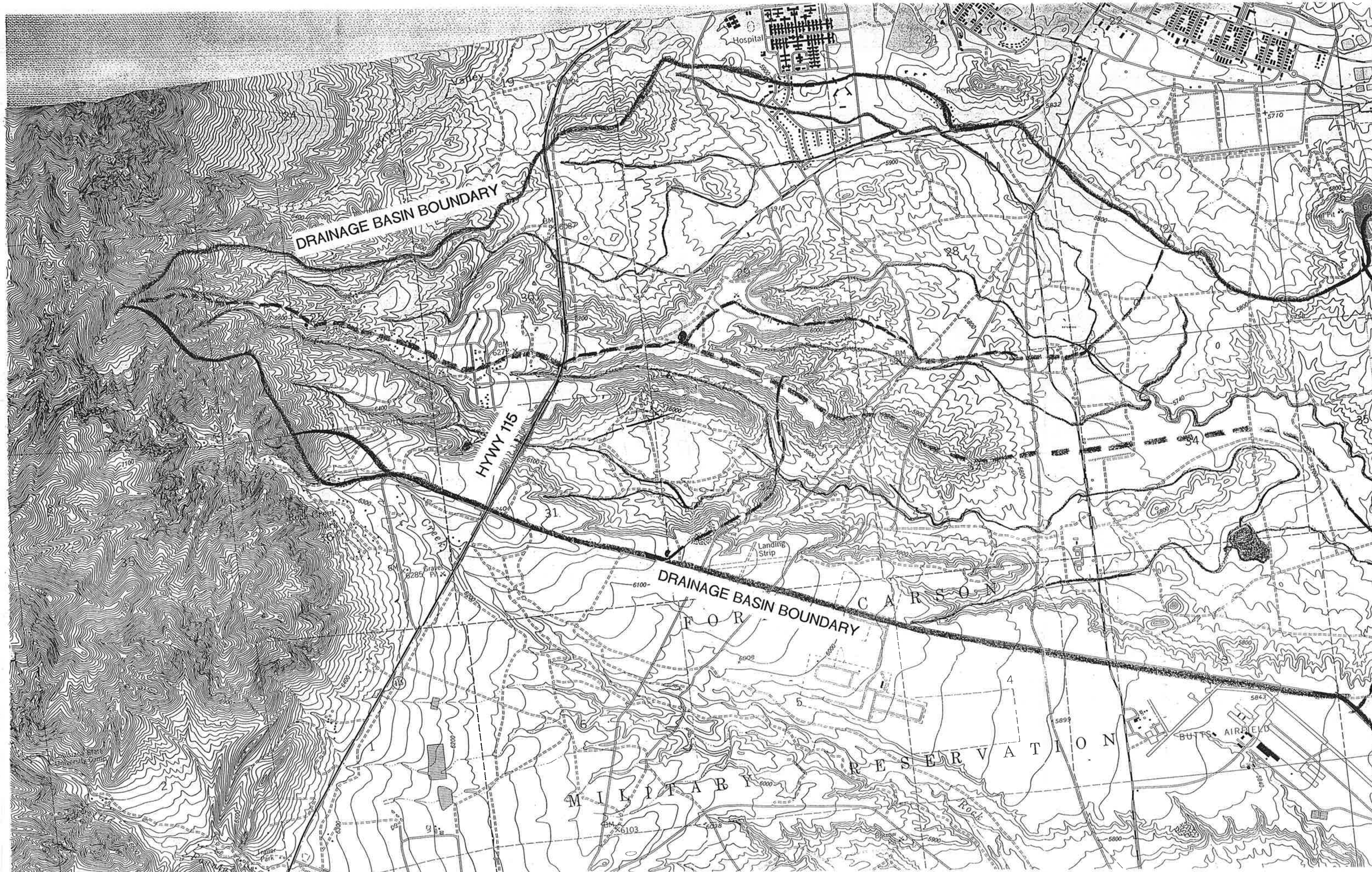
FOUNTAIN CREEK

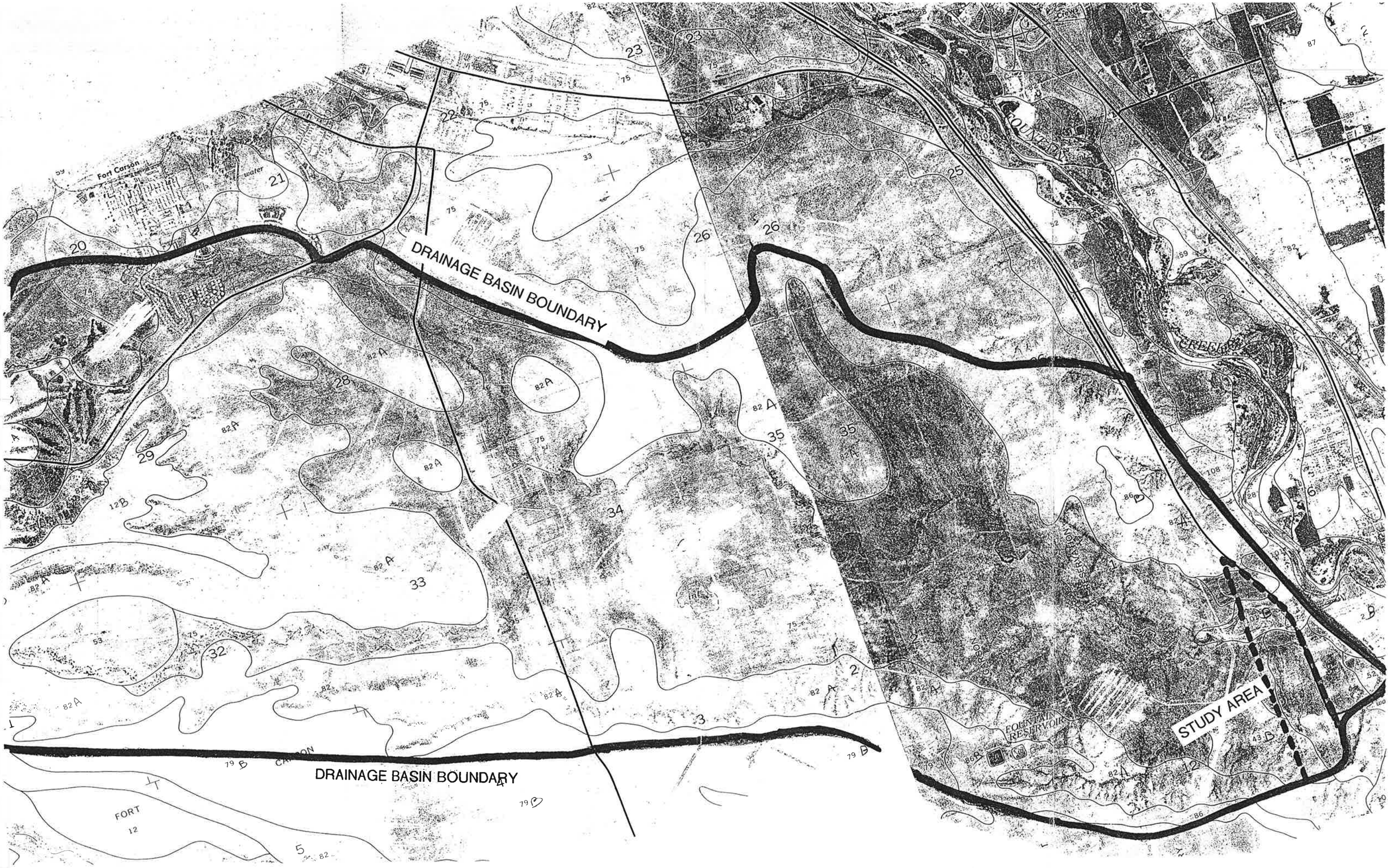
FEDERAL EMERGENCY MANAGEMENT AGENCY

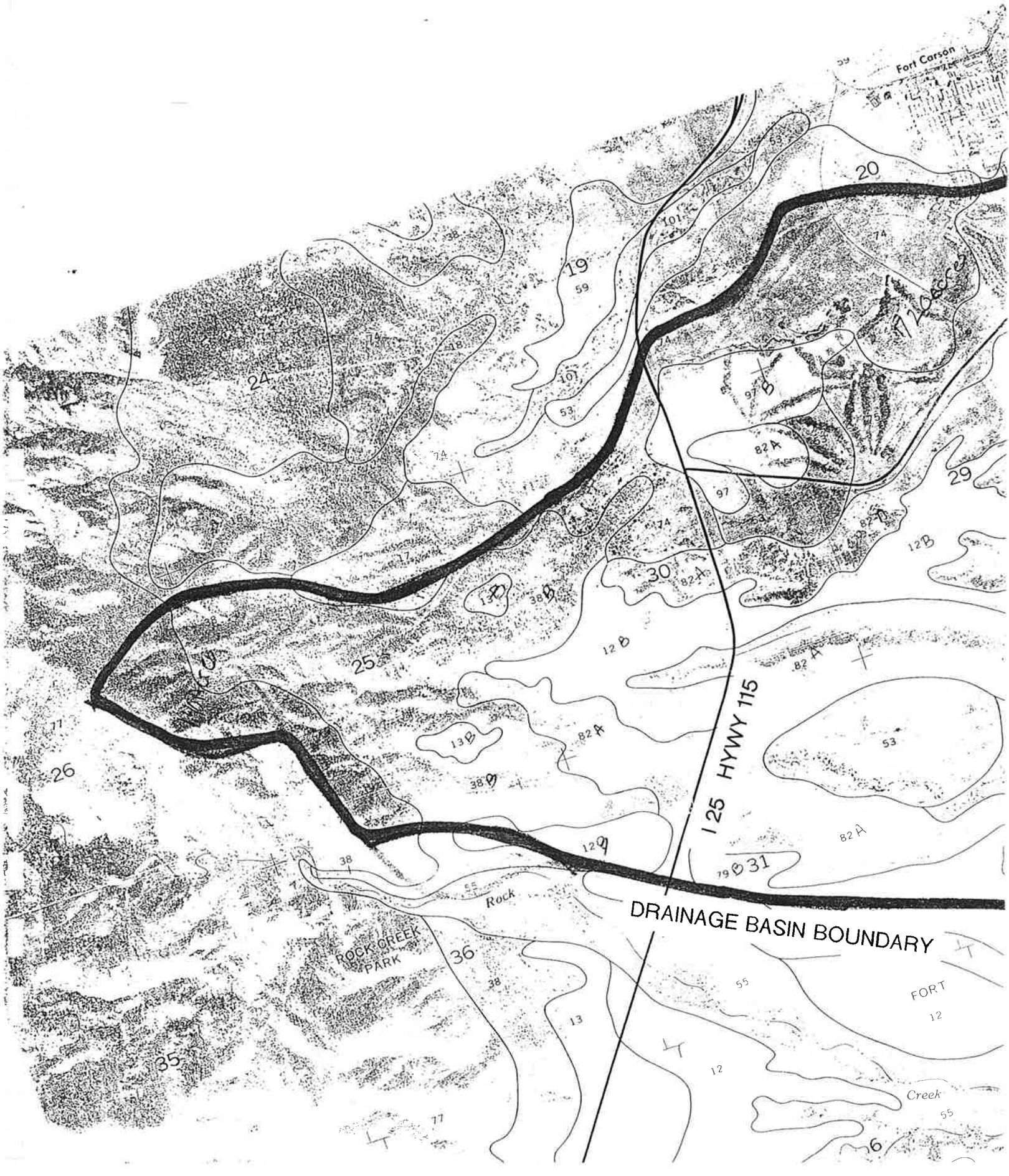
EL PASO COUNTY, CO
(UNINCORPORATED AREAS)

52P


DRAINAGE BASIN BOUNDARY
DRAINAGE BASIN BOUNDARY
STUDY AREA
E-1
55
E-2
9625
FORT CARSON
MILITARY RESERVATION
I-25
Hospital
Landing Strip
Reservoir
Sewage Disposal Plant
Radio Tower
Crows
Well
Mobile Home Park
FOUNTAIN CREEK REGIONAL PARK
Substation
Water Tank
Pumping Sta.
Aqueduct
Gravel Pit
BUTTS AIRFIELD
Hanson Nature Park
PIPELINE
Rock
Creek
Ditch


DRAINAGE BASIN BOUNDARY
HYWY 115
DRAINAGE BASIN BOUNDARY
FORT CARSON
MILITARY RESERVATION
Hospital
Landing Strip
BUTTS AIRFIELD
Rock Creek Park
Gravel Pit
Trailer Park


DRAINAGE BASIN BOUNDARY
DRAINAGE BASIN BOUNDARY
STUDY AREA
Fort Carson
water
FOUNTAIN RESERVOIR
FORT


Fort Carson
20
19
24
120 acres
29
30
25
26
35
36
I 25 HYWY 115
DRAINAGE BASIN BOUNDARY
ROCK CREEK PARK
Rock
Creek
FORT

HEC1 S/N: 1906330095 HMVersion: 6.30 Data File: 99023a.hc1

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*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
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XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
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::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC1 S/N: 1906330095 HMVersion: 6.30 Data File: 99023a.hc1

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*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

Runoff Determination @ West Bank Trib. East of Christian Ranch
Existing Development Conditions Upstream
100yr/24 hour Storm = 4.6" (99023A.HC1)

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	15	MINUTES IN COMPUTATION INTERVAL
IDATE	17jun99	STARTING DATE
ITIME	1000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	20 99	ENDING DATE
NDTIME	1245	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL 0.25 HOURS
TOTAL TIME BASE 74.75 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1       ID   Runoff Determination @ West Bank Trib. East of Christian Ranch
  2       ID   Existing Development Conditions Upstream
  3       ID   100yr/24 hour Storm = 4.6"  (99023A.HC1)
  4       IT      15 17jun99    1000     300
  5       IO       5       0       0

  6       KK     OS1 Undeveloped Drainage Area West of I25/ inclusive of Christian Ranch
  7       KM     100 Year Basin Runoff from OS1
  8       BA   15.04
  9       PB     4.6
 10       IN      15
 11       PC  .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143   .0165
 12       PC  .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530    .060
 13       PC  .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900   .8000
 14       PC  .8100   .8200   .8250   .8300   .8350   .8400   .8430   .8500   .8550   .8600
 15       PC  .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938   .8975
 16       PC  .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270   .9300
 17       PC  .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525   .9550
 18       PC  .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775   .9800
 19       PC  .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913   .9925
 20       PC  .9938   .9950   .9963   .9975   .9988  1.000
 21       LS             70
 22       UD  1.56
 23       ZZ
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	OS1	4328.	7.25	2064.	706.	235.	15.04		

*** NORMAL END OF HEC-1 ***

HEC1 S/N: 1906330095 HMVersion: 6.30 Data File: 99023b.hc1

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE  07/26/1999  TIME  15:55:52 *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

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

```
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID   Runoff Determination @ West Bank Trib. East of Christian Ranch
    2     ID   Exist Dev Conditions Upstream; Dev Conditions for Christian Ranch
    3     ID   100yr/24 hour Storm = 4.6"  (99023B.HC1)
    4     IT      15 26jul99    1000     300
    5     IO       5       0       0

    6     KK     OS1 Undev Drainage Area West of Ranch w/ Dev area of Christian Ranch
    7     KM     100 Year Basin Runoff from OS1
    8     BA   15.04
    9     PB     4.6
   10     IN      15
   11     PC  .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143   .0165
   12     PC  .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530    .060
   13     PC  .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900   .8000
   14     PC  .8100   .8200   .8250   .8300   .8350   .8400   .8430   .8500   .8550   .8600
   15     PC  .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938   .8975
   16     PC  .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270   .9300
   17     PC  .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525   .9550
   18     PC  .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775   .9800
   19     PC  .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913   .9925
   20     PC  .9938   .9950   .9963   .9975   .9988  1.000
   21     LS          70.2
   22     UD  1.56
   23     ZZ
```

HEC1 S/N: 1906330095 HMVersion: 6.30 Data File: 99023b.hc1

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE  **/**/1999  TIME  00:00:** *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


Runoff Determination @ West Bank Trib. East of Christian Ranch
Exist Dev Conditions Upstream; Dev Conditions for Christian Ranch
100yr/24 hour Storm = 4.6" (99023B.HC1)

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	15	MINUTES IN COMPUTATION INTERVAL
IDATE	26jul99	STARTING DATE
ITIME	1000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	29 99	ENDING DATE
NDTIME	1245	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL 0.25 HOURS
TOTAL TIME BASE 74.75 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	OS1	4375.	7.25	2084.	712.	237.	15.04		

*** NORMAL END OF HEC-1 ***

Runwl WS Elev
@ Elev 32 en
Monument Creek

HEC2 S/N: 1916530056 HMVersion: 6.50 Data File: 99023cr.hc2

```
*********************************************
*  HEC-2 WATER SURFACE PROFILES             *
*                                           *
*  Version   4.6.2;  May 1991               *
*                                           *
*  RUN DATE    14JUN99    TIME   16:05:29   *
*********************************************
```


```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

```
::::::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::::::
:::                                          :::
:::   FULL MICRO-COMPUTER IMPLEMENTATION     :::
:::                                          :::
::::::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::::::
```

```
============================
H A E S T A D   M E T H O D S
============================
```


37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

Run Date: 14JUN99 Run Time: 16:05:29 HMVersion: 6.50 Data File: 99023cr.hc2 Page 1

THIS RUN EXECUTED 14JUN99 16:05:29

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

T1 Preliminary Water Surface Profiles w/ Assumed Exist Bridge Section
T2 Christian Ranch OWA Project #: 99023 Date: 6/14/99
T3 West Bank Tributary 100 Year Storm Event/Assumed Bridge Config

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	0	0	0	0	0	32	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1	0	0	0	0	0	-1			

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

	100	105	150							
NC	.030	.030	.040	.3	.5					
QT	1	4300								
X1	1	13	350	380						
GR	43	1	42	250	40	265	22	350	20	370
GR	19.5	375	22	380	22	485	22	770	24	850
GR	34	925	40	1040	44	1120				
X1	2	0	0	0	360	340	350			
X3	10	0	0	0	0	0	0	27	27	
SB	1.05	1.6	2.6	0	40	2	250	3	21	21
X1	3	0	0	0	30	30	30			
X2	0	0	1	25.5	27					
X3	10							27	27	
BT	6	1	40	40	195	27	25.5	255	27	25.5
BT	615	28	28	760	30	30	990	40	40	
X1	4				60	60	60			
X1	5	11	515	555	550	560	555			
GR	46	1	26	170	26	330	26	460	24	515
GR	23.5	535	28	555	30	690	34	705	42	840
GR	44	880								
X1	6	10	470	550	95	85	85			
GR	48	1	40	130	28	190	28	350	26	470
GR	24	525	28	550	32	690	36	790	48	915

X1	7	9	410	470	200	200	210			
GR	48	1	44	75	38	180	32	410	25	430
GR	26	470	28	585	34	750	44	810		
X1	8	9	400	545	150	165	150			
GR	50	1	42	45	38	170	34	400	26	420
GR	30	545	32	585	40	690	50	810		
X1	9	8	420	485	170	150	170			
GR	45	1	40	60	40	170	38	250	28	420
GR	26.5	460	32	485	52	720				
X1	10	6	185	265	170	190	180			
GR	48	1	38	65	30	185	27.5	230	44	265
GR	50	350								
X1	11	7	80	205	210	255	240			
GR	42	1	34	80	30.5	120	36	205	44	260
GR	44	350	50	455						
X1	12	9	310	440	205	220	200			
GR	52	1	48	20	44	310	34	325	32	390
GR	36	440	40	460	45	515	48	590		

West Bank Tributary

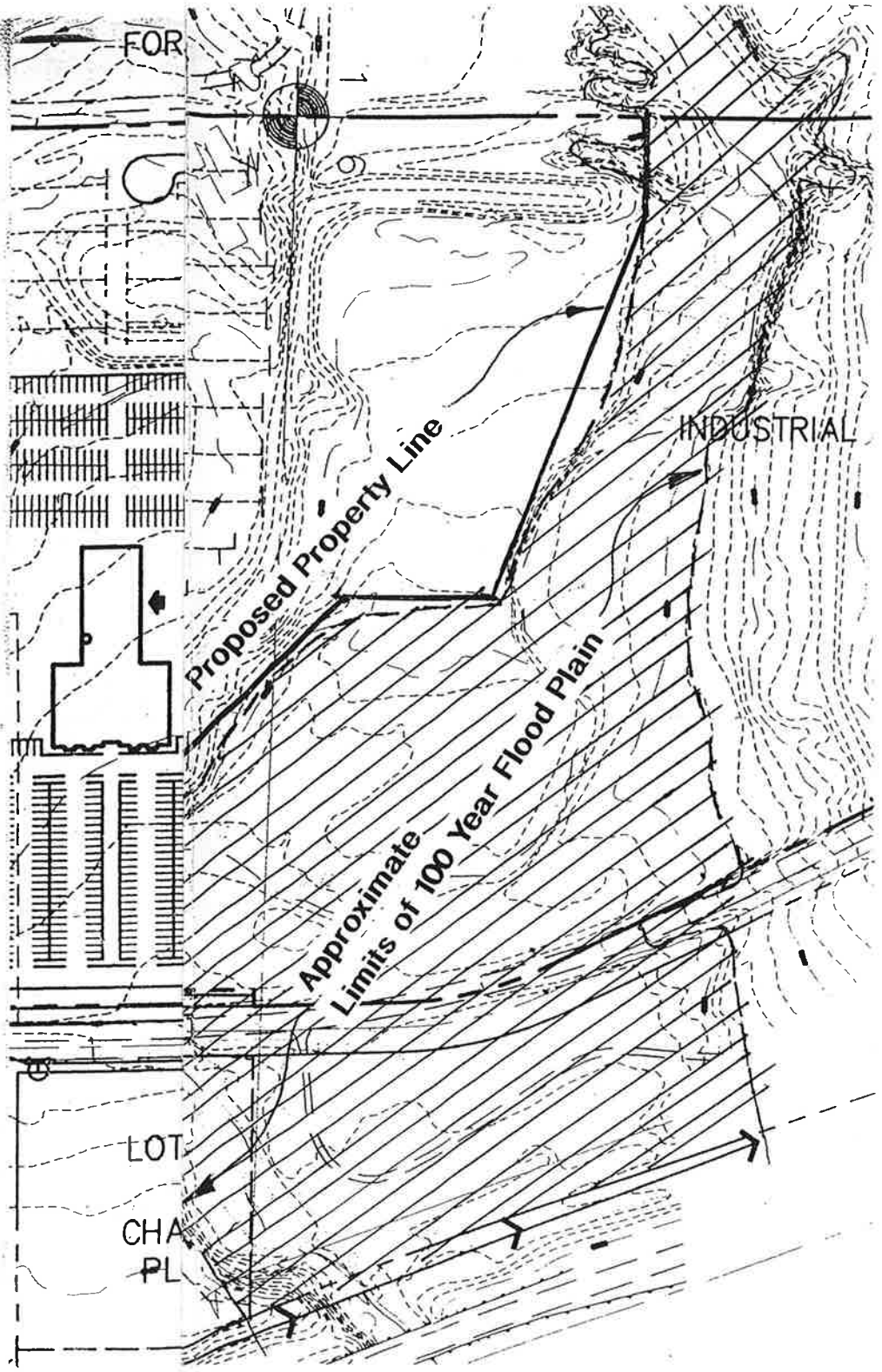
SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	1.000	0.00	0.00	0.00	19.50	4300.00	32.00	23.34	32.01	0.13	0.67	5433.61	11764.79
	2.000	350.00	0.00	0.00	19.50	4300.00	32.00	27.07	32.01	0.13	0.67	5436.45	11774.43
	3.000	30.00	27.00	25.50	19.50	4300.00	32.01	0.00	32.02	0.13	0.67	5447.66	11812.50
	4.000	60.00	0.00	0.00	19.50	4300.00	32.01	23.34	32.02	0.13	0.67	5442.15	11793.78
*	5.000	555.00	0.00	0.00	23.50	4300.00	32.02	27.27	32.05	0.89	1.31	2991.98	4549.78
*	6.000	85.00	0.00	0.00	24.00	4300.00	32.01	28.81	32.08	2.64	2.14	2106.45	2644.54
*	7.000	210.00	0.00	0.00	25.00	4300.00	32.03	29.41	32.25	9.48	3.53	1132.66	1396.29
*	8.000	150.00	0.00	0.00	26.00	4300.00	32.02	31.22	32.88	67.41	7.53	589.32	523.73
	9.000	170.00	0.00	0.00	26.50	4300.00	33.04	32.25	34.02	60.32	8.41	549.03	553.67
*	10.000	180.00	0.00	0.00	27.50	4300.00	34.14	34.14	35.85	110.95	11.09	418.11	408.22
	11.000	240.00	0.00	0.00	30.50	4300.00	37.14	36.22	38.02	62.59	7.65	579.90	543.54
	12.000	200.00	0.00	0.00	32.00	4300.00	38.32	36.93	39.15	50.14	7.37	590.05	607.25

West Bank Tributary

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	1.000	4300.00	32.00	0.00	0.00	0.00	607.22	0.00
	2.000	4300.00	32.00	0.00	0.00	0.00	607.28	350.00
	3.000	4300.00	32.01	0.00	0.01	0.00	607.50	30.00
	4.000	4300.00	32.01	0.00	0.00	0.00	607.39	60.00
*	5.000	4300.00	32.02	0.00	0.00	0.00	578.46	555.00
*	6.000	4300.00	32.01	0.00	0.00	0.00	520.66	85.00
*	7.000	4300.00	32.03	0.00	0.01	0.00	286.76	210.00
*	8.000	4300.00	32.02	0.00	0.00	0.00	180.37	150.00
	9.000	4300.00	33.04	0.00	1.02	0.00	162.97	170.00
*	10.000	4300.00	34.14	0.00	1.10	0.00	121.22	180.00
	11.000	4300.00	37.14	0.00	3.00	0.00	163.90	240.00
	12.000	4300.00	38.32	0.00	1.17	0.00	133.12	200.00


FOR
INDUSTRIAL
Proposed Property Line
Approximate Limits of 100 Year Flood Plain
LOT
CHA
PL

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200 FAX (719) 531-6266

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Soils Type

38	Jarre Part	B
13	Bresser	B
12	Bresser	B
82	Schamber	A
53	Manzanola	C
75	Razor	C
86	Stoneham	B
43	Kim	B
33	Heldt	C
101	Torrifluvents	B
79	Satanta	B
77	Rock Outcrop	D
97	Truckton	B
74	Razor	C
52	Manzanola	C

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200 FAX (719) 531-6266

JOB Christian Master Plan
SHEET NO. _____ OF _____
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

Floodplain Study w/ Undeveloped Christian Site

A Flow Determination from FEMA Study

Flow at Cross Section upstream of Tributary

Cross Section	BI
Section Area	7772 ft²
Mean Vel	8.5 fps
Flow	66,060 fps

Flow @ Cross Section downstream of tributary

Cross Section	BH
Section Area	6016 ft²
mean Vel	11.1 fps
Flow	66,780

Difference 720cfs

B Flow Determination from SCS method

1 Drainage Area =

	Area	CN	
Total Area 9625 acres			
Type A-B Soils	5255 acres	65	Pasture/Range
Type C-D Soils	4370 acres	76	Pasture/Range
	9625 acres 15 m²	70 Ave.	

2 Time of Concentration

Overland - Negligible due to rock outcropping & steep grades

Stream Flow

Linear Fwl 52,000ft from base of mtn.

Elevation Difference 6500 - 5540 = 960

Slope = 1.9% (Ave)

$$T_c = \left[\frac{11.9\left(\frac{52{,}000}{5280}\right)^3}{960}\right]^{0.385} = 2.6 \text{ hr. or } 5.6 \text{ fps}$$

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors

1015 Elkton Drive
Colorado Springs, Colorado 80907
(719) 531-6200 FAX (719) 531-6266

JOB Christian MDP
SHEET NO. 1 OF
CALCULATED BY DATE 7/26/99
CHECKED BY DATE
SCALE

Floodplain Study w/ Developed Christian Site

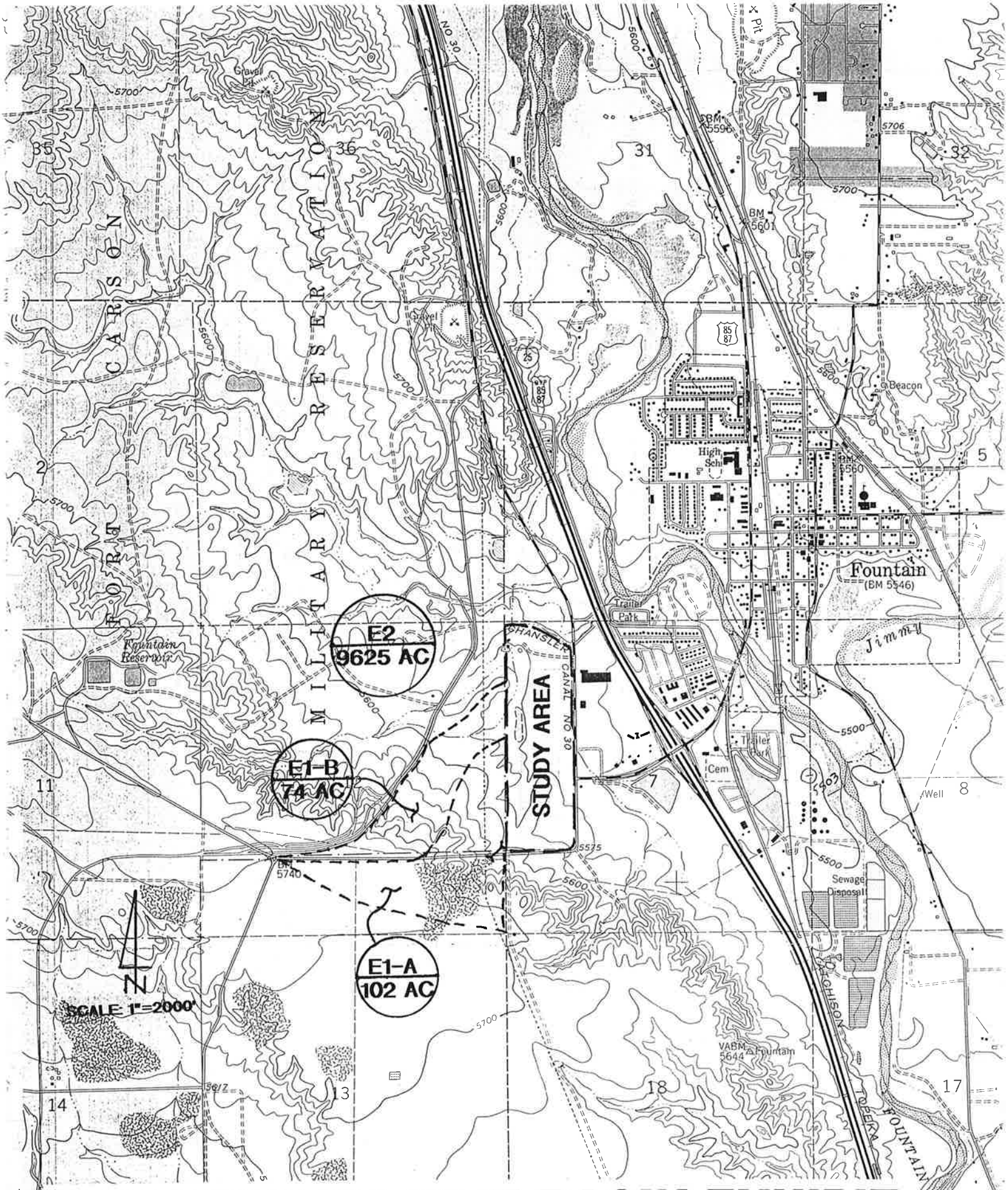
A. Drainage Area
Total Area = 9625 Acres.

	Area	CN	
Type A/B Soils	5255	65	Pasture/Range
Type C/D Soils	4282	76	" "
Christian Development	88	95	
	9625	70.2 Ave	

B. Time of Concentration
Same as initial study

C. Rainfall amount
I_{100} = 4.6 Inches

ADJACENT OFFSITE BASIN EXHIBIT



ADJACENT OFFSITE BASIN EXHIBIT

RATIONAL METHOD FOR RUNOFF COMPUTATIONS

BASIN	AREA	GEOMETRY		C		Tc	INTENSITY,in/hr		PEAK FLOW cfs	
	(acres)	Length	Height	5 yr	100 yr		5 yr	100yr	5 yr	100yr
E1-A	102	3900'	156'	0.25	0.35	38	2	3.57	51	127.4
E1-B	74	--	--	0.25	0.35	29	2.4	4.15	44.4	107.5
E1-A & E1-B COMBINED	176	--	--	0.25	0.35	39	1.95	3.5	85.8	215.6

OBERING, WURTH & ASSOCIATES
CONSULTING CIVIL ENGINEERS
PROFESSIONAL LAND SURVEYORS

CHRISTIAN ANNEXATION MDDP
OWA PROJECT NO. 99035
NOVEMBER, 1999

D:sgb/99035.xls

HYDROLOGIC SUMMARY EXHIBITS

CHRISTIAN ANNEXATION MDDP

Rational Method

OWA Proj. 99035

July 28, 1999

RUNOFF SUMMARY

Point No.	Basin	Existing Runoff					Developed Runoff			
		Tc	C5	C100	Q5	Q100	C5	C100	Q5	Q100
1	A	30	0.25	0.35	6	14.5	0.9	0.95	41.4	75.1
2	B	26	0.30	0.45	16.6	42.7	0.9	0.95	88.3	160.2
3	C	27	0.30	0.45	8.4	21.4	0.9	0.95	32.1	63.3
4	D	37	0.30	0.45	35.2	92.9	0.9	0.95	181.2	332.0

DETENTION POND SUMMARY

Location	Basin	5 Year Event		100 Year Event		Approx. Pond Size
		Qin	Qout	Qin	Qout	(ac-ft)
1	A	41.4	6.0	75.1	14.5	1.17
2	B	88.3	16.6	160.2	42.7	1.95
3	C	32.1	8.4	63.3	21.4	0.67
4	D	181.2	35.2	332.0	92.9	6.02

Notes: Final pond sizes are to be determined upon completion of final grading plan and final location of pond

HYDRAULIC SUMMARY EXHIBITS

STORM SEWER SUMMARY

Detention Alternate

Location	Q des max (cfs)	Pipe Diam (in)	Min Slope (%)	Velocity (fps)	Capacity (cfs)	Comments
1-2	14.5	18	1.5	7	15	
Stub @ 2	57.2	36	1.0	10	70	
2-3	57.2	36	1.0	10	70	
3-4	78.6	42	0.8	9	90	
Outfall Pipe	171.5	48	1.3	12	180	

Notes
Storm sewer is sized to accommodate the 100 year historic discharge form the individual tracts
Pond facilities are assumed to be located at the NE corner of each interior tract

Non- Detention Alternate

Location	Q des max (cfs)	Pipe Diam (in)	Min Slope (%)	Velocity (fps)	Capacity (cfs)	Comments
1-2	41.4	30	1	8	45	
Stub @ 2	88.3	42	0.8	9	90	
2-3	129.7	48	0.9	10	140	
3-4	161.8 to 343	48 to 72	1.2 to 1.0	10 to 12	170 to 350	
Outfall Pipe	343	72	1	12	350	

Notes
Storm sewer is sized to accommodate the 5 year developed discharge form the individual tracts
Excess flow form the 100 year storm is to be directed to the existing channel via surface swales

DETENTION POND EXHIBITS

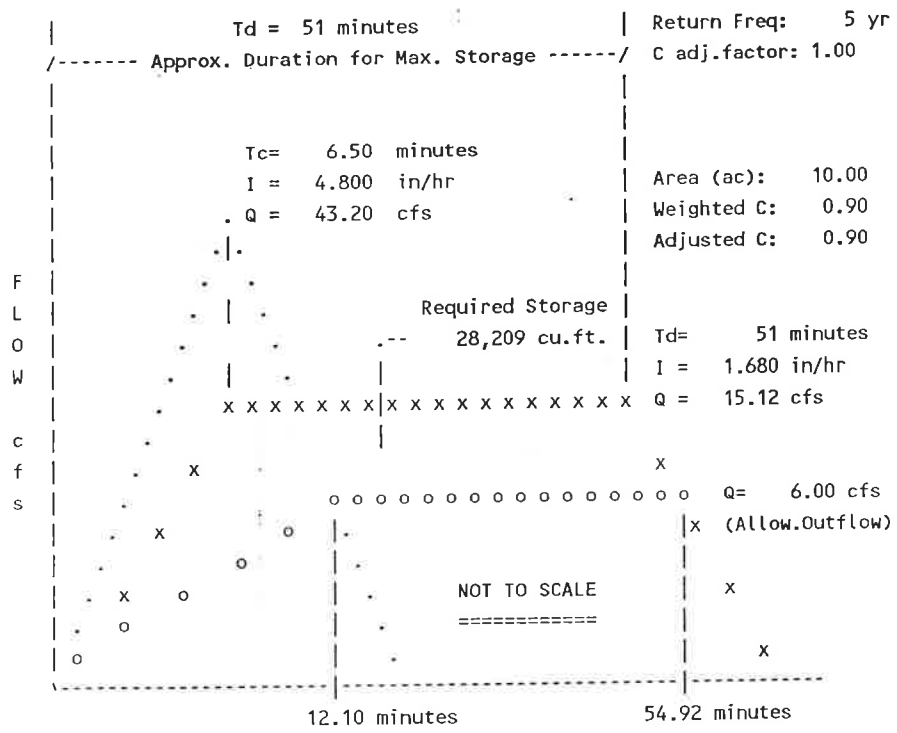
QUick TR-55 Ver.5.46 S/N:1315430357
Executed: 10:11:35 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
5 Year Storm Event
Detention Alternate (First Fleet Site, Subbasin A)

```
**************************************************************************
*  RETURN FREQUENCY:   5 yr     |  Allowable Outflow:     6.00 cfs     *
*  'C' Adjustment: 1.000        |  Required Storage:    28,209 cu.ft. *
*-------------------------------------------------------------------------*
*  Peak Inflow:   15.12 cfs        Inflow .HYD stored: NONE STORED      *
**************************************************************************
```



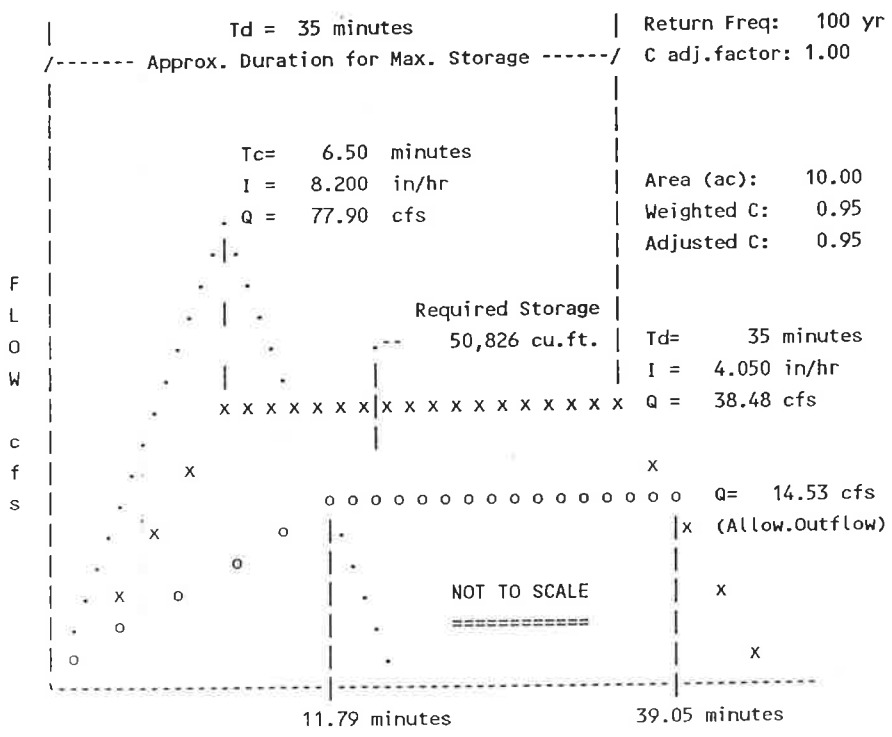
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 10:01:34 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
100 Year Storm Event
Detention Alternate (First Fleet Site, Subbasin A)

RETURN FREQUENCY: 100 yr	Allowable Outflow: 14.53 cfs
'C' Adjustment: 1.000	Required Storage: 50,826 cu.ft.
Peak Inflow: 38.48 cfs	Inflow .HYD stored: NONE STORED



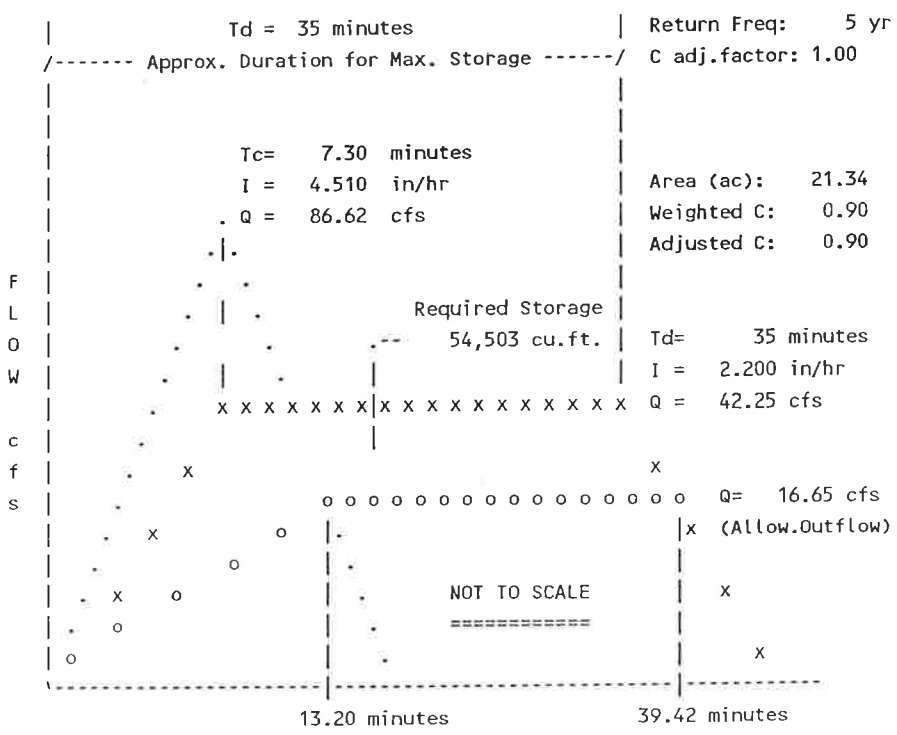
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 10:13:20 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
5 Year Storm Event
Detention Alternate (Commercial Site, Subbasin B)

* RETURN FREQUENCY: 5 yr	Allowable Outflow: 16.65 cfs *
* 'C' Adjustment: 1.000	Required Storage: 54,503 cu.ft. *
* Peak Inflow: 42.25 cfs	Inflow .HYD stored: NONE STORED *



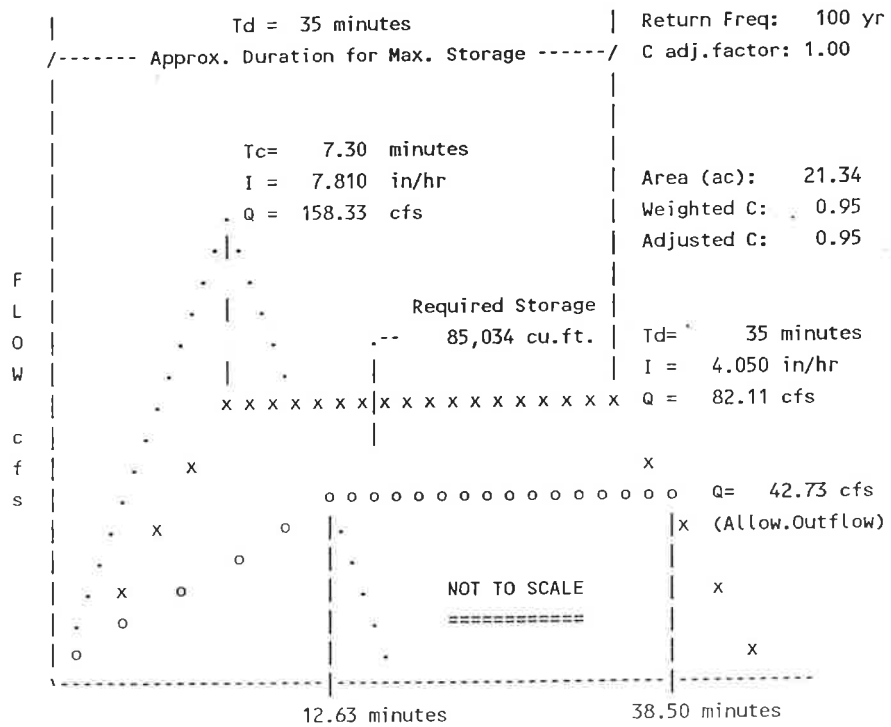
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 10:05:14 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
100 Year Storm Event
Detention Alternate (Commercial Site, Subbasin B)

```
**************************************************************************
*  RETURN FREQUENCY: 100 yr     |  Allowable Outflow:    42.73 cfs     *
*  'C' Adjustment: 1.000        |  Required Storage:    85,034 cu.ft. *
*-------------------------------------------------------------------------*
*  Peak Inflow:   82.11 cfs        Inflow .HYD stored: NONE STORED     *
**************************************************************************
```



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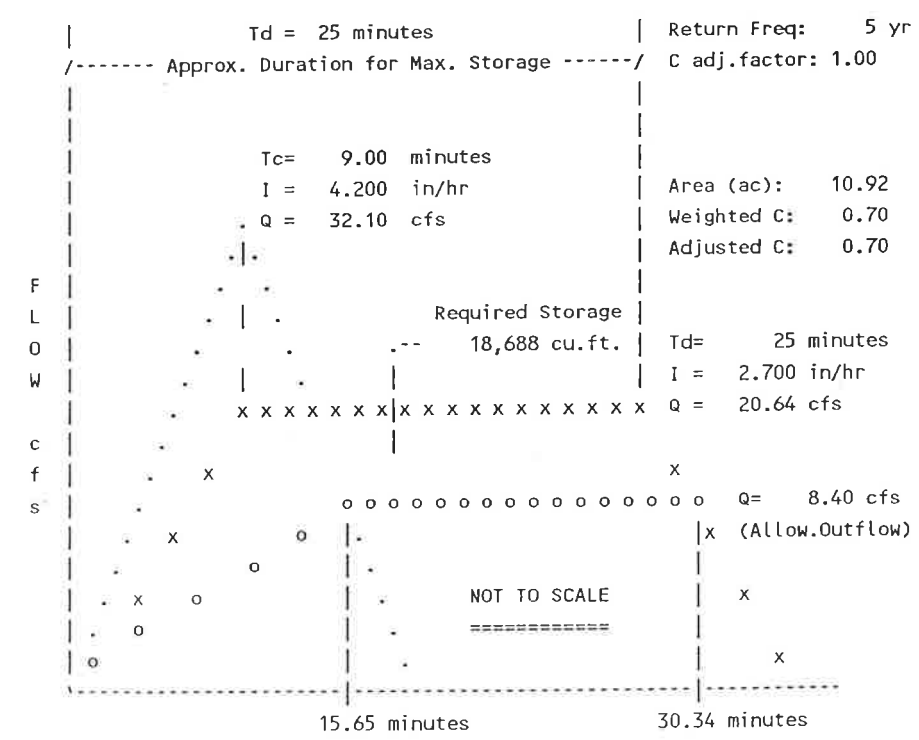
Executed: 13:10:42 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
5 Year Storm Event
Detention Pond Alternate (Christian Subdivision Fil. No.1, Sub.C)

* RETURN FREQUENCY: 5 yr	Allowable Outflow: 8.40 cfs *
* 'C' Adjustment: 1.000	Required Storage: 18,688 cu.ft. *
* Peak Inflow: 20.64 cfs	Inflow .HYD stored: NONE STORED *



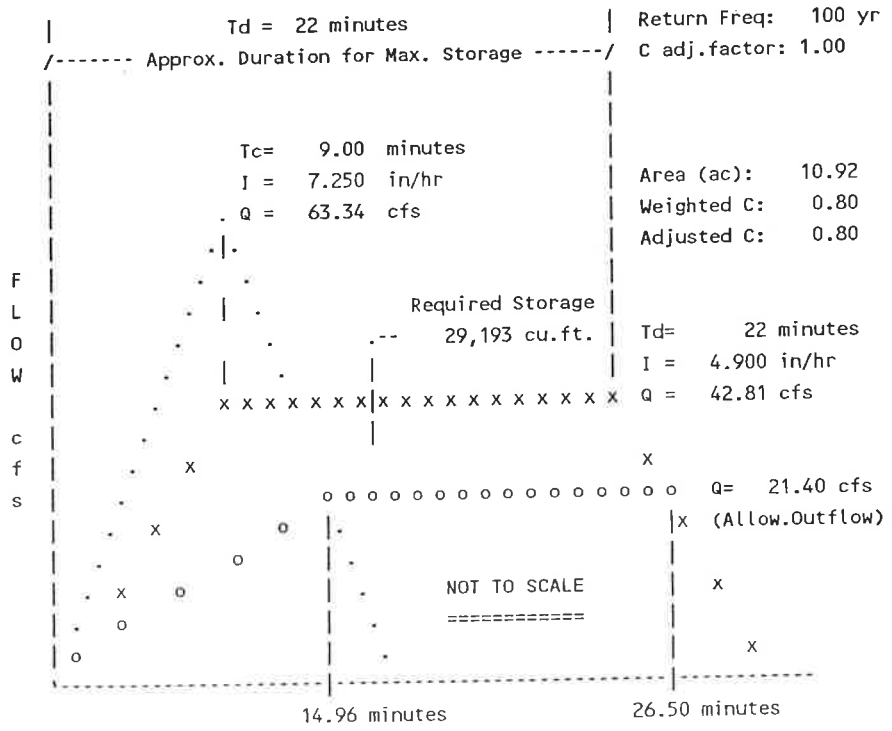
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 13:09:36 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
100 Year Storm Event
Detention Pond Alternate (Christian Subdivision Fil. No.1, Sub.C)

```
**********************************************************************
*  RETURN FREQUENCY: 100 yr    |  Allowable Outflow:    21.40 cfs    *
*  'C' Adjustment: 1.000       |  Required Storage:    29,193 cu.ft. *
*--------------------------------------------------------------------*
*  Peak Inflow:   42.81 cfs       Inflow .HYD stored: NONE STORED     *
**********************************************************************
```



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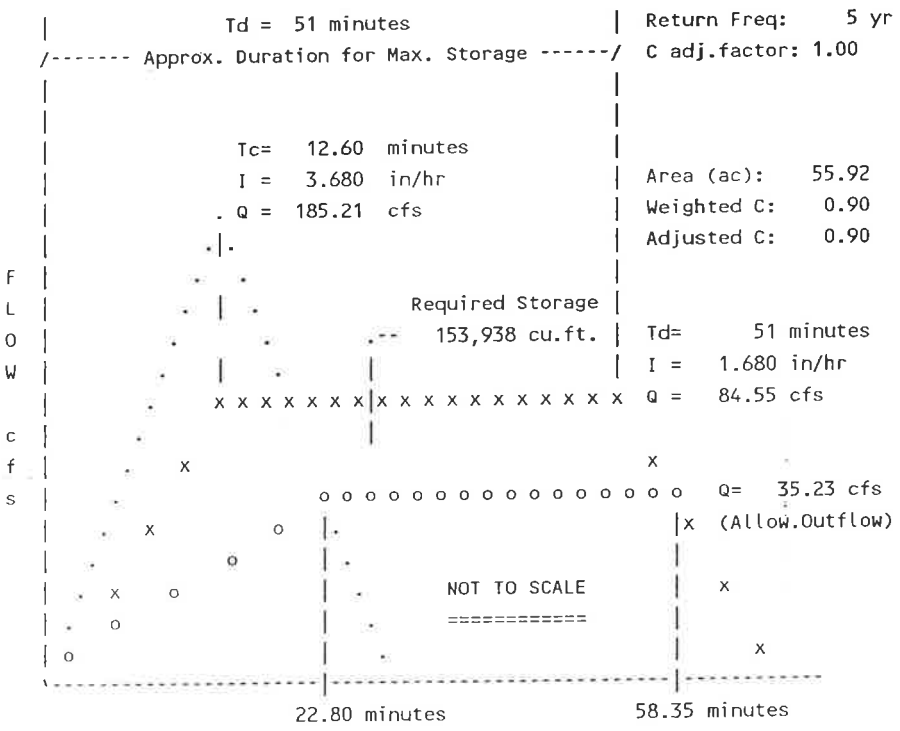
Executed: 10:08:39 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
5 Year Storm Event
Detention Alternate (ADT Site, Subbasin D)

* RETURN FREQUENCY: 5 yr	Allowable Outflow: 35.23 cfs *
* 'C' Adjustment: 1.000	Required Storage: 153,938 cu.ft. *
* Peak Inflow: 84.55 cfs	Inflow .HYD stored: CHRISTI .HYD *



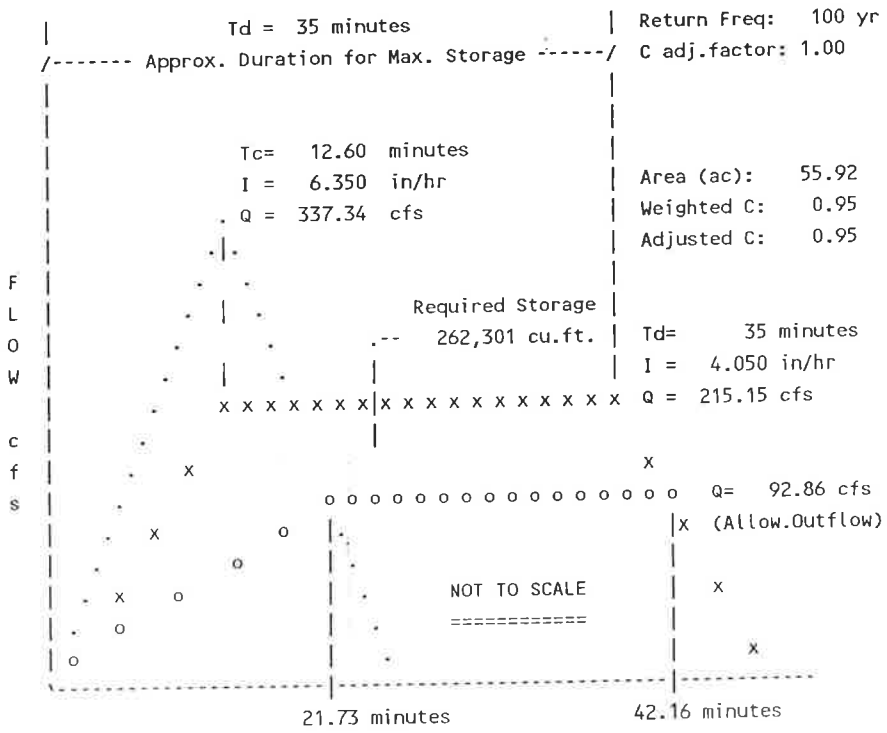
Quick TR-55 Ver.5.46 S/N:1315430357
Executed: 09:57:54 07-28-1999

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

Christian Annexation Phase II
100 Year Storm
Detention Alternate (ADT Site, Subbasin D)

* RETURN FREQUENCY: 100 yr	Allowable Outflow: 92.86 cfs *
* 'C' Adjustment: 1.000	Required Storage: 262,301 cu.ft. *
* Peak Inflow: 215.15 cfs	Inflow .HYD stored: CHRISTI .HYD *



MOUSE LETTER REPORT

GREYSTONE®

Environmental Consultants, Inc.

August 23, 1999

Peter Plage
U.S. Fish and Wildlife Service
Ecological Services
P.O. Box 25486
DFC
Denver, Colorado 80225-0207

Dear Peter,

Obering, Wurth, and Associates has proposed to construct a 56 acre Auto Auction Facility near the City of Fountain in El Paso County, Colorado. The project would include grading the entire area and paving 39 of the 56 acres. Rip-rap would also be added to the steep upland bank on the southwest side of Charter Oak Ranch Road from the storm sewer outfall (just west of the Charter Oak Ranch Road bridge) approximately 100 feet upstream. This rip-rap would not disturb any potential Preble's meadow jumping mouse (*Zapus hudsonious preblei*) habitat. This new facility would occur within 300 feet of an unnamed tributary of Fountain Creek. The project is bounded on the west side by the Fort Carson Military Reservation and on the east side by Charter Oak Ranch Road. The wetland associated with the unnamed tributary of Fountain Creek on the north side of the property was delineated by the Army Corps of Engineers (COE) and will not be disturbed. The project occurs in the southwest ¼ of the southwest ¼ of section 6 and the northwest ¼ of the northwest ¼ of section 7, Township 16 south, Range 65 west (Figure 1). The project is located on the Fountain, CO USGS 7.5 minute quadrangle map. Because the site occurs within the historic range of the Preble's meadow jumping mouse, a habitat assessment of the site was conducted on August 13, 1999. The results of that assessment are presented below.

The habitat along the unnamed tributary of Fountain Creek consists of patches of dense bulrush and sedge, with cattails and salt cedar mixed in. The herbaceous layer was not very dense as there was evidence of recent cattle grazing. There was some foxtail barley, smooth brome, and western wheat. The small riparian area also supports a few cottonwood trees and several alder trees, forming a patchy woody overstory. No willows occur along this stretch of stream. The area also includes a fair amount of weedy species including mullein, sunflower, and milkweed. This area is not suitable habitat for the Preble's Meadow Jumping Mouse due to the lack of willows, the limited woody overstory, and the amount of weedy species in the area.

The project would not impact any riparian habitat. The firm has already consulted with the COE and will protect the entire wetland area adjacent to the project area. Therefore, based on the

5231 South Quebec Street • Greenwood Village, Colorado 80111
Phone (303) 850-0930 • Fax (303) 721-9298
Web Site: www.greystone-consultants.com • E-mail: greystone@greystone-consultants.com

following considerations we do not feel that the proposed project would adversely impact the Preble's meadow jumping mouse. First, no potentially suitable habitat for the mouse occurs within the project area. Second, all the proposed activities would occur within an area that has been disturbed by cattle for a long period of time and it would not disturb any riparian or wetland habitat. Based on these considerations we would like the Services concurrence on the lack of suitable Preble's habitat within the project area.

If you have any questions, or require additional information please feel free to contact me at (303) 850-0930. Your attention in this matter is greatly appreciated.

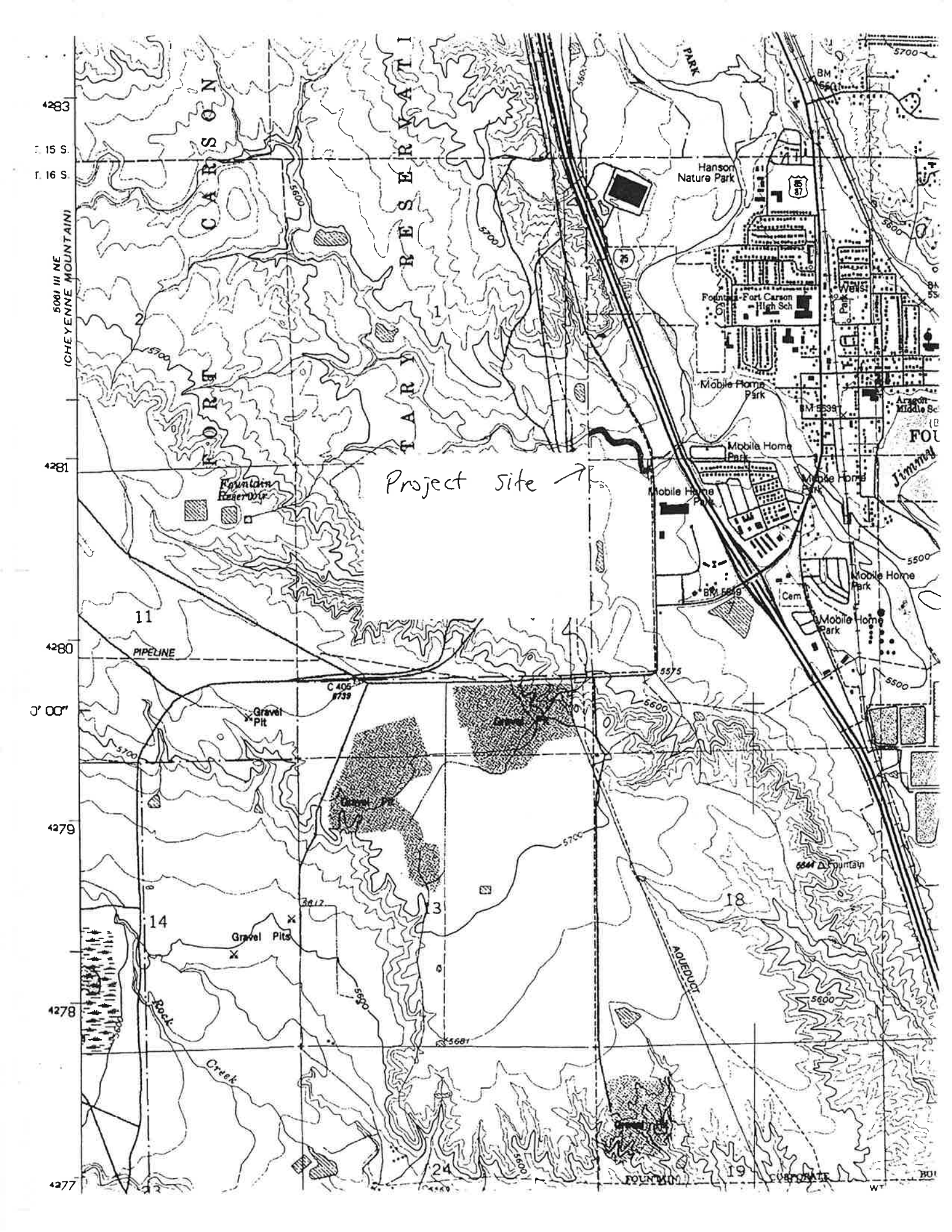
Sincerely,

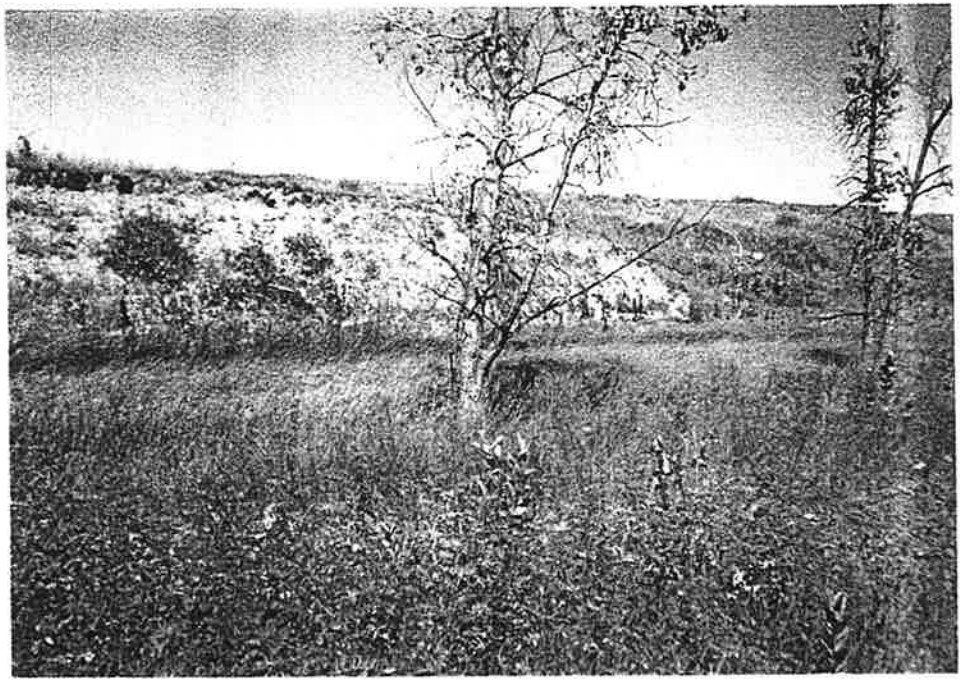
Patrick F. Golden

Patrick Golden
Staff Biologist

attachment

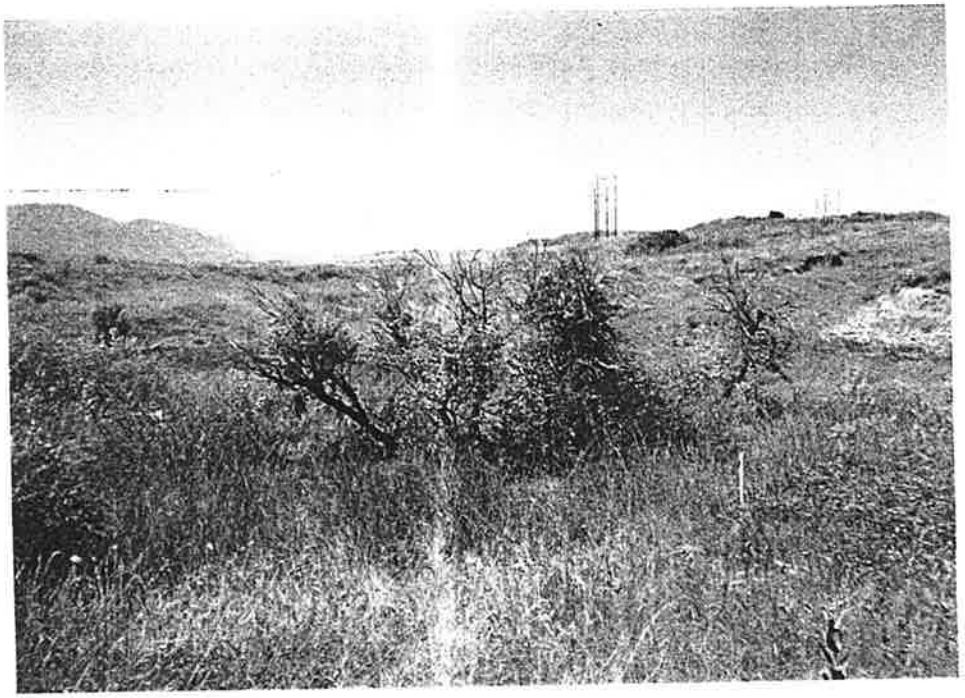
cc Ken Harrison


Project Site
Hanson Nature Park
Fountain-Fort Carson High Sch
Mobile Home Park
Fountain Reservoir
PIPELINE
Gravel Pit
Gravel Pits
Rock Creek
AQUEDUCT
FORT CARSON MILITARY RESERVATION
PARK
Cem
Fountain
5061 III NE
CHEYENNE MOUNTAIN
T. 15 S.
T. 16 S.

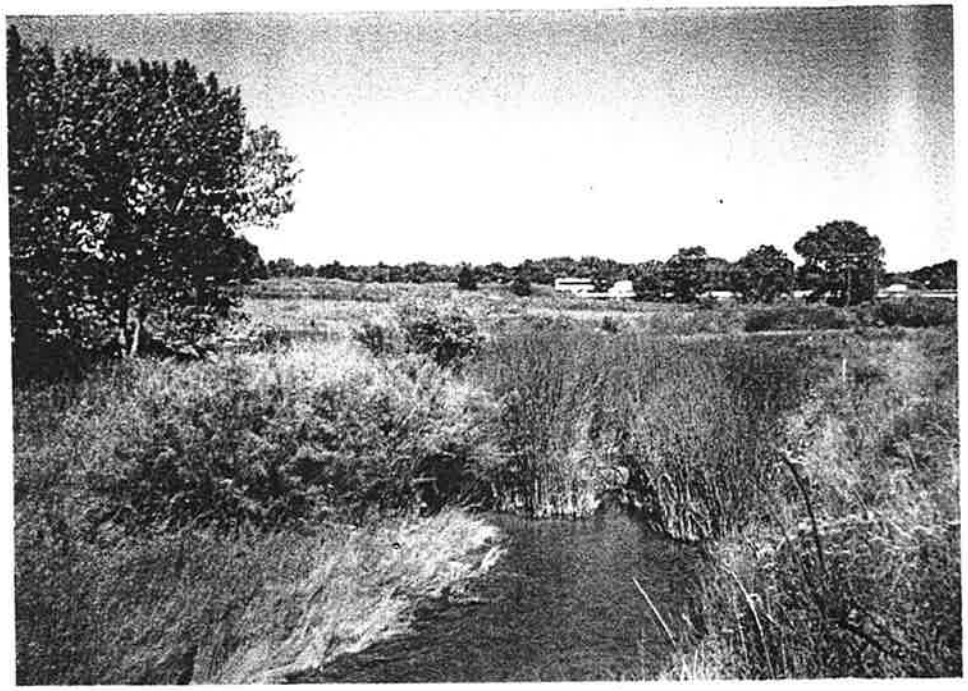


West side of property near Fort Carson

Weedy species in wetland

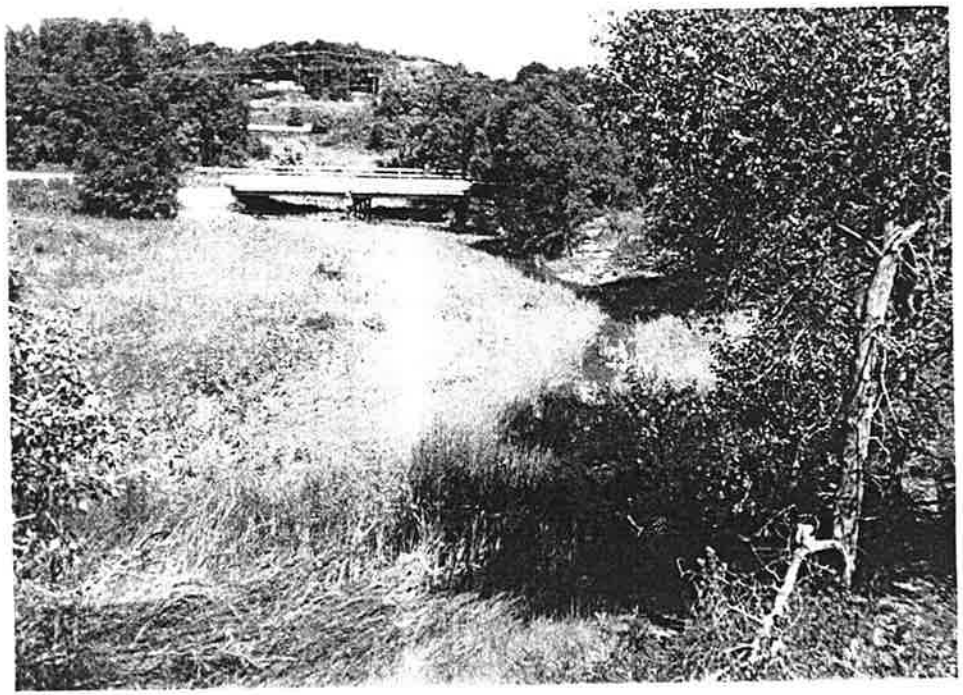


Typical habitat



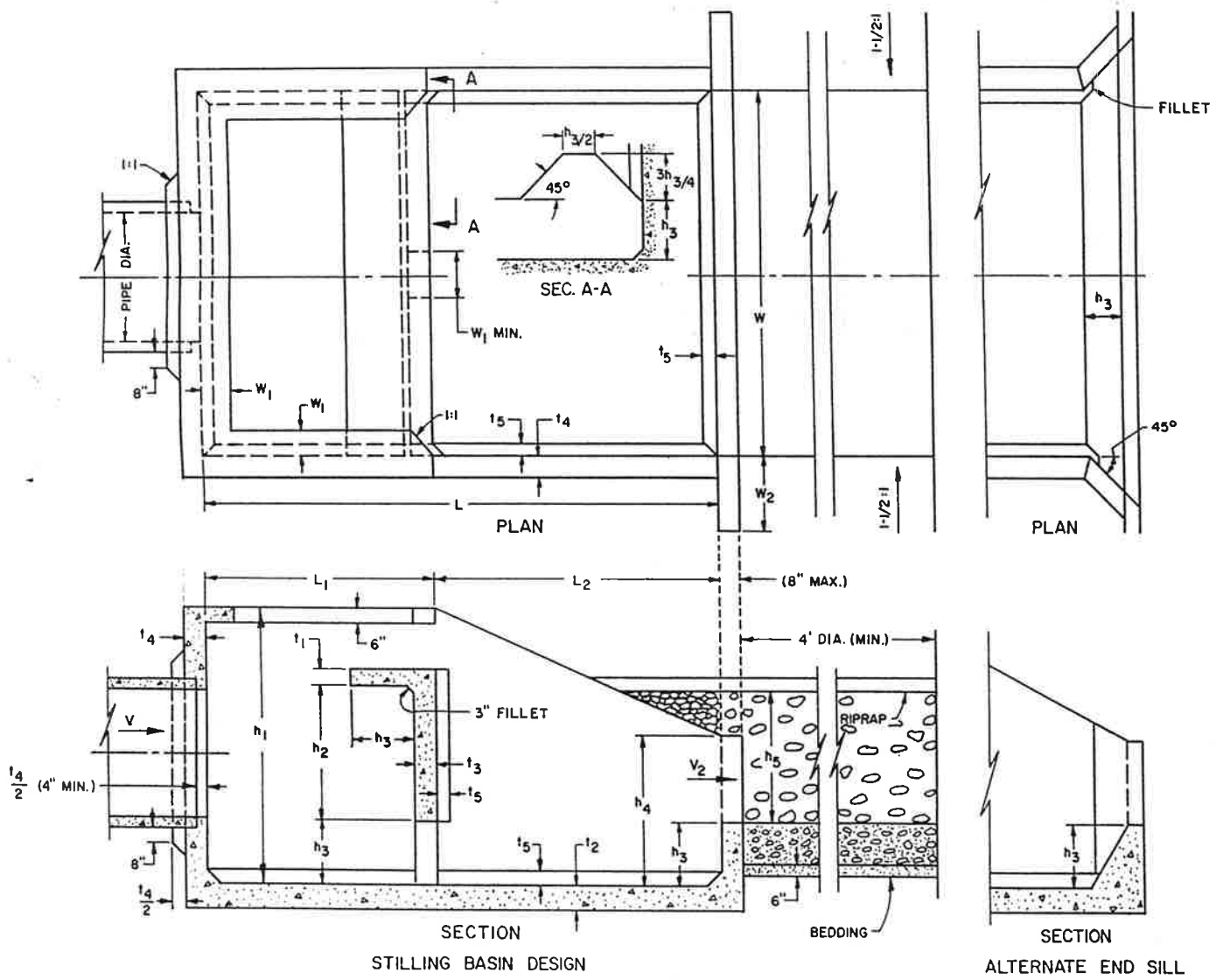
Habitat near Charter Oak Ranch Road

Habitat near Charter Oak Ranch Road



Habitat near Charter Oak Ranch Road

MISCELLANEOUS EXHIBITS

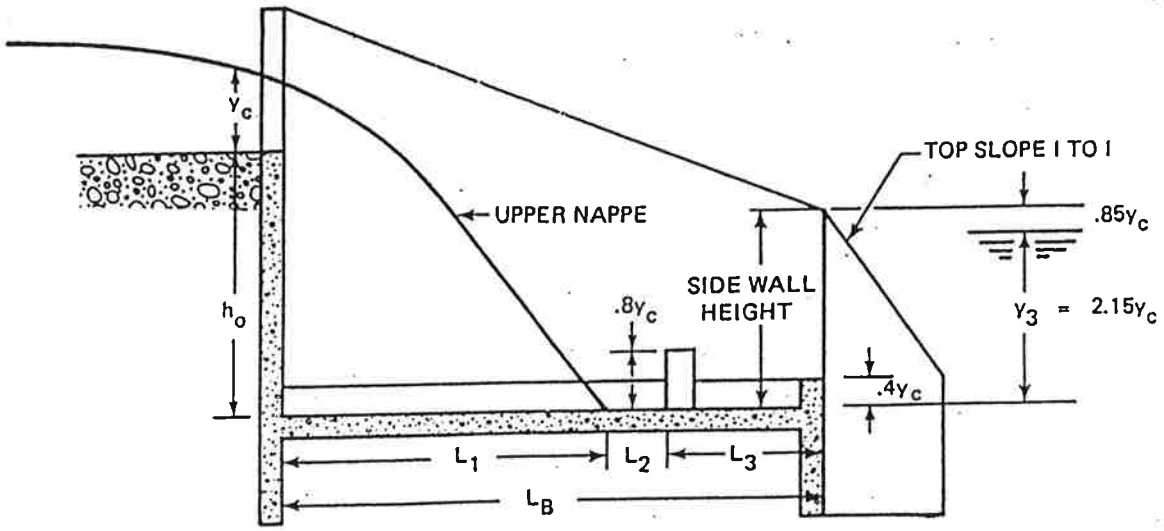


IMPACT ENERGY DISSIPATOR - USBR TYPE VI

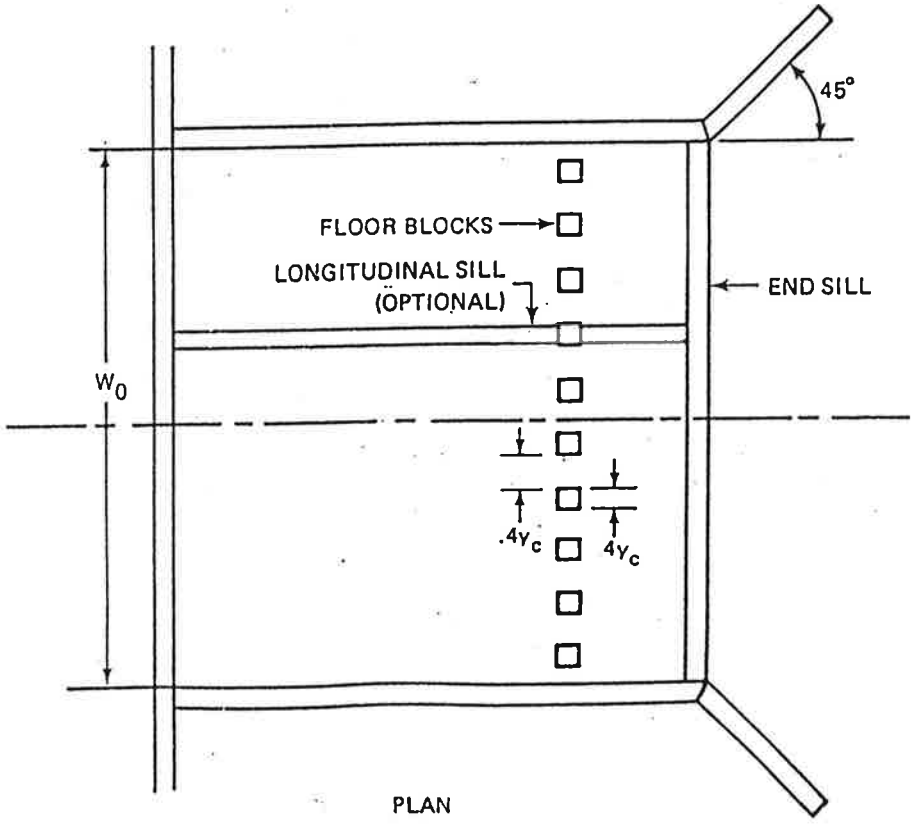
The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date
9-30-90

Figure
10-A.3



SECTION AT CENTER LINE



PLAN

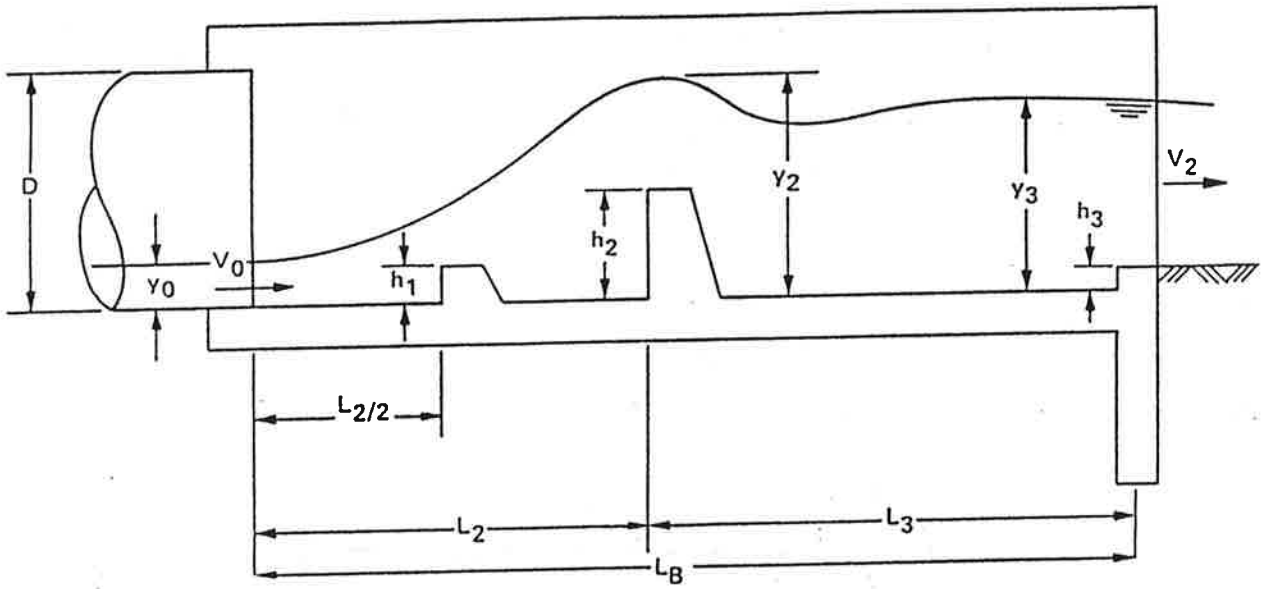
The City of Colorado Springs / El Paso County
Drainage Criteria Manual

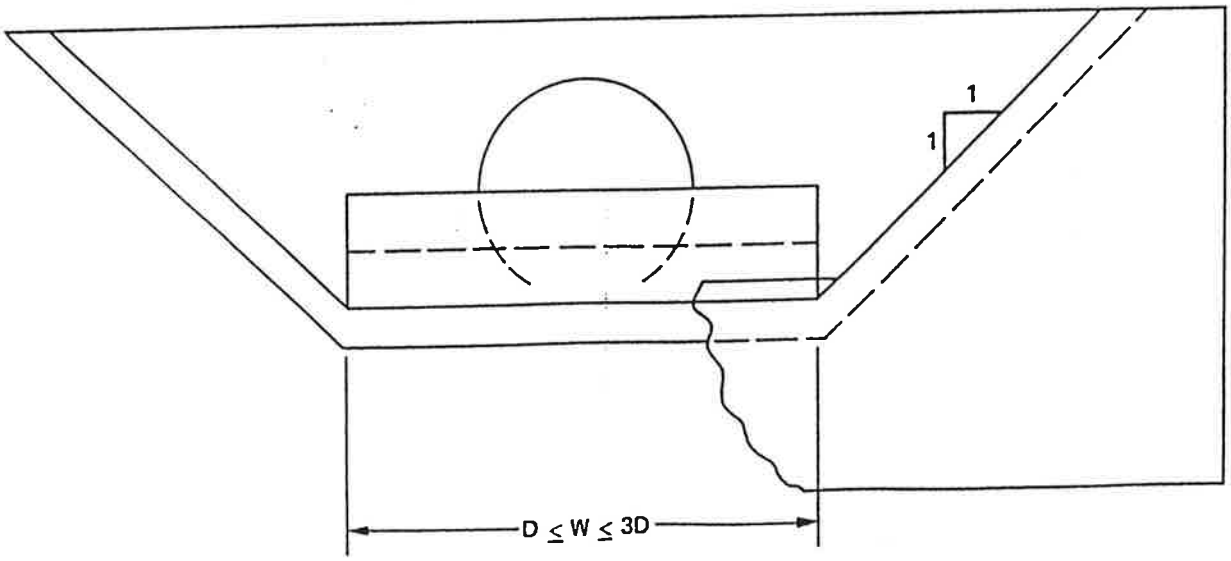
Straight Drop Spillway Stilling Basin

10-58

Date: 9-30-90

Figure: 10-D.3





The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Contra Costa Energy Dissipator - Dimensions

Date: 9-30-90

Figure: 10-8.4

VII-A. C.S.U. RIGID BOUNDARY BASIN

The Colorado State University rigid boundary basin (VII-A-1) which uses staggered rows of roughness elements is illustrated in figure VII-A-1.

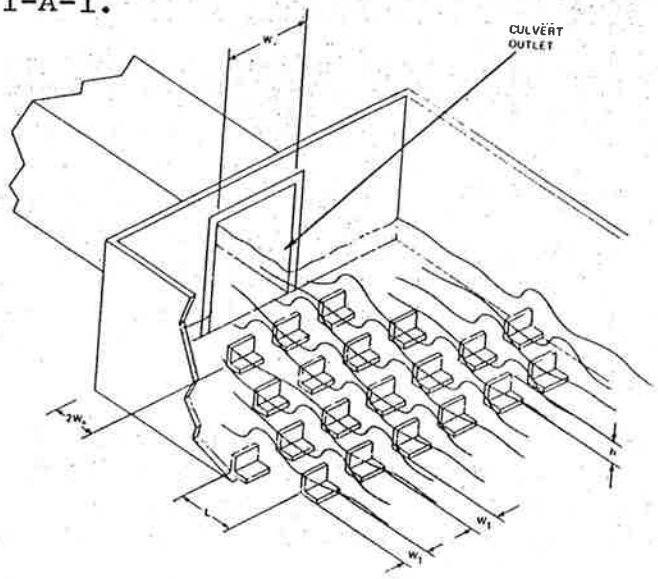
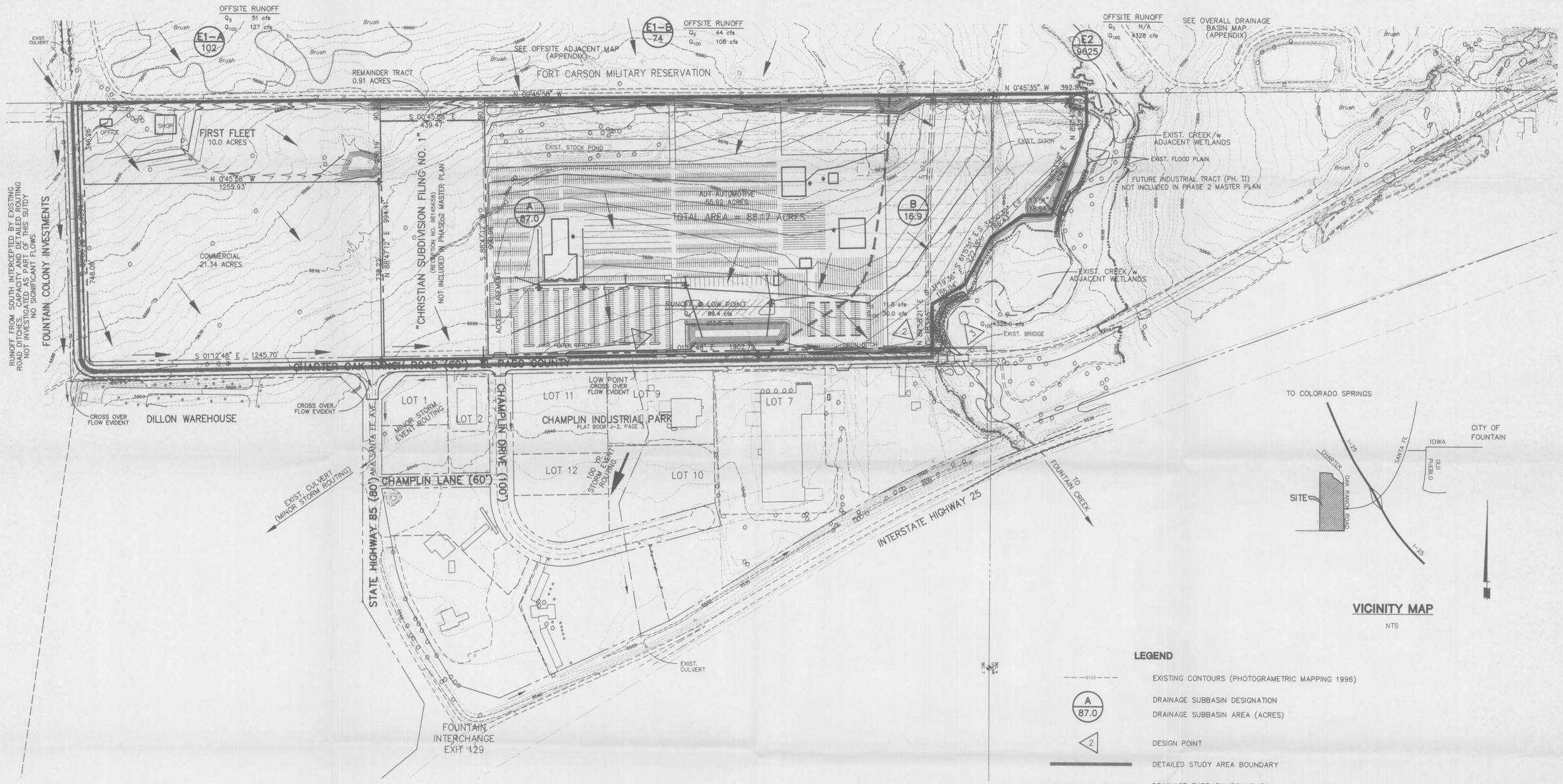


FIGURE VII-A-1. SKETCH OF C.S.U. RIGID BOUNDARY BASIN

CHRISTIAN ANNEXATION PHASE II
HISTORIC DRAINAGE BASIN MAP



VICINITY MAP

NTS

LEGEND

- EXISTING CONTOURS (PHOTOGRAMETRIC MAPPING 1996)
- A / 87.0 — DRAINAGE SUBBASIN DESIGNATION / DRAINAGE SUBBASIN AREA (ACRES)
- 2 — DESIGN POINT
- DETAILED STUDY AREA BOUNDARY
- DRAINAGE SUBBASIN BOUNDARY
- FLOW DIRECTION
- Q_5 43.8 cfs, Q_{100} 102.9 cfs — HISTORIC FLOWS

SCALE IN FEET: 1" = 200'

REVISIONS:

NO.	DATE	DESCRIPTION	BY
1	11/12/99	FINAL REVIEW COMMENTS	RLC

ISSUED FOR FINAL APPROVAL NOV. 12, 1999

SHEET TITLE: HISTORIC DRAINAGE BASIN MAP

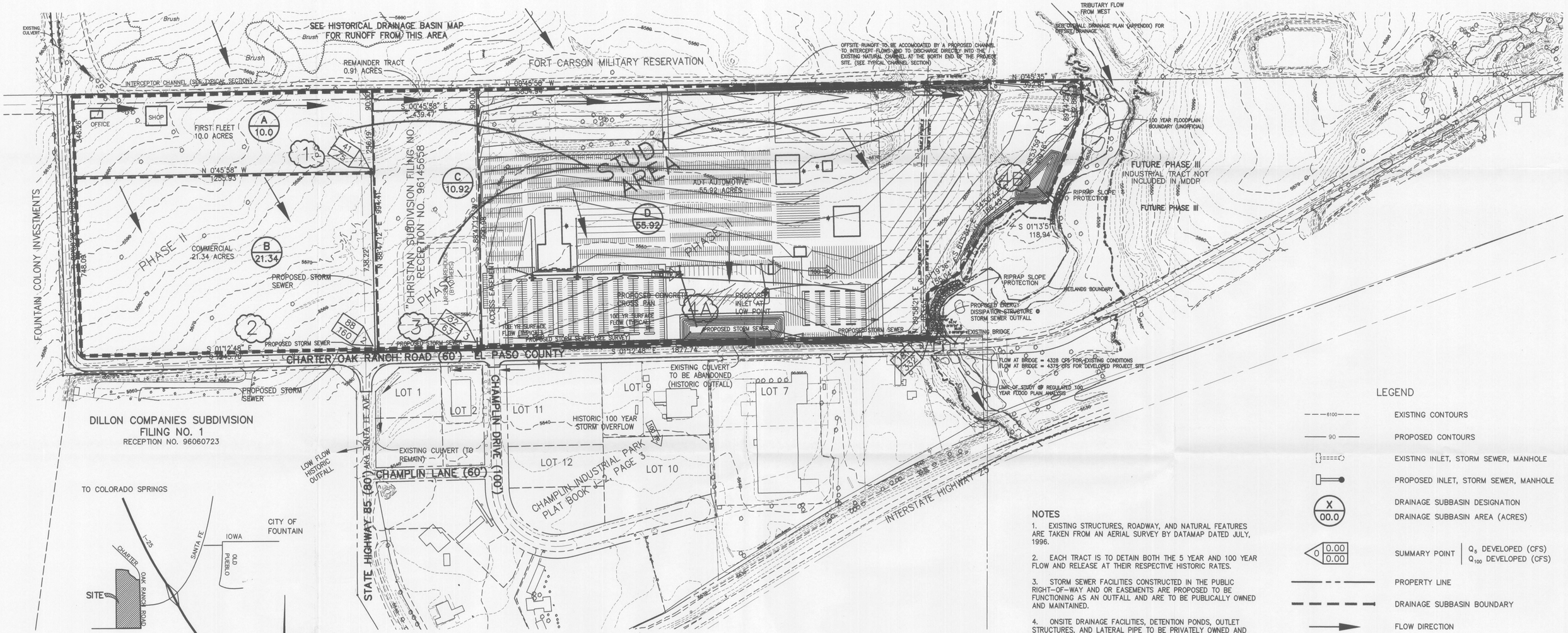
PROJECT: CHRISTIAN ANNEXATION PHASE II

PREPARED BY:
Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-6200

FIELD BOOK NO.	N/A
SCALE:	1" = 200'
DATE:	AUG. 1999
DESIGNED BY:	KCH
CHECKED BY:	TLW/RGO
DRAWN BY:	RLC
PROJECT NO.	99035
SHEET NO.	HD-1
OF 1 SHEETS	

PROJECT NO. 99035 UPDATED VERSION: 11/11/99

CHRISTIAN ANNEXATION - PHASE I & II
MASTER DEVELOPMENT DRAINAGE PLAN



DILLON COMPANIES SUBDIVISION
FILING NO. 1
RECEPTION NO. 96060723

VICINITY MAP

NTS

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- EXISTING INLET, STORM SEWER, MANHOLE
- PROPOSED INLET, STORM SEWER, MANHOLE
- DRAINAGE SUBBASIN DESIGNATION / DRAINAGE SUBBASIN AREA (ACRES)
- SUMMARY POINT | Q_5 DEVELOPED (CFS) / Q_{100} DEVELOPED (CFS)
- PROPERTY LINE
- DRAINAGE SUBBASIN BOUNDARY
- FLOW DIRECTION
- PROPOSED DETENTION POND

NOTES

1. EXISTING STRUCTURES, ROADWAY, AND NATURAL FEATURES ARE TAKEN FROM AN AERIAL SURVEY BY DATAMAP DATED JULY, 1996.
2. EACH TRACT IS TO DETAIN BOTH THE 5 YEAR AND 100 YEAR FLOW AND RELEASE AT THEIR RESPECTIVE HISTORIC RATES.
3. STORM SEWER FACILITIES CONSTRUCTED IN THE PUBLIC RIGHT-OF-WAY AND OR EASEMENTS ARE PROPOSED TO BE FUNCTIONING AS AN OUTFALL AND ARE TO BE PUBLICALLY OWNED AND MAINTAINED.
4. ONSITE DRAINAGE FACILITIES, DETENTION PONDS, OUTLET STRUCTURES, AND LATERAL PIPE TO BE PRIVATELY OWNED AND MAINTAINED. FINAL LOCATION AND SIZE TO BE DETERMINED AT PRELIMINARY DESIGN.
5. ALL DEVELOPED DISCHARGE FROM THE SITE IS TO BE DIRECTED TO THE EXISTING NATURAL CHANNEL LOCATED NORTH OF THE PROJECT SITE. NO FLOW IS TO CROSS CHARTER OAK RANCH ROAD.
6. PUBLIC DRAINAGE FACILITIES ARE SUBJECT TO SUITABLE ASSURANCES FOR CONSTRUCTION AT THE TIME OF PLATTING.

0 100 200 400

SCALE IN FEET: 1" = 200'

RUNOFF SUMMARY

Location	Basin	Existing Runoff					Developed Runoff			
		Tc	C_5	C_{100}	Q_5	Q_{100}	C_5	C_{100}	Q_5	Q_{100}
1	A	30	0.25	0.35	6.0	14.5	0.9	0.95	41.4	75.1
2	B	26	0.30	0.45	16.6	42.7	0.9	0.95	88.3	160.2
3	C	27	0.30	0.45	8.4	21.4	0.9	0.95	32.1	63.3
4	D	37	0.30	0.45	35.2	92.9	0.9	0.95	181.2	332.0
				TOTAL	66.2	171.5		TOTAL	343.0	630.6

DETENTION POND SUMMARY

Location	Basin	5 Year Event		100 Year Event		Approx. Pond Size (ac-ft)
		Q_{in}	Q_{out}	Q_{in}	Q_{out}	
1	A	41.4	6.0	75.1	14.5	1.17
2	B	88.3	16.6	160.2	42.7	1.95
3	C	32.1	8.4	63.3	21.4	0.67
4	D	181.2	35.2	332.0	92.9	6.02

Notes:
Final pond sizes are to be determined upon completion of final grading plan and final location of pond.

STORM SEWER SUMMARY

Detention Alternative

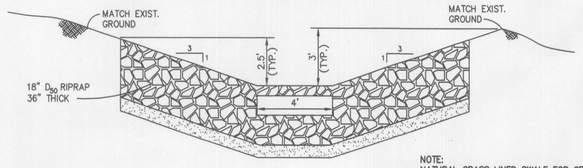
Location	Qdes max (cfs)	Pipe Dia. (in)	Min. Slope (%)	Velocity (fps)	Capacity (cfs)
1-2	14.5	18	1.5	7	15
Stub @ 2	57.2	36	1.0	10	70
2-3	57.2	36	1.0	10	70
3-Low Pt.	78.6	42	0.8	9	90
Low Pt.-4		48	0.8	11	140
Outfall Pipe	171.5	48	1.3	12	180

Notes:
Storm sewer is sized to accommodate the 100 year historic discharge from the individual tracts. Pond facilities are assumed to be located at the NE corner of each interior tract.

Non-Detention Alternative

Location	Qdes max (cfs)	Pipe Dia. (in)	Min. Slope (%)	Velocity (fps)	Capacity (cfs)
1-2	41.4	30	1	8	45
Stub @ 2	88.3	42	0.8	9	90
2-3	129.7	48	0.9	10	140
3-Low Pt.	161.8 to 343.0	48 to 72	1.2 to 1.0	10 to 12	170 to 213
Low Pt.-4		54 to 72	1	13 to 12	213 to 350
Outfall Pipe	343.0	72	1	12	350

Notes:
Storm sewer is sized to accommodate the 5 year developed discharge from the individual tracts. Excess flow from the 100 year storm is to be directed to the existing channel via surface swales.



NOTE:
NATURAL GRASS LINED SWALE FOR GRADES UP TO 1.00%. ROCK RIPRAP (SHOWN) FOR GRADES GREATER THAN 1.00%.

TYPICAL CHANNEL SECTION ALONG FORT CARSON MILITARY RESERVATION BOUNDARY

SCALE: 1" = 4'

ISSUED FOR FINAL APPROVAL NOV. 12, 1999

NO.	DATE	REVISION	BY
3	11-12-99	ISSUED FOR APPROVAL	RGO/RLC
2	10-14-99	REVISED PER FINAL CITY COMMENTS	RGO/VPT
1	8/27/99	REVISED PER REVIEW COMMENTS	RLC/KCH/RGO

SHEET TITLE: CHRISTIAN ANNEXATION MASTER DEVELOPMENT DRAINAGE PLAN

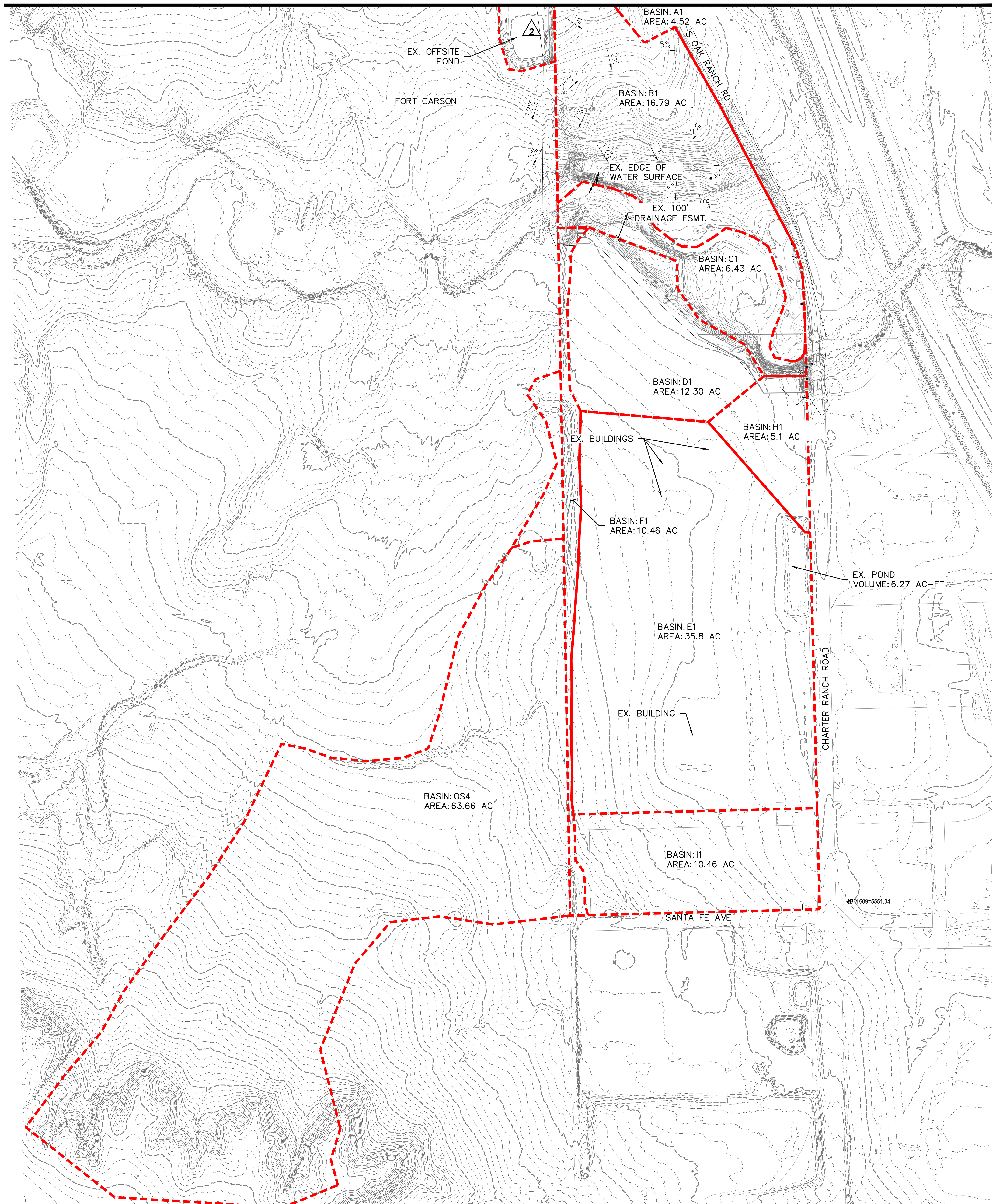
PROJECT: PHASE I AND II FOUNTAIN, COLORADO

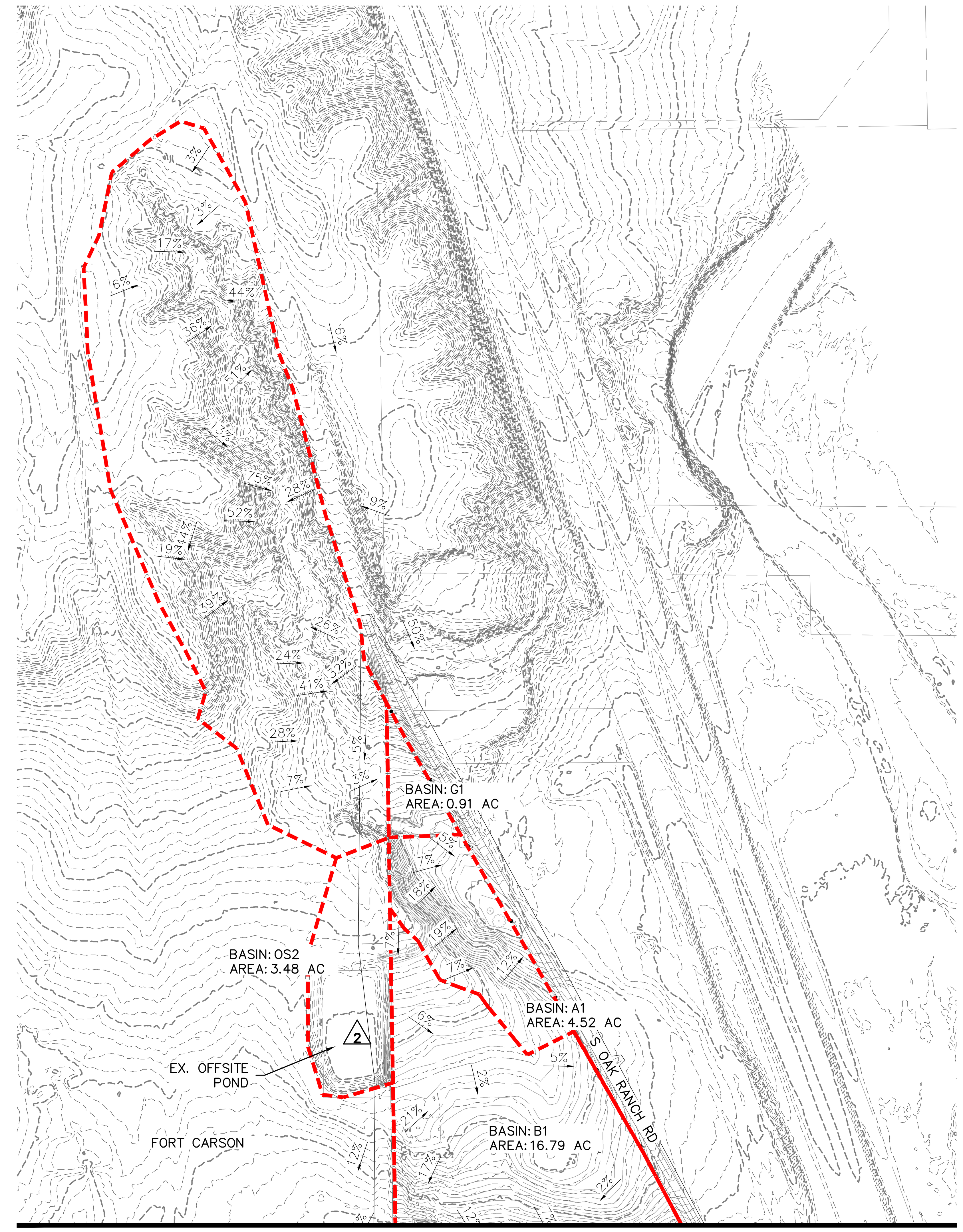
PREPARED BY:
Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-6200

FIELD BOOK NO.: N/A
SCALE: 1" = 200'
DATE: AUG. 1999
DESIGNED BY: KCH
CHECKED BY: TLW/RGO
DRAWN BY: RLC
PROJECT NO.: 99035
SHEET NO.: MP-1
OF 1 SHEETS

APPENDIX F
DRAINAGE MAPS

SEE RIGHT





SEE LEFT

Existing Conditions Drainage Basin Summary					
Basin	Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
G1	0.91	0.02	0.15	0.04	0.72
A1	4.52	0.02	0.15	0.18	3.11
B1	16.79	0.08	0.50	2.36	34.13
C1	6.43	0.03	0.45	0.36	10.64
D1	12.30	0.81	0.87	35.50	82.56
E1	35.80	0.81	0.87	103.34	240.29
F1	10.46	0.03	0.45	0.38	11.40
H1	5.1	0.81	0.87	15.34	35.67
I1	10.46	0.03	0.45	1.16	34.44
OS1	23.24	0.02	0.02	0.68	11.76
OS2	3.48	0.08	0.15	0.76	10.95
OS3	1.57	0.08	0.5	0.29	4.14
OS4	63.66	0.08	0.5	8.16	118.04

N

250 125 0 250 500
GRAPHIC SCALE
1" = 250'

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NOTICE

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24 HOUR EMERGENCY CONTACT

ATWELL
866.850.4200 www.atwell.com
4900 N SCOTTSDALE RD, SUITE 1600
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(480) 218-8831
COA# 16251

S6, T16S, R65W
S CHARTER OAK RANCH RD
FOUNTAIN
EL PASO COUNTY, COLORADO

PROPOSED CARVANA/ADESA EXPANSION LOT

EXISTING DRAINAGE MAP

A.P.N.# 5606000037 & 5606000037

CARVANA
300 E. RIO SALADO PKWY. BLDG. 1
TEMPE, ARIZONA 85281

DATE 4/23/2026

REVISIONS

N.T.S.

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CHECKED BY: LMS
PROJECT MANAGER: BH
JOB #: 25010228
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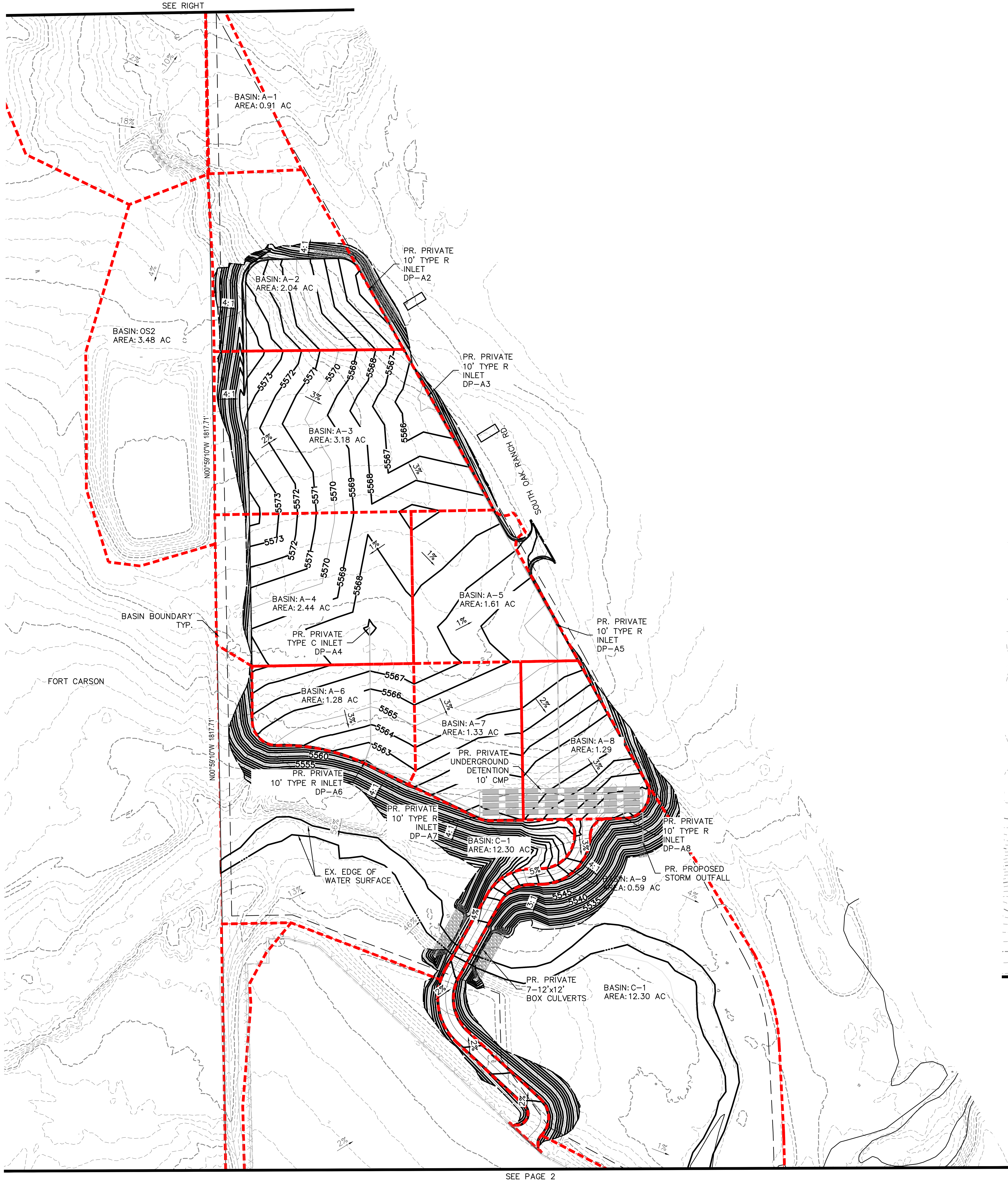

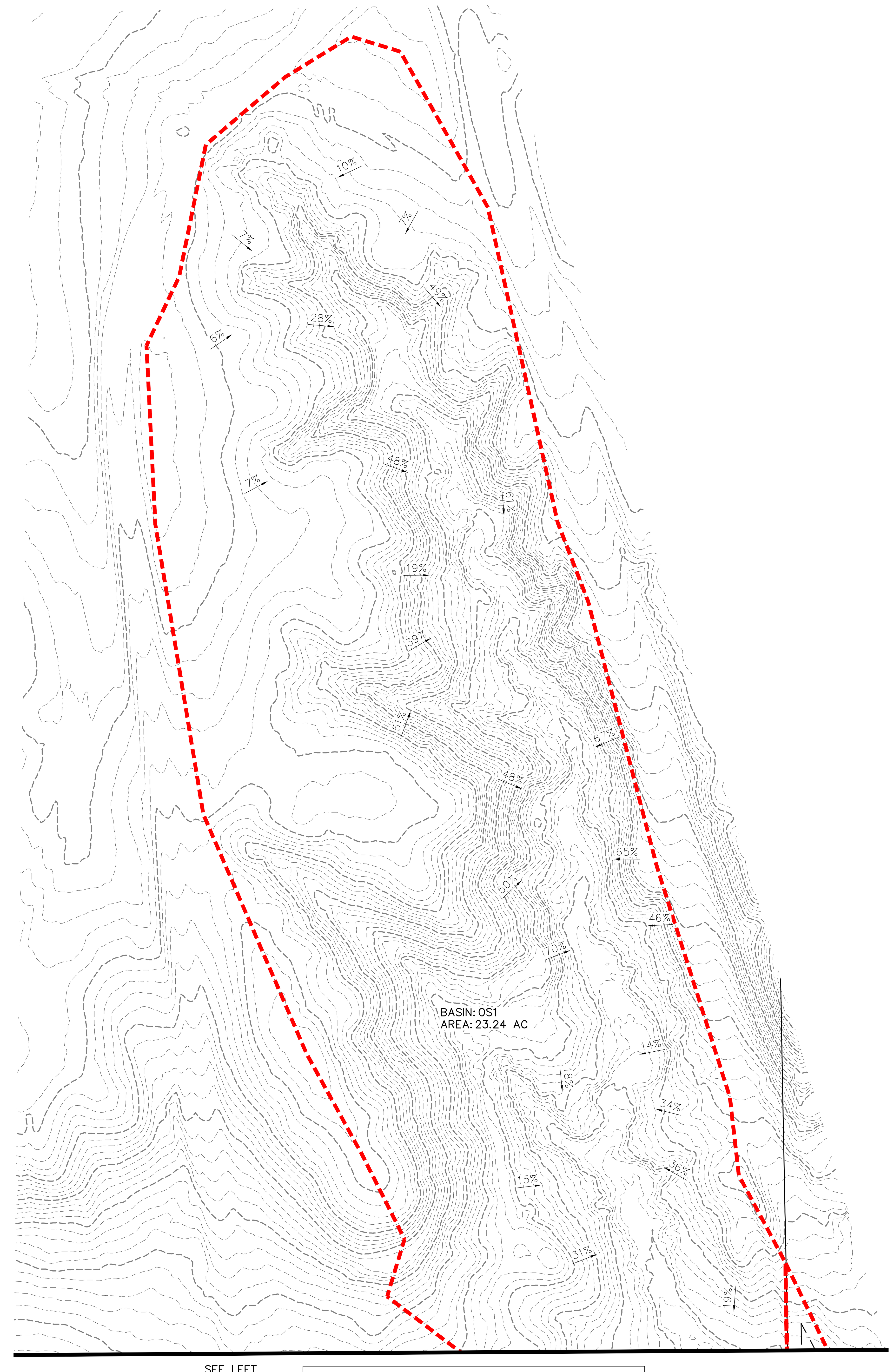

Proposed Conditions Drainage Basin Summary						
Basin	Design Point	Area (acres)	C_5	C_{100}	Q_5 (cfs)	Q_{100} (cfs)
A1	A1	0.91	0.02	0.15	0.04	0.72
A2	A2	2.04	0.51	0.59	3.05	7.80
A3	A3	3.18	0.81	0.87	9.80	22.94
A4	A4	2.44	0.81	0.87	7.86	18.41
A5	A5	1.61	0.81	0.87	4.96	11.61
A6	A6	1.28	0.81	0.87	4.15	9.71
A7	A7	1.33	0.81	0.87	4.38	10.25
A8	A8	1.29	0.81	0.87	3.74	8.75
A9	A9	0.59	0.81	0.87	2.07	4.85
C1	C	12.30	0.03	0.45	0.87	25.81
D1	D	12.3	0.81	0.87	35.5	82.56
E1	E	35.8	0.81	0.87	103.34	240.29
F1	F	10.46	0.03	0.45	0.38	11.4
H1	H	5.1	0.81	0.87	15.34	35.67
I1	I	10.46	0.03	0.45	1.16	34.44

GRAPHIC SCALE
1" = 100'

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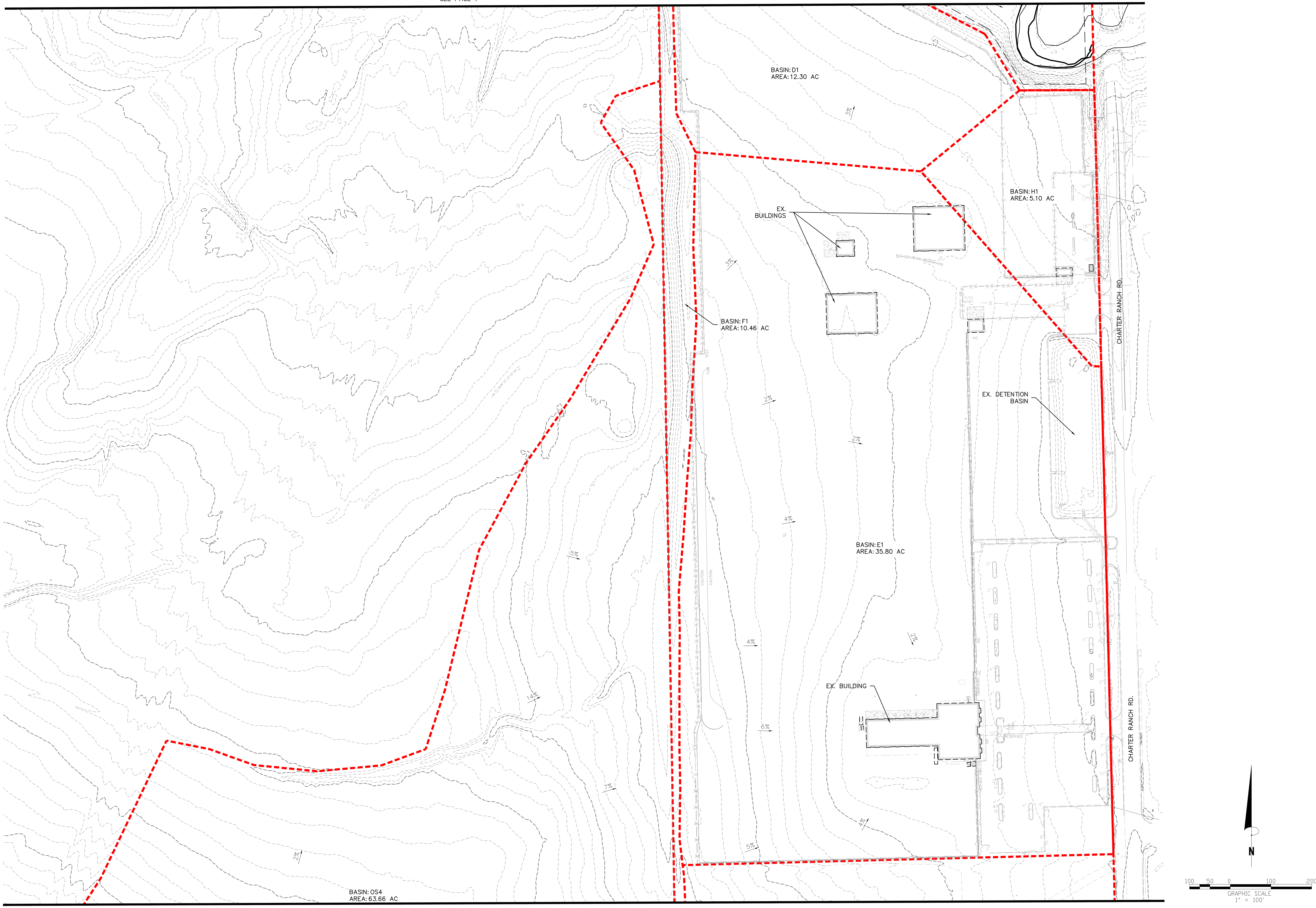

SEE PAGE 3

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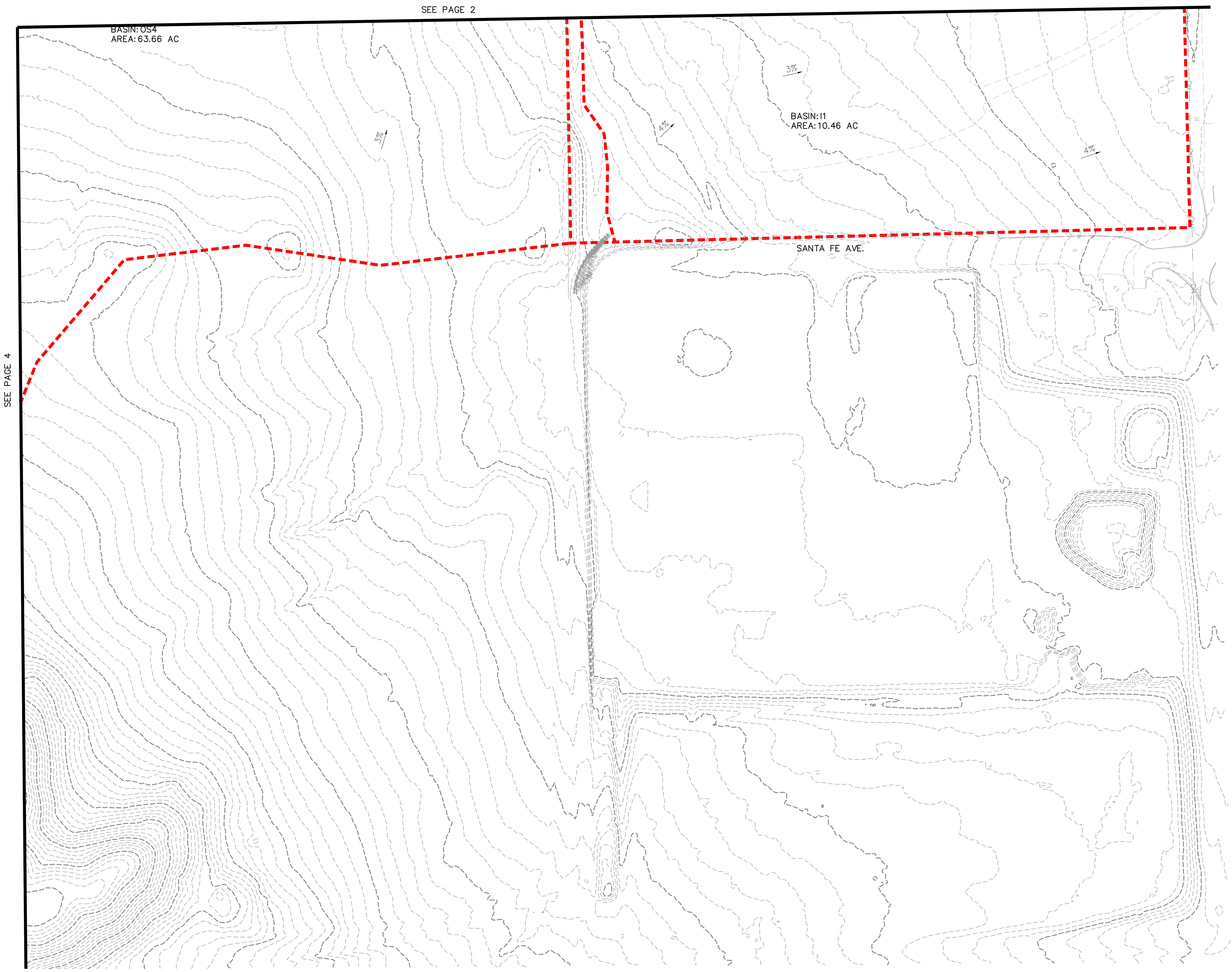

100 50 0 100 200
GRAPHIC SCALE
1" = 100'

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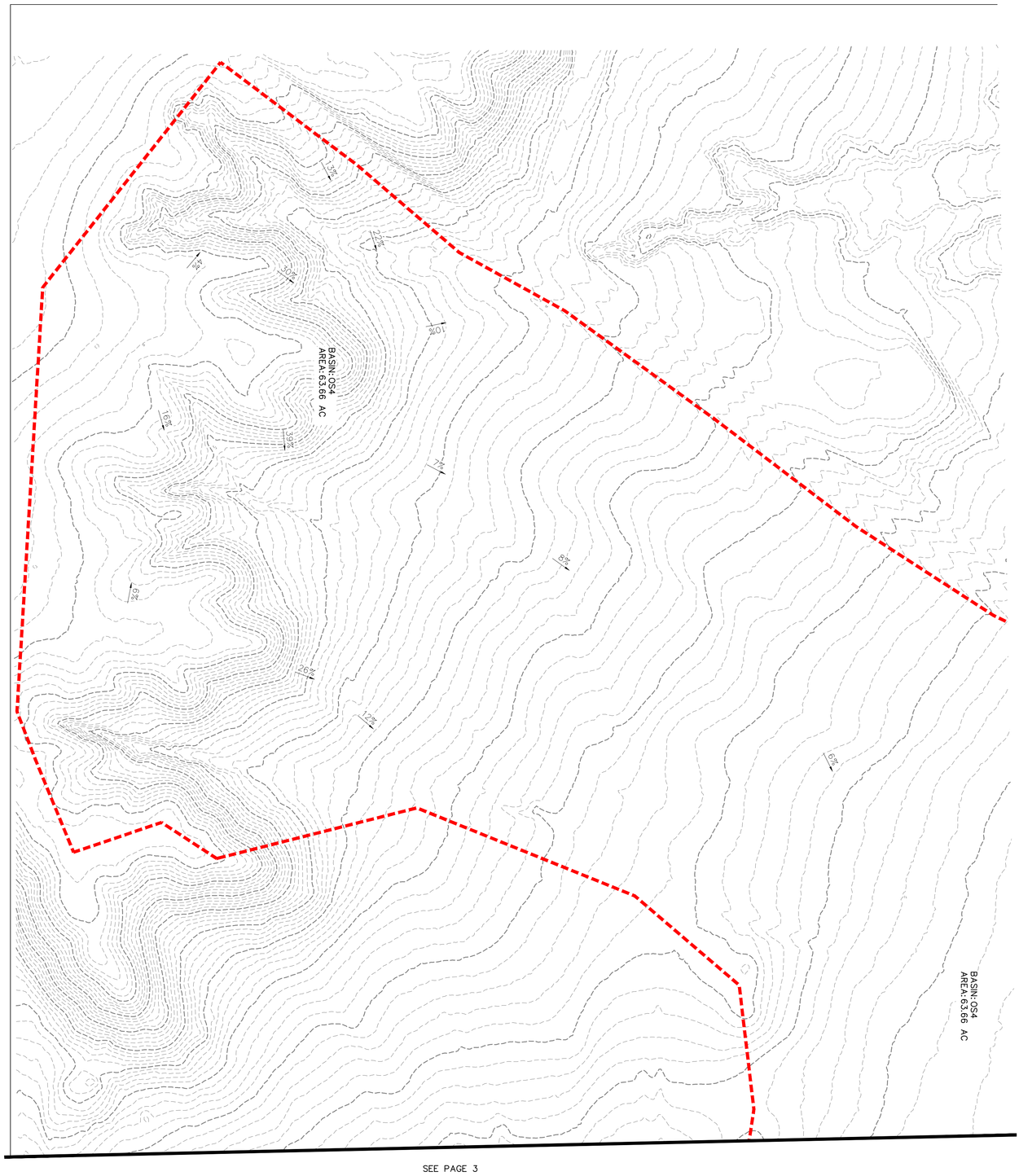

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