FINAL DRAINAGE REPORT
FOR
STERLING RANCH FILING NO. 2

Prepared For:
SR Land, LLC
20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

See comment letter also.

May 2020
Project No. 25188.01

Prepared By:
JR Engineering, LLC
5475 Tech Center Drive
Colorado Springs, CO 80919
719-593-2593

SF-20-015

PCD File No. SF-1820

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

____________________________________ ______________________
Mike Bramlett, Colorado P.E. # 32314 Date
For and On Behalf of JR Engineering, LLC

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

Business Name: SR Land, LLC

By: ______________________________

Title: ______________________________
Address: 20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

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

____________________________________ ______________________
Jennifer Irvine, P.E. Date
County Engineer/ ECM Administrator

Conditions:

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PURPOSE

This document is the Final Drainage Report for Sterling Ranch Filing No.2. The purpose of this document is to identify and analyze the on and offsite drainage patterns and to ensure that post development runoff is routed through the site safely and in a manner that satisfies the requirements set forth by the El Paso County Drainage Criteria Manual. The following report is an analysis of the drainage for the entire development and surrounding areas.

GENERAL LOCATION AND DESCRIPTION

Location

Sterling Ranch Filing No. 2 is located in Section 32, Township 12 South, Range 65 West of the 6th Principal Meridian, Section 33, Township 12 South, Range 65 West of the 6th Principal Meridian and Section 4, Township 13 South, Range 65 West of the 6th Principal Meridian within unincorporated El Paso County, Colorado. The site is bound on the west by existing Vollmer Road. The site is bound on the north by the Barbarick Subdivision. The property is bound to the east by the Sterling Ranch Phase 2 and Vollmer Road to the west. The site is bound on the south by Sterling Ranch Road and Marksheffel Road. Sterling Ranch lies within the Sand Creek Drainage Basin. Flows from this site are tributary to Sand Creek.

Description of Property

verify with updated plat

Sterling Ranch Filing No. 2 consists of 49.643 acres and is presently undeveloped. Vegetation is sparse, consisting of native grasses. Existing site terrain generally slopes from north to south at grade rates that vary between 2% and 8%.

Sterling Ranch Filing No. 2 is currently zoned "RS-5000" for residential single family development. Improvements proposed for the site include paved, streets, trails, utilities, and storm drainage improvements, drainage swales, and detention ponds as normally constructed for a residential development. Two full spectrum detention facilities are proposed to be constructed to provide water quality treatment and detain stormwater for the development. The proposed water quality and detention facilities will also be designed to incorporate the Sterling Ranch Phase 2 and Copper Chase at Sterling Ranch developments as well as other offsite areas. Approximately 174 acres are tributary to Pond W5 which includes all 49 acres of Sterling Ranch Filing No. 2. Approximately 350.74 acres of offsite area are tributary to Pond W-4.

Soils for this project are classified as Blakeland Loamy Sand (8), Flakeland-Fluvaquentic Haplaquolis (9) and Columbine Gravelly Sandy Loam (19). These soils are characterized as Hydrologic Soil Types "A". Group A soils exhibit high infiltration rates when thoroughly wet, and consist mainly of deep, well drained to excessively drained sands or gravelly sands. Pring Coarse Sandy Loam (71) is characterized as Hydrologic Soil Types "B". Group B soils exhibit moderate infiltration rate when thoroughly wet, and consist primarily of deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. A soil map of the site can be found in Appendix A.

provide total disturbed for all platted/constructed filings including Filing 2

and 2

will be

has been?

Wetlands

Sterling Ranch was authorized under Section 404 of the Clean Water Act to discharge dredged and fill materials into waters of the United States to conduct work associated with construction of Sterling Ranch Residential Development in accordance with Action Number SPA-2015-00428-SCO. A copy of the permit is within the Appendix of this report. For the construction of Sterling Ranch Filing No. 1, ~2950 square feet of wetlands will be displaced and mitigated. The disturbance areas are located within the general area of Pond W5 and Pond W4, which outfall into the Sand Creek Channel. A mitigation area is designated on the construction drawings. Coordination with the wetlands consultant and the Army Corp of Engineers will be in conformance with the wetland permit. No other construction associated with Sterling Ranch Filing No. 1 will disturb the existing wetlands. Sterling Ranch Filing No. 2 will have significant wetland disturbance. The area(s) of mitigation are shown on the construction drawings and are also included in this report. The memo and map from Core Consultants showing intent to have wetlands delineated in the Filing No. 2 areas of wetland disturbance and mitigation can be found in the appendix.

Floodplain Statement

Based on the FEMA FIRM Maps number 08041C0533G, dated December 7, 2018, a portion of the project site that is adjacent to the existing drainageway lies within Zone AE. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. The majority of the proposed development lies within Zone X. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. No grading operations are proposed within the Zone AE at this time. FIRM Maps have been presented in Appendix A.

Drainage Basins and Sub-basins

Existing Major Basin Descriptions

The Sterling Ranch Filing No. 2 site consists of 49.643 acres and is located in the Sand Creek Drainage Basin. This area was previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Corporation, revised March 1996. More recently the area was studied in the "Preliminary Drainage Report for Sterling Ranch-Phase 1", dated May 2015, by M&S Civil Consultants, Inc.

Address MDDP

The Sand Creek DBPS assumed the Sterling Ranch property to have a "large lot residential" use for the majority of the site. However, the proposed master plan is a mix of; school, multi-family, single-family, and commercial land uses, resulting in higher runoff. The site generally drains from north to south consisting of rolling hills. Currently, the site is used as pasture land for cattle. Sand Creek is located east of the site running north to south. This reach of drainage conveyance is not currently improved. There are a few stock ponds within the creek channel used for cattle watering.

Phase 2?

existing

A planned subdivision to the north of the proposed site known as Barbarick Subdivision will release flows onto the Sterling Ranch Filing No. 2 site. These flows are collected by detention ponds and are released at the north property line of the proposed Sterling Ranch Filing No. 2 site. See "Final Drainage Report for Barbarick Subdivision, Portions of Lots 1, 2 and Lots 3 & 4, by Matrix Design Group, June 2016". These offsite flows have been accounted for in order to ensure the proposed storm sewer infrastructure will have adequate capacity. If future offsite development occurs upstream of Sterling Ranch from the west, the properties will be required to detain to historic/ existing conditions per the County / City drainage criteria. A proposed drainage map showing these offsite basins can be found in Appendix E.

The following drainage basin narratives are based on information derived from field visits, USGS topographic mapping, aerial topography, field surveys and information provided by others familiar with the site. A "sheet flow" verses "concentrated ditch flow" designation was determined as best as possible from the available source topography, actual conditions may vary. A summary of peak runoff for the basins and designated design points are depicted on the Existing Conditions Drainage Map in the appendix.

Existing Sub-basin Drainage

Basin EXA1 (Q_5=7.2 cfs, Q_{100}=12.1 cfs) is 17.68 acres and is primarily open space and the existing Vollmer road. Runoff from this basin drains to the south east to DP 1 where it ultimately outfalls into the Sand Creek Drainageway.

Basin EXA2 (Q_5=5.4 cfs, Q_{100}=9.0 cfs) is 19.59 acres and is primarily open space and the existing Vollmer Road. Runoff from this basin drains to the south east to DP 2. Runoff is captured by an existing swale at DP 4.1 where it is conveyed to the Sand Creek Drainageway.

(Sand Creek tributary reach 159?)

Basin EXA3 (Q_5=1.4 cfs, Q_{100}=2.3 cfs) is 5.66 acres and is primarily open space. Runoff from this basin drains south to DP 3 where it ultimately outfalls into the Sand Creek Drainageway.

Basin EXA4 (Q_5=10.6 cfs, Q_{100}=17.8 cfs) is 50.72 and is primarily open space. Runoff from this basin drains to the south to DP 4. Runoff is then captured by an existing swale at DP 4.1 where it is conveyed to the Sand Creek Drainageway.

Basin EXB (Q_5=3.0 cfs, Q_{100}=5.0 cfs) is 11.78 acres and is comprised of open space and a portion of Sand Creek along the eastern most portion of the Sterling Ranch Filing No. 2 site. Runoff from this basin drains into Sand Creek.

Basin OS1 (Q_5=23.9 cfs, Q_{100}=40.1 cfs) is 23.82 acres and is located just north of the site. Flows from this sub-basin flow directly onto basin A4. Runoff from this sub-basin eventually flow to the existing swale at DP 4.1 where it is conveyed into Sand Creek.

EX

Basin OS2 (Q_5=37.3 cfs, Q_{100}=62.6 cfs) is comprised of 85.59 acres. Flows from this sub-basin flow directly onto basin A4. Runoff from this sub-basin eventually flow to the existing swale at DP 4.1 where it is conveyed into Sand Creek.

Basin OS3 (Q_5=1.8 cfs, Q_{100}=3.1 cfs) is 6.66 acres and is located just north of the site. Flows from this sub-basin flow directly onto basin A4. Runoff from this sub-basin eventually flow to the existing swale at DP 4.1 where it is conveyed into Sand Creek.

Basin OS4 (Q_5=0.5 cfs, Q_{100}=0.9 cfs) is 2.19 acres is comprised of open space just north of the site. Runoff from this basin drains south directly onto Basin B1 where it outfalls directly into Sand Creek.

Basin OS5 (Q_5=7.5 cfs, Q_{100}=23.4 cfs) is 9.27 acres and is comprised of existing single family residential. Runoff from this site drains southwest onto basin A4 where it eventually flows to the existing swale at DP 4.1. From here, it is conveyed south into Sand Creek.

Address OS20, OS21A and OS21B and address DPBS and MDDP flows.

Proposed Sub-basin Drainage

The following is a description of the offsite and onsite basins, offsite bypass flows and the overall future drainage characteristics for the development of Sterling Ranch Filing No. 2. Ponds W4 and W5 are sized for the ultimate development, therefore, future developments have been included. As the future sites develop, final drainage reports will be completed to confirm the assumptions made in this report. Calculations have been provided to show the proposed storm infrastructure will adequately convey flows in the ultimate condition. The following basins parameters and developed runoff were determined using the Rational Method. Surface flow is designated as design points with whole numbers (1) and storm sewer routing as design points with decimals (1.0). See Appendix B for all Rational Method calculations and storm water routing.

Basin A consists of Sub-Basins A1-A22 combining for a total of 123.19 acres. This basin represents all 49.643 acres of the proposed Sterling Ranch Filing 2 development. This basin is primarily single-family residential, roadway and minor open space. This basin also contains future commercial sites, the future Sterling Ranch Phase 2 development, the proposed Copper Chase at Sterling Ranch Development and a proposed school site. Stormwater runoff is conveyed via public streets where it is captured via a series of on-grade and sump inlets. Runoff is then piped to a proposed onsite Full Spectrum Detention Pond W5. From the detention pond, the treated flows are then released directly into the Sand Creek Drainageway at below historic rates.

Sub-basin A1 (Q_5=4.4 cfs, Q_{100}=9.4 cfs) consists of approximately 2.06 acres and is the northern most portion of the Sterling Ranch Filing No. 2 Phase 1 development. This basin is primarily single-family residential and minor open space. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter then captured by a 10' on-grade inlet at DP 1. From here, the flow is piped to Pond W5.

Sub-basin A2 (Q_5=1.9 cfs, Q_{100}=3.9 cfs) consists of approximately 0.82 acres and is the north eastern most portion of the Sterling Ranch Filing No. 2 Phase 1 development. This basin is primarily multifamily residential and minor open space. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter then captured by a 10' Type R on-grade inlet at DP 2. From here, the flow is piped to Pond W5.

Sub-basin A3 (Q_5=11.1 cfs, Q_{100}=24.7 cfs) consists of approximately 6.76 acres and is the north western most portion of the Sterling Ranch Filing No. 2 Phase 1 development. This basin is primarily single-family residential and minor open space. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type-R on-grade inlet at DP 3. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1 & A2.

Sub-basin A4 (Q_5=3.7 cfs, Q_{100}=7.4 cfs) consists of approximately 1.51 acres and is the southern portion of Alzada Drive and this basin is primarily single-family residential(Copper Chase at Sterling Ranch) and proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 10' Type-R on-grade inlet at DP 4. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A3.

Sub-basin A5 (Q_5=4.1 cfs, Q_{100}=8.3 cfs) consists of approximately 1.70 acres and is the western portion of Bynum Drive. This basin is primarily single-family residential and proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R on-grade inlet at DP 5. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A4.

mail kiosks, parking, landscaping, sidewalks

Sub-basin A6A (Q_5=2.2 cfs, Q_{100}=4.1 cfs) consists of approximately 0.53 acres. This basin will serve as a commercial tract. Runoff from this sub-basin will sheet flow to DP 6A where it flows via curb and gutter to the 15' Type R inlet at DP6. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A5.

Sub-basin A6 (Q_5=3.3 cfs, Q_{100}=6.6 cfs) consists of approximately 1.37 acres and is the eastern portion of Bynum Drive. This basin is primarily single-family residential and proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R inlet on-grade inlet at DP 6. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A6A.

Sub-basin A7 (Q_5=27.5 cfs, Q_{100}=60.6 cfs) represents the future Copper Chase at Sterling Ranch development and consists of approximately 19.00 acres. This basin is primarily single-family residential and open space. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 36" RCP storm sewer stub at DP 7. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A6. Prior to being developed, storm runoff from this sub-basin will overland flow to temporary swales, where the flows will be captured by an interim 36" FES and piped to Pond W5.

with sediment control structure

Sub-basin A8 (Q_5=3.0 cfs, Q_{100}=6.3 cfs) consists of approximately 1.48 acres and is the south western portion of Sterling Ranch Road. This basin is primarily single-family residential and proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R on-grade inlet at DP 8. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A7.

Sub-basin A9 (Q_5=1.9 cfs, Q_{100}=3.7 cfs) consists of approximately 0.61acres and is the south eastern portion of Sterling Ranch Road. This basin is comprised primarily of the proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R on-grade inlet at DP 9. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A8.

Sub-basin A10 (Q_5=9.2 cfs, Q_{100}=17.3 cfs) consists of approximately 2.61 acres and is the south western portion of Marksheffel Road. This basin is comprised primarily of the proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R on-grade inlet at DP 10. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A9.

Sub-basin A11 (Q_5=9.5 cfs, Q_{100}=18.1 cfs) consists of approximately 2.89 acres and is the north western portion of Marksheffel Road. This basin is comprised primarily of the proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R on-grade inlet at DP 11. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A10.

Sub-basin A12 (Q_5=1.9 cfs, Q_{100}=9.5 cfs) consists of approximately 3.87 acres and represents the open space area between the Sterling Ranch Filing No. 2 Phases 1 & 2 developments. This basin is primarily open space. This basin also contains a 50' and 30' gas easement that contain 3 major gas lines. Runoff from this sub-basin will be conveyed via sheet flow and earthen swale to an area inlet at DP 12. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A11.

Sub-basin A13 (Q_5=15.7 cfs, Q_{100}=34.6 cfs) consists of approximately 9.65 acres and is the northern portion of the future Sterling Ranch Phase 2 development. This basin is primarily single-family residential and minor open space. Runoff from this sub-basin will be captured by a storm sewer stub at DP 13. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A12. Prior to being developed, storm runoff from this sub-basin will overland flow to temporary swales, where the flows will be captured by an interim 36" FES and piped to Pond W5.

Sub-basin A14 (Q_5=16.0 cfs, Q_{100}=37.9 cfs) consists of approximately 11.76 acres and is the proposed future school site on the northern side of Sterling Ranch Road. Runoff from this sub-basin will be routed to a 36" RCP storm sewer stub at DP 14. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A13. Prior to being developed, storm runoff from this sub-basin will overland flow to temporary swales, where the flows will be captured by an interim 36" FES and piped to Pond W5.

Sub-basin A15 (Q_5=5.4 cfs, Q_{100}=11.7 cfs) consists of approximately 2.91 acres and is the north eastern portion of Sterling Ranch Road. This basin is primarily single-family residential and proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R on-grade inlet at DP 15. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A14.

Sub-basin A16 (Q_5=4.4 cfs, Q_{100}=9.6 cfs) consists of approximately 2.34 acres and is the south eastern portion of Sterling Ranch Road. This basin is primarily single-family residential and proposed roadway. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15' Type R on-grade inlet at DP 16. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A15.

Sub-basin A17 (Q_5=1.4 cfs, Q_{100}=4.7 cfs) consists of approximately 1.76 acres and is the open space located along the western portion of the sterling Ranch Phase 2 development south of Sterling Ranch

Road. This basin is primarily single-family open space with a small amount of lot runoff. Runoff from this sub-basin will be captured by a future Type C inlet at DP 17 and coveyed via sheet flow and a drainage swale. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A16.

future

anticipated to be

Sub-basin A18 (Q_5=4.3 cfs, Q_{100}=14.0 cfs) consists of approximately 5.27 acres and is the commercial site and open space located at the corner of Sterling Ranch Road and Marksheffel Road. This basin is primarily open space and a commercial lot. Runoff from this sub-basin will sheetflow to a 24” RCP storm sewer stub located at DP 18. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A17.

Sub-basin A19 (Q_5=38.8 cfs, Q_{100}=85.4 cfs) consists of approximately 31.85 acres and is the southern portion of the future Sterling Ranch Phase 2 development. This basin is primarily single-family residential and minor open space. Runoff from this sub-basin will be routed to a 42” storm sewer stub at DP 19 via curb and gutter and storm sewer. From here, the flow is piped to Pond W5 along with the flows from Sub-basin A1-A18. Prior to being developed, stormwater runoff from this sub-basin will overland flow directly into Pond W5.

Sub-basin A20 (Q_5=6.6 cfs, Q_{100}=12.2 cfs) consists of approximately 1.83 acres and is the south western portion of Marksheffel Road. This basin is primarily proposed roadway and landscaping. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a future 15’ Type R on-grade inlet at DP 20. From here, the flow is piped directly to Pond W5 along with the flows from Sub-basin A21.

Sub-basin A21 (Q_5=6.8 cfs, Q_{100}=12.6 cfs) consists of approximately 1.93 acres and is the south eastern portion of Marksheffel Road. This basin is primarily proposed roadway and landscaping. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a future 15’ Type R on-grade inlet at DP 21. From here, the flow is piped directly to Pond W5 along with the flows from Sub-basin A20.

Sub-basin A22 (Q_5=2.7 cfs, Q_{100}=15.4 cfs) consists of approximately 8.68 acres and represents Pond W5. This basin is primarily multifamily residential and open space. Runoff from this sub-basin will sheet flow directly into Pond W5 and be conveyed to DP 22. From here, the flow will combine with the runoff from Basin A. An outlet structure will release the treated flows directly into the Sand Creek Drainageway.

Basin B consists of Sub-Basins B1-B5 combining for a total of 13.77 acres. This basin represents Vollmer Road and Pond W4. This basin is primarily proposed roadway. Stormwater runoff is conveyed via Vollmer Road where it is captured via a series of on-grade and sump inlets. Runoff is then piped to a proposed roadside swale where it will ultimately outfall into the onsite Pond W4. From the detention pond, the treated flows are then released into a storm sewer system that conveys them directly into the Sand Creek Drainageway at below historic rates along with the treated flows from Pond W5.

north of ...

Sub-basin B1 (Q_5=8.8 cfs, Q_{100}=15.8 cfs) consists of approximately 2.98 acres and is the north eastern portion of Vollmer Road. This basin is primarily proposed roadway and landscaping. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter to a 15’ Type R on-grade inlet at DP 23. From here, the flow is piped to a proposed roadside swale. This swale will convey the runoff from Sub-basin B1 to Pond W4.

Vollmer Road
plans are needed.

clarify locations

Sub-basin B2 (Q_5=11.5 cfs, Q_{100}=20.6 cfs) consists of approximately 3.89 acres and is the north western portion of Vollmer Road. This basin is primarily proposed roadway and landscaping. Runoff from this sub-basin will be conveyed via curb and gutter and sheet flow then captured by a 15' Typr R on-grade inlet at DP 24. From here, the flow is piped to a proposed roadside swale. This swale will convey the runoff from Sub-basin B1 and Sub-basin B2 to Pond W4.

Sub-basin B3 (Q_5=7.8 cfs, Q_{100}=14.0 cfs) consists of approximately 2.05 acres and is the south eastern portion of Vollmer Road. This basin is primarily proposed of roadway and landscaping. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter then captured by a 15' Type R sump inlet at DP 27. From here, the flow is piped directly to Pond W4.

Sub-basin B4 (Q_5=7.4 cfs, Q_{100}=13.2 cfs) consists of approximately 1.94 acres and is the south eastern portion of Vollmer Road. This basin is primarily proposed roadway and landscaping. Runoff from this sub-basin will be conveyed via sheet flow and curb and gutter then captured by a 15' Type R sump inlet at DP 28. From here, the flow is piped directly to Pond W4.

Sub-basin B5 (Q_5=0.9 cfs, Q_{100}=6.4 cfs) consists of approximately 2.91 acres and represents Pond W4. This basin is primarily open space. Runoff from this sub-basin will sheet flow directly into Pond W4 and be conveyed to DP 30. From here, the flow will combine with the runoff from Basin B, and Basins OS20 & OS21. An outlet structure will release the treated flows directly into the Sand Creek Drainageway ~~along with treated flows from Pond W5.~~

via __ LF of __" RCP running southeast along the west side of Marksheffel road

Basin C consists of Sub-Basins C1-C2 combining for a total of 13.07 acres. This basin represents the future commercial sites located along Marksheffel Road. This basin is primarily proposed roadway and future commercial developments. Stormwater runoff is conveyed via a drainage swale to a 66" RCP where it combines with treated flows from Pond W5 and is released into Sand Creek.

Sub-basin C1 (Q_5=2.0 cfs, Q_{100}=15.0 cfs) consists of approximately 8.01 acres and is the commercial lot located at the corner of Vollmer Road and Marksheffel Road. Runoff from this sub-basin will be captured by a future onsite water quality pond, where it will release to a storm sewer stub located at DP 31. From here, the flow is piped directly to the Sand Creek Drainageway along with treated flows from Pond W5 and Pond W4. In the interim condition, flows will enter an earthen swale at DP 31 and will be routed through Sub-basin C2 to DP 32.

Address culvert entry design to capture all flows at this point

Sub-basin C2 (Q_5=1.4 cfs, Q_{100}=10.0 cfs) consists of approximately 5.06 acres located in the southwest corner of the development and has the Sanitary Sewer Lift Station for Sterling Ranch. Runoff from this sub-basin will be captured by a future onsite water quality pond, where it will release to a storm sewer stub located at DP 32. From here, the flow is piped directly to the Sand Creek Drainageway along with treated flows from Pond W4 and Pond W5. In the interim condition, flows generated within this basin combine with the flows from sub-basin C1 in an earthen swale where they will enter a 66" RCP where the flow is piped directly to the Sand Creek Drainageway along with treated flows from Pond W4 and Pond W5.

Basin OS consists of Sub-Basins OS2-OS4, OS20, OS21A, and OS21B combining for a total of 387.75 acres. This basin represents the offsite flows that have been incorporated in the storm sewer and pond design. Sub basins OS20, OS21A, and OS21B represent the low density residential land located to the west of the site along Vollmer Road. Sub-basins OS2 and OS3 represent the future Barbarick Subdivision directly north of the site. Sub-basin OS4 represents the existing residential

Address culvert entry design to capture flows at OS2 and OS3, and how any overflows will be conveyed lots located just east of the Pond W5 location. Flows from these sub-basins enter the site or are captured directly by one of the proposed detention ponds. Each sub-basin is discussed in more detail below.

how calculated? provide MDDP values also

Sub-basin OS20 (Q_5=33.7 cfs, Q_{100}=226.1 cfs) consists of approximately 308.0 acres and represents the offsite basin to the northwest of the site. This basin is comprised of partially developed low density residential. Runoff from this basin overland flows to a roadside swale along Vollmer Road. Flows in the swale will be routed through an existing 3.5' x 5.5' HECMP at DP 25 where it will outfall into Pond W4. A riprap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Sub-basin OS21A (Q_5=2.8 cfs, Q_{100}=18.7 cfs) consists of approximately 20.26 acres and represents the offsite basin to the west of the site. This basin is comprised of partially developed low density residential. Runoff from this basin overland flows to a roadside swale along Vollmer Road at DP 26. Flows in the swale will outfall directly into Pond W4. A riprap apron will be constructed to dissipate energy and prevent local scour at the outlet.

Sub-basin OS21B (Q_5=2.1 cfs, Q_{100}=14.5 cfs) consists of approximately 8.71 acres and represents the offsite basin to the west of the site. This basin is comprised of partially developed low density residential. Runoff from this basin will overland flow to a propose Type D inlet at DP 29. Flows will then outfall directly into Pond W4 and will utilize a forebay to dissipate energy. From here, the flows will be treated and outfall into the Sand Creek Drainageway.

Sub-basin OS2 (Q_5=13.8 cfs, Q_{100}=39.1 cfs) consists of approximately 17.0 acres and represents the western portion of the Barbarick Subdivision. Developed flows from this basin will be captured by a future onsite detention pond and released directly onto the Sterling Ranch Filing No. 2 Site. A storm sewer stub has been proposed to capture these flows at DP OS2. From here, the treated flows will be piped to Pond W5 where it will ultimately outfall into the Sand Creek Drainageway.

Phase 2?

Sub-basin OS3 (Q_5=17.6 cfs, Q_{100}=48.9 cfs) consists of approximately 28.7 acres and represents the eastern portion of the Barbarick Subdivision. Developed flows from this basin will be captured by a future onsite detention pond and released directly onto the Sterling Ranch Filing No. 2 Site. A storm sewer stub has been proposed to capture these flows at DP OS3. From here, the treated flows will be piped to Pond W5 where it will ultimately outfall into the Sand Creek Drainageway.

provide additional description on how this will work

Sub-basin OS4 (Q_5=2.6 cfs, Q_{100}=8.8 cfs) consists of approximately 5.08 acres and represents the existing residential lots to the east of the proposed Pond W5. Existing flows from this basin will overland flow directly onto the Sterling Ranch Filing No. 2 Site into Pond W5. From here, the treated flows will outfall into the Sand Creek Drainageway.

There will be bank stabilization improvements to the Sand Creek Drainage Channel with the development of the Sterling Ranch Filing No. 2 site to maintain the integrity of Pond W5. However, channel improvements for Sand Creek (checks, drops, etc.) will be installed in accordance with the analysis performed by Kiowa Engineering.

(awaiting resubmittal)

Address SCS or method used for basin OS20

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

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

Hydrologic Criteria

All hydrologic data was obtained from the "El Paso Drainage Criteria Manual" Volumes 1 and 2, and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. One hour point rainfall data for the storm events is identified in the table below. Rational Method calculations were prepared, in accordance with Section 3.0 of the EPCDCM, for the sub-basins that directly impact the sizing of the proposed storm sewer outfalls. Rational method calculations are presented in Appendix B.

Table 1: 1-hr Point Rainfall Data

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

Hydraulic Criteria

Mile High Flood District's MHFD-Detention, Version 4.03 workbook was used for pond sizing. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets are presented in Appendix C. The Mile High Flood District's spreadsheet UD_Inlet v4.05, released March 2017, was also utilized to determine street and inlet capacities of the development. Using Storm StormCAD V8i, a modeling program for stormwater drainage, the hydraulic grade lines and energy grade lines were determined for the storm sewer network. Manhole and pipe losses for the model were obtained from the *Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computation Methods*, by AMEC Earth & Environmental, Inc. The manhole loss coefficients used in the model can be seen in Table 2. StormCAD results along with street and inlet capacities are presented in Appendix B.

Table 2 - StormCAD Standard Method Conversions

StormCAD Conversion Table			
Bend Loss	Bend Angle	K coefficient Conversion	
	0	0.05	
	22.5	0.1	
	45	0.4	
	60	0.64	
	90	1.32	
Lateral Loss	1 Lateral K coefficient Conversion		
	Bend Angle	Non Surcharged	Surcharged
	45	0.27	0.47
	60	0.52	0.9
	90	1.02	1.77
	2 Laterals K coefficient Conversion		
	45	0.96	
	60	1.16	
	90	1.52	

DRAINAGE FACILITY DESIGN

General Concept

The proposed stormwater conveyance system was designed to convey the developed Sterling Ranch Filing No. 2 runoff to the proposed full spectrum water quality and detention pond W5 via storm sewer. Pond W4 will be utilized to detain and treat large portions of offsite area. The proposed ponds were designed to release at less than historic rates to minimize adverse impacts downstream. Treated water will outfall directly into the Sand Creek Drainageway, where it will eventually outfall into Fountain Creek. All Ponds will be owned and maintained by Sterling Ranch Metro District. A proposed drainage map is presented in Appendix E showing locations of the pond and channel outfall locations.

Address the impacts to Sand Creek from re-routing flows to the Pond W5/PondW4 diversion outfall.

Specific Details

Four Step Process to Minimize Adverse Impacts of Urbanization

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

Step 1, Reducing Runoff Volumes: The development of the project site is a proposed fingle-family development with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes.

This is not the case for the channel and properties upstream of the historic confluence with re-routed flows

Step 2, Stabilize Drainageways: Sterling Ranch Filing No. 2 utilizes storm sewer throughout the project site. This storm sewer directs the on-site development flows to the full spectrum detention Pond W5 that releases at or below historic rates into the Sand Creek Drainageway. Measures shall be implemented to prevent any negative impacts to the drainageway. Riprap at the outfall locations will be utilized to prevent any erosion. An emergency overflow spillway rundown has been designed from Pond W5 down into the Sand Creek Drainageway. The overflow channel will help protect and stabilize the drainageway by reducing channel degradation and erosion. The channel utilizes 4 foot deep "VH Soil Riprap" base with a minimum 4 inch overlay of topsoil, seed and mulch. The proposed reduction in released flows compared to the pre-developed flows, will also prevent any negative impacts to developments downstream. A detailed analysis of the Sand Creek Drainageway is currently being conducted by Kiowa Engineering. This report will cover stabilization measures and channel improvements needed for this reach of the Sand Creek Drainageway.

Step 3, Treat the WQCV: Water Quality treatment is provided in two proposed full spectrum water quality detention ponds: Pond W4 and Pond W5. Pond W5 will receive all runoff generated within Sterling Ranch Filing No. 2 as well as future Sterling Ranch Phase 2 and Copper Chase at Sterling Ranch, a school site and a small portion of offsite areas. Pond W4 will receive runoff generated from portions of Vollmer Road and a large portion of offsite areas to the north and west of Vollmer road. In general, the runoff from this site will be collected within inlets and conveyed to the proposed ponds via storm sewer. Upon entrance to the ponds, flows will be captured in a forebay designed to promote settlement of suspended solids. A trickle channel is also incorporated into the ponds to minimize the amount of standing water. The outlet structures have been designed to detain the water quality capture volume (WQCV) for 40 hours, and the extended urban runoff volume (EURV) for 72 hours. All flows released from the ponds will be reduced to less than historic rates into the Sand Creek Drainageway. These ponds will facilitate pollutant removal for the site, while also reducing peak stormwater rates into the Sand Creek Drainageway.

Step 4, Consider the need for Industrial and Commercial BMP's: future commercial sites are proposed within this development. Site specific storm water quality and erosion control plans will be required for each commercial tract prior to development. A site specific storm water quality and erosion control plan and narrative have also been prepared in conjunction with this final drainage report. Site specific temporary source control BMPs as well as permanent BMP's will be detailed in this plan and narrative to protect receiving waters.

Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention are provided for all developed basins. For this site, two detention ponds have been proposed. The WQCV for each pond shall be released within 40 hours and the EURV shall be released within 72 hours. The table below provides the volumes required for each pond, along with their respective release rates for the 5-year and 100-year storm. Both ponds will utilize forebays, trickle channels, and outlet structures to dissipate energy and treat flows. The outlet structure for these ponds shall reduce the release rates for all storm events to less than historic rates to minimize adverse impacts to downstream stormwater facilities. A broad crested weir is provided as an emergency spillway for each pond. The emergency spillway provided for Pond W5 will convey flows directly into the Sand Creek Drainageway. The emergency spillway provided for Pond W4 shall convey flows to the existing roadside swale along Vollmer Road. Both spillways will utilize riprap aprons to prevent scour at the outlets. Pond and outlet structure calculations and sizing can be found in Appendix C.

Table 3. Pond Volumes & Release Rates

	REQUIRED VOLUME (AC-FT)	VOLUME PROVIDED (AC-FT)	WQCV (AC-FT)	EURV (AC-FT)	5-YEAR RELEASE (CFS)	100-YEAR RELEASE (CFS)
POND W5	17.992	18.079	3.231	11.150	3.7	149.2
POND W4	8.317	8.437	1.330	1.730	9.5	229.2

A preliminary design for the ultimate configuration of Pond W4 has been used to calculate potential volume. Upon future upstream development, an expansion of Pond W4 will need to be finalized. The pond is designed to treat approximately 352.2 acres and provide approximately 2.294 ac-ft of water quality storage. Modifications will be required to ensure the outlet structure complies with local and Mile High Flood District criteria. A preliminary pond sizing for the ultimate condition can be found in the appendix.

Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate must be submitted with each Final Drainage Report. The Erosion Control Plan for Sterling Ranch Filing No. 2 has been submitted with this report.

SRMD?

No - see comment letter.

Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within the any platted County ROW will be owned and maintained by El Paso County. All proposed drainage structures within the property or tracts will be owned and maintained by the property owner. Vegetation in the natural and improved portions of Sand Creek Drainageway is the responsibility of El Paso County. This includes all mowing, seeding and weed control activities. An Inspection & Maintenance Plan has been submitted concurrently with this final drainage report that details the required maintenance activities and intervals to ensure proper function of all stormwater infrastructure in the future. The full spectrum detention ponds will be owned & maintained by the property owner.

SRMD?

Sand Creek Drainageway Improvements

Per the Sand Creek DBPS, Sand Creek and connected tributaries in the area of the site will require improvements. The east tributary reaches within the site boundary (DBPS SEG: 169, 186, 164, 159) will not require improvements because they will no longer be present, as development in the areas will eliminate them, and replace them with, a storm sewer system to discharge into Sand Creek. Sand Creek itself will continue to be routed through the development. Per the DBPS, selective rip rap linings, grade control check structures, and drop structure improvements are required to stabilize the channel to prevent further degradation, scour and meandering. Full spectrum detention will also be used on its benefits to the integrity of the Sand Creek Drainageway. A separate analysis with detailed alternative sections, HEC-RAS analyses, and proposed improvements is currently being conducted by Kiowa Engineering. This analysis will outline the channel improvements that will be necessary for the section of Sand Creek Drainageway that is adjacent to the site.

Address improvements needed from W5 outfall to historic confluence.

If any "swapping" of DBPS improvements for proposed improvements is intended to offset drainage fees it needs to be addressed here and go to the drainage board. The Filing 1 improvements credits also need to be finalized.

Drainage & Bridge Fees

The site lies within the Sand Creek Drainage Basin. An approximate estimate is presented below, exact fees to be determined at time of final plat. See full Drainage and Bridge fee worksheet in Appendix D for the fee calculation spreadsheet.

2020 DRAINAGE AND BRIDGE FEES – Sterling Ranch Filing No. 2				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Sterling Ranch Drainage Fee	Sterling Ranch Bridge Fee
33.905	$19,698	$8,057	$667,871.33	$273,176.94

Construction Cost Opinion

The City of Colorado Springs Drainage Criteria Manual specifies a Cost Estimate of proposed drainage facility improvements be submitted with the Final Drainage Report. A construction cost opinion has been provided below. The below cost opinion is only an estimate of facility and drainage infrastructure cost and may vary.

Item	Description	Quantity	Unit Cost			Cost
1	18”RCP	731	$65	/LF	$	47,515.00
2	24" RCP	464	$78	/LF	$	36,192.00
3	30" RCP	492	$97	/LF	$	47,724.00
4	36" RCP	651	$120	/LF	$	78,120.00
5	42" RCP	598	$160	/LF	$	95,680.00
6	48" RCP	1266	$195	/LF	$	246,870.00
7	66" RCP	1915	$332	/LF	$	635,780.00
8	72" RCP	2738	$380	/LF	$	1,040,440.00
9	84" RCP	329	$520	/LF	$	171,080.00
10	18”FES	1	$390	/LF	$	390. 00
11	24" FES	1	$468	/EA	$	468.00
12	30" FES	2	$582	/EA	$	1,164.00
13	36" FES	2	$720	/EA	$	1,440.00
14	42" FES	2	$960	/EA	$	1,920.00
15	66" FES (Temp.)	1	$1992	/EA	$	1,992.00
16	84" Headwall	2	$10000	/EA	$	20,000.00
17	15' CDOT Type R At-Grade	6	$10633	/EA	$	63,798.00
18	10' CDOT Type R At-Grade	10	$7861	/EA	$	78,610.00
19	2.9’x5.5’ CDOT TYPE D	1	$5731	/EA	$	5,731.00
20	Storm Sewer MH, box base < 15 feet	24	$11627	/EA	$	279,048.00
21	Storm Sewer MH,slab base ~ 15 feet-20 feet	2	$6395	/EA	$	12,790.00

22	Storm Sewer MH, box base > 20 feet	1	$20000	/EA	$	20,000.00
23	*Detention Pond W5	1	$75000	/EA	$	75,000.00
24	*Detention Pond W4	1	$65000	/EA	$	65,000.00
25	Forebay Structure	1	$15000	/EA	$	15,000.00
26	Mod CDOT Outlet Structure	2	$15000	/EA	$	30,000.00
			Total		**$**	**3,071,752.00**

SUMMARY

Development of this site will not adversely affect the surrounding development per this final drainage report and will have no negative impact of the neighboring developments. Assumptions were made for the offsite future developments that utilize the drainage infrastructure within this report. As the future sites develop, final drainage reports will be completed to confirm the assumptions made in this report. The proposed drainage facilities will adequately convey, detain and route runoff from the tributary and onsite flows to the Sand Creek Drainage channel. Full spectrum detention and water quality ponds W4 and W5 will be used to discharge developed flows into Sand Creek per the Urban Drainage criteria flow rates, which are at or less than the historic flow. Care will be taken during construction to accommodate overland flow routes onsite and temporary drainage conditions. The development of the Sterling Filing No. 2 project shall not adversely affect adjacent or downstream property.

REFERENCES:

1. El Paso County Drainage Criteria Manual Volume 1, El Paso County, CO, 1994.

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

3. Sand Creek Drainage Basin Planning Study, Kiowa Engineering, January 1993.

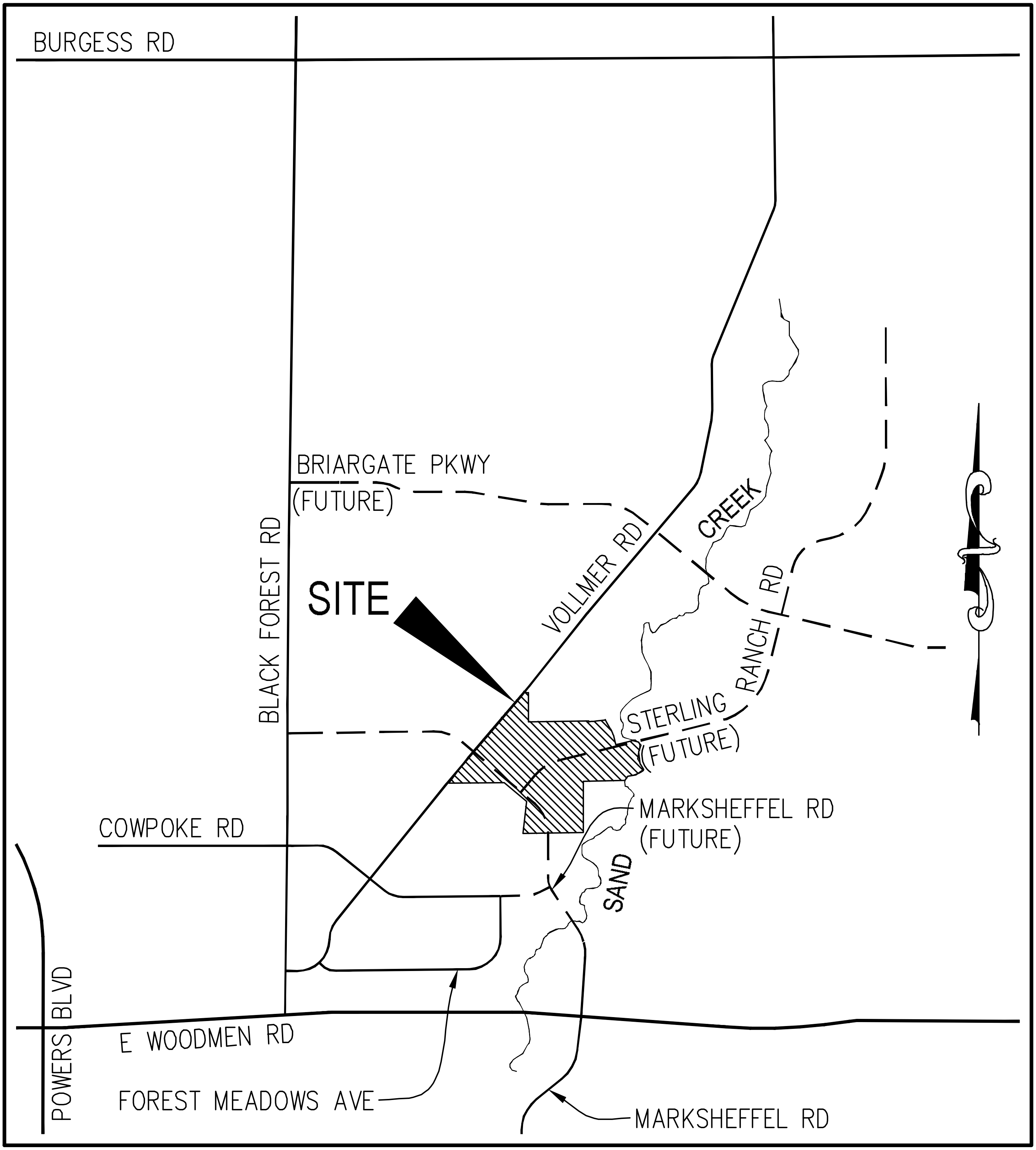
4. Final Drainage Report for Barbarick Subdivision, Portions of Lots 1, 2 and Lots 3 & 4, by Matrix Design Group, dated June 2016

5. Final Drainage Report for Sterling Ranch Filing No. 2, by M&S Civil Consultants, dated March 2018

Add DCM Volume 2, ECM, DCM update (City Chapter 6), Sterling Ranch MDDP

APPENDIX A

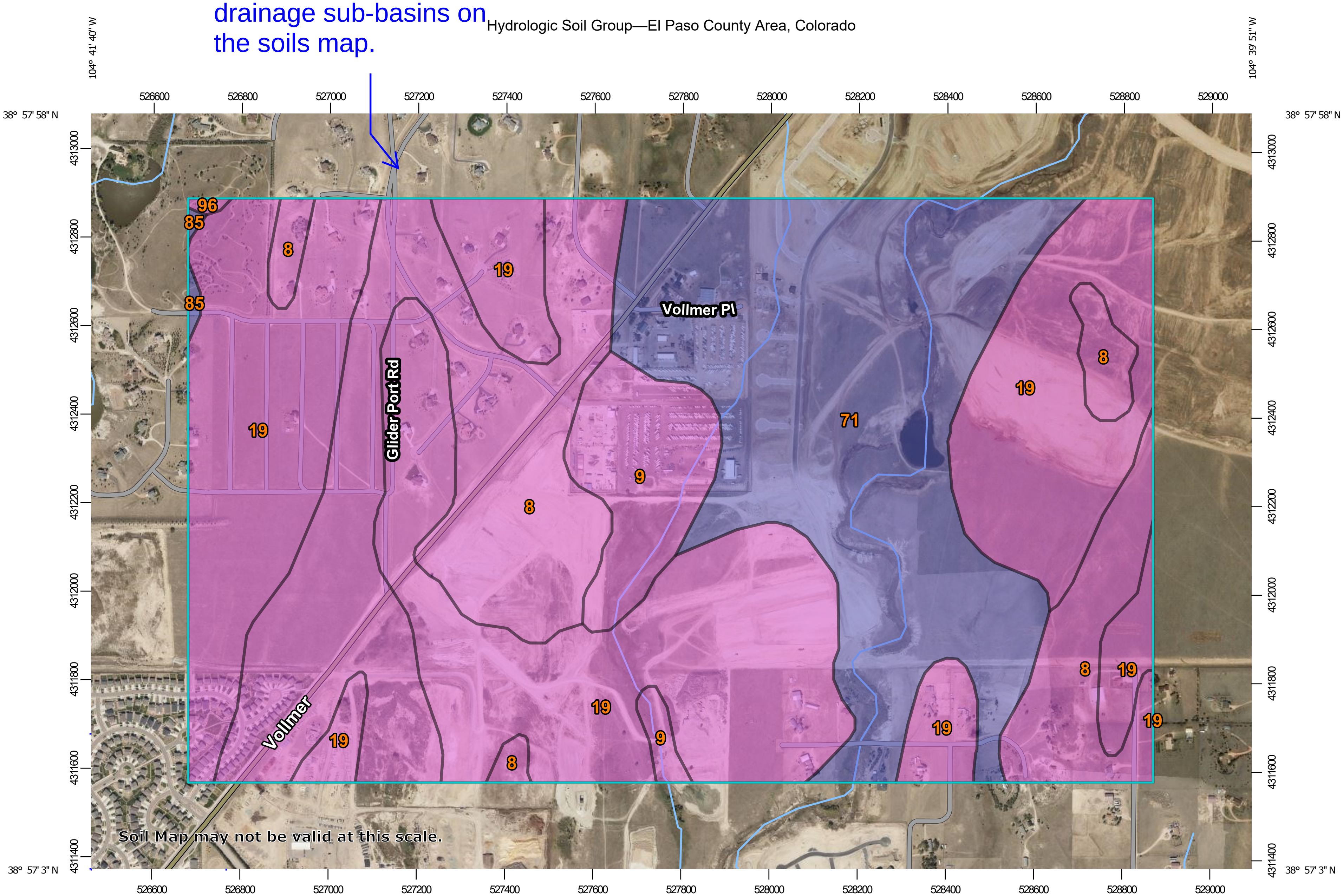
FIGURES AND EXHIBITS



VICINITY MAP

N.T.S.

Show overlay of applicable drainage sub-basins on the soils map.



Map Scale: 1:12,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

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.

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Aug 19, 2018—May 26, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	182.3	25.4%
9	Blakeland-Fluvaquentic Haplaquolls	A	36.8	5.1%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	307.5	42.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	188.4	26.3%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	B	1.2	0.2%
96	Truckton sandy loam, 0 to 3 percent slopes	A	0.6	0.1%
Totals for Area of Interest			**716.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

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

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, 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.

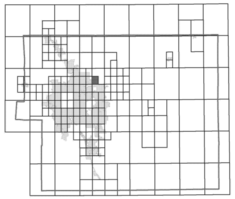
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this 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

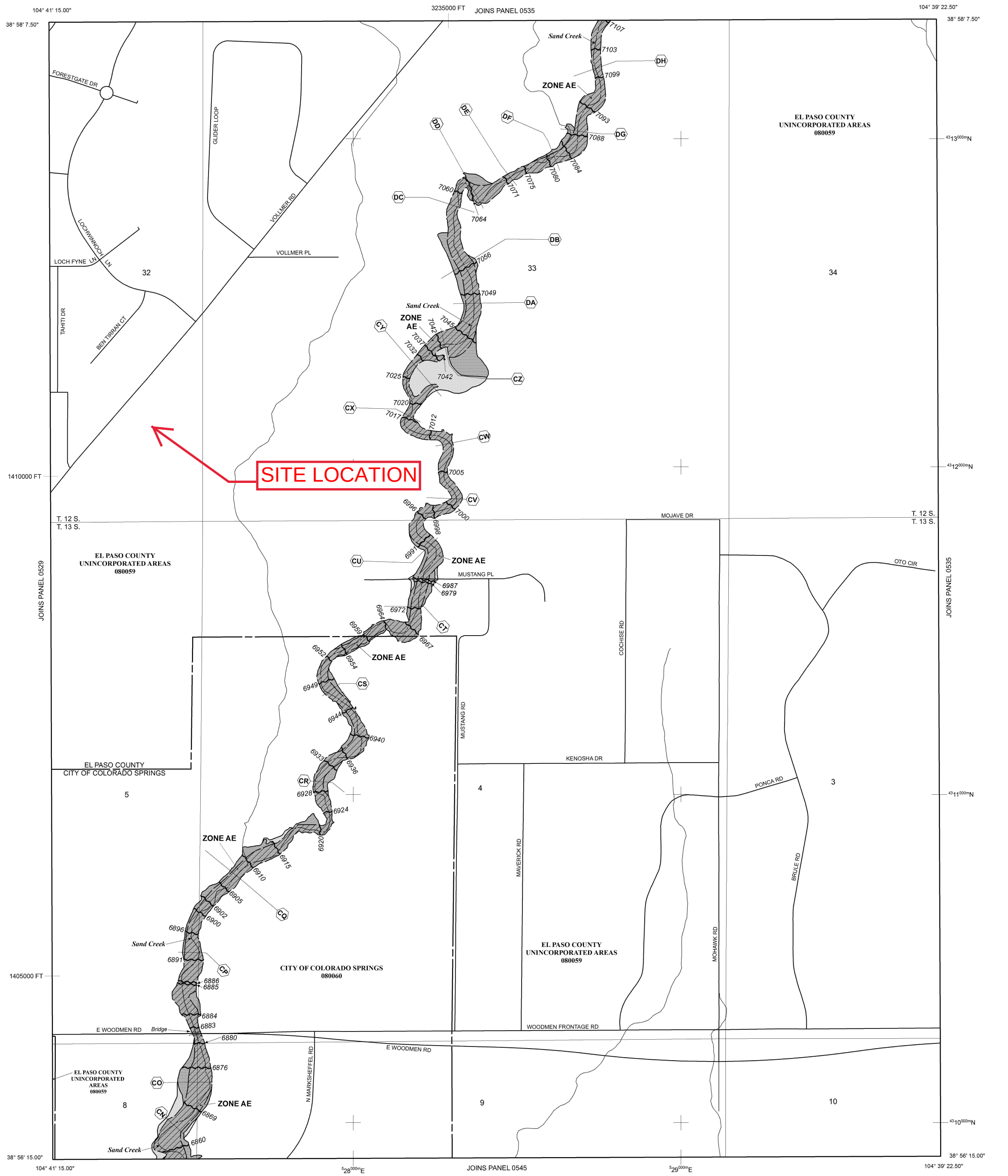
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

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.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST, AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.

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)
- $^{42}75^{000m}$N: 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT: 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- 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

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0533G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 533 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0533	G
EL PASO COUNTY	080059	0533	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 08041C0533G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
200 SOUTH SANTA FE AVENUE, SUITE 301
PUEBLO, COLORADO 81003-4270

SIGNED

February 29, 2016

Regulatory Division

SUBJECT: Action No. SPA-2015-00428-SCO, Sterling Ranch Residential Development Project, El Paso County, Colorado

Jim Morley
SR Land, LLC
20 Boulder Crescent Suite 201
Colorado Springs, CO 80903

Mr. Morley:

You are hereby authorized under Section 404 of the Clean Water Act to discharge d dged and fill material in to waters of the U ted States to conduct work in associated with construction of the Sterling Ranch Resid ntial Developme n accordance with Action Number SPA-2015-00428-SCO. A copy of the permit is enclosed.

To use this p mit, you m ensure that the work is onducted in accordance with the terms and co ons of t permit. You must submi revised drawings to us for approva prior to con truction should any changes be found necessary in either the location or plans he work. Approval of revised plans may be gr nted if they a e found not contrary to the public interest.

This permit s not an approval of the project design features, nor does it ly that the constructio is ade e for its intended purpose. This permit does not horize any injury to property asion of rights or a infringement of Federal, st or local laws or regulations. You must possess the au rity, including property rig , to undertake the proposed work.

Enclosed is a compliance certification form. U completion of the roject, please sign and date the for nd return it to this office.

If you have any questions concerning our regulatory p ogram, please contact me at 719-543-6915 or by e-mail at van.a.truan@usace.army.n . At your convenience, please complete a Customer Service Survey at http://per2.nwp.usace.army.mil/survey.html.

Sincerely,

Van Truan
Chief, Southern Colorado
Regulatory Branch

Enclosure(s)

CORE CONSULTANTS

September 23, 2016

Mr. Virgil Sanchez
MS Civil Consultants, Inc.
20 Boulder Crescent, Suite 110
Colorad Springs, CO 80903

RE: and C tland Memo
Ster e ential Development Project
El Paso County, Colorado

Dear Mr. Sanchez:

CORE Consultants, Inc. (CORE) was r ined by MS Civil Consultants, complete a wetland delineation for portions of e proposed S ling Ranch Residential Development Pr t ("Project"). The Project is located on appr imately 1,50 res in unir orporated El Paso County unty), Colorado, and encompasses a portio of the perennial stream Sand Creek, its western trib ies, and adjacent uplands. CORE submitted a formal wetland delineation report to the U.S. Army rps of Engineers (USACE) as component of a Section 404 permit application for the Pro ermit umber SPA-2015-00428-SCO), which was approved by the USAC in February, 2016.

At the time of 404 permit issuance, CORE had perfo etland surveys in all of the Project covered by the permit. However, at the time of this w vetland surveys covering future phases of developme have not been performed. Prior to development of future phases covered under PA-15-0042 O, a formal wetland delineation will ormed in those areas, d any necessary 404 rmitting be obtained. Based on CORE's finding ghout Sand Creek in the current p it area, CORE expects that wetlands may occur throughout odplain in portions of Sand Creek in future development areas further downstream (achment *tland Location Map*).

If you should have any questions, concerns, or require additional information, please feel free to contact our office directly at 303.703.4444.

Sincerely,
CORE Consultants, Inc.

Daniel Maynard
or Ecologist

Sterling Ranch
Wetland Location Map
El Paso County, Colorado

Proposed Storm Pipe
·sed Detention Pond
ıd
Watercourse
100-year Floodplain

0 250 500
Feet
1 inch = 250 feet

Date: 9/23/2016
Project #: 15-001

CORE CONSULTANTS

CIVIL ENGINEERING
DEVELOPMENT CONSULTING
NATURAL RESOURCES CONSULTING
LAND SURVEYING
303.703.4444
1950 W. Littleton Blvd., Ste. 109
Littleton, CO 80120

APPENDIX B

HYDROLOGIC/ HYDRAULIC CALCULATIONS

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision:	Sterling Ranch Filing No. 2	Project Name:	Sterling Ranch Subdivision (Existing)
Location:	El Paso County	Project No.:	25188.01
		Calculated By:	CJD
		Checked By:	
		Date:	5/15/20

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious) Neighborhood Area (70% Impervious)				1 Acre lot Rersidential (20% Impervious) Light Commercial (80% Impervious)				Lawns (0% Impervious) School (55% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
EXA1	17.68	0.90	0.96	1.31	7.4%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	16.37	1.9%	0.15	0.40	9.3%
EXA2	19.59	0.90	0.96	0.59	3.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	19.00	1.9%	0.11	0.38	5.0%
EXA3	5.66	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	5.66	2.0%	0.09	0.36	2.0%
EXA4	50.72	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	50.72	2.0%	0.09	0.36	2.0%
EXB	11.78	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	11.78	2.0%	0.09	0.36	2.0%
OS1	23.82	0.90	0.96	0.00	0.0%	0.45	0.59	11.03	30.1%	0.59	0.70	4.15	13.9%	0.09	0.36	8.64	0.7%	0.34	0.53	44.8%
OS2	85.59	0.90	0.96	0.09	0.1%	0.45	0.59	5.09	3.9%	0.59	0.70	13.37	12.5%	0.09	0.36	67.04	1.6%	0.19	0.43	18.0%
OS3	6.66	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	6.66	2.0%	0.09	0.36	2.0%
OS4	2.19	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	2.19	2.0%	0.09	0.36	2.0%
OS5	9.27	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	3.49	7.5%	0.09	0.36	5.78	1.2%	0.28	0.49	8.8%
TOTAL (A1-B1)	105.43																			3.8%
TOTAL (OS1-OS5)	127.53																			21.2%
TOTAL	232.96																			13.3%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County

Project Name: Sterling Ranch Subdivision (Existing)
Project No.: 25188.01
Calculated By: CJD
Checked By:
Date: 5/15/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					tc CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EXA1	17.68	A	9%	0.15	0.40	225	3.5%	17.0	1417	2.0%	20.0	2.8	8.4	25.4	1642.0	40.7	25.4
EXA2	19.59	A	5%	0.11	0.38	300	2.3%	23.5	1568	2.7%	20.0	3.3	8.0	31.5	1868.0	41.6	31.5
EXA3	5.66	A	2%	0.09	0.36	300	2.5%	23.3	581	2.5%	20.0	3.1	3.1	26.4	881.0	32.3	26.4
EXA4	50.72	A	2%	0.09	0.36	221	4.1%	17.1	2510	1.7%	20.0	2.6	16.2	33.2	2731.0	60.5	33.2
EXB	11.78	A	2%	0.09	0.36	277	2.4%	22.7	326	7.0%	20.0	5.3	1.0	23.8	603.0	27.9	23.8
OS1	23.82	A	45%	0.34	0.53	300	3.0%	16.5	1197	2.8%	20.0	3.3	6.0	22.4	1497.0	26.2	22.4
OS2	85.59	A	18%	0.19	0.43	229	4.0%	15.7	3294	2.2%	20.0	3.0	18.3	34.1	3523.0	54.8	34.1
OS3	6.66	A	2%	0.09	0.36	197	2.9%	18.0	444	2.6%	20.0	3.2	2.3	20.3	641.0	30.6	20.3
OS4	2.19	A	2%	0.09	0.36	290	1.4%	27.9	72	1.8%	20.0	2.7	0.5	28.4	362.0	26.6	26.6
OS5	9.27	A	9%	0.28	0.49	300	2.7%	18.6	784	2.4%	20.0	3.1	4.2	22.8	1084.0	32.7	22.8

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

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

Table 6-2. NRCS Conveyance factors, K

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

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

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

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

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

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

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Project Name: Sterling Ranch Subdivision (Existing)
Project No.: 25188.01
Calculated By: CJD
Checked By:
Date: 5/15/20

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
Design Storm: 5-Year

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	*I* (in/hr)	Q (cfs)	tc (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	EXA1	17.68	0.15	25.4	2.65	2.73	7.2															Existing Topography
	2	EXA2	19.59	0.11	31.5	2.24	2.41	5.4					5.4	2.24	1.7					1529	1.3	19.8	Existing Topography Swale conveyance to DP 4.1
	3	EXA3	5.66	0.09	26.4	0.51	2.67	1.4															Existing Topography
	4	EXA4	50.72	0.09	33.2	4.56	2.33	10.6															Existing Topography Overland flow to DP 4.1
	10	OS1	23.82	0.34	22.4	8.19	2.92	23.9					23.9	8.19	1.9					2779	1.4	33.3	Existing Topography Overland flow to DP 4.1
	9	OS2	85.59	0.19	34.1	16.29	2.29	37.3					37.3	16.29	1.9					2577	1.4	30.8	Existing Topography Overland flow to DP 4.1
	8	OS3	6.66	0.09	20.3	0.60	3.07	1.8					1.8	0.60	2.4					1785	1.5	19.3	Existing Topography Overland flow to DP 4.1
	5	OS5	9.27	0.28	22.8	2.58	2.90	7.5					7.5	2.58	2.4					399	1.5	4.3	Existing Topography Overland flow to DP 4.1
	4.1								64.9	34.46	1.32	45.6											Sum of DP 2, DP 4, DP 5, DP8, DP 9, & DP 10, Overland flow to the Sand Creek Drainageway
	7	OS4	2.19	0.09	26.6	0.20	2.66	0.5					0.5	0.20	4.5					660	2.1	5.2	Existing Topography Overland flow to DP 6.1
	6	EXB	11.78	0.09	23.8	1.06	2.83	3.0															Existing Topography Overland flow to DP 6.1
	6.1								31.8	1.26	2.39	3.0											Sum of DP 6 & DP 7, Overland flow to the Sand Creek Drainageway

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
Design Storm: 100-Year

Project Name: Sterling Ranch Subdivision (Existing)
Project No.: 25188.01
Calculated By: CJD
Checked By:
Date: 5/15/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	tc (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	EXA1	17.68	0.15	25.4	2.65	4.58	12.1															Existing Topography
	2	EXA2	19.59	0.11	31.5	2.24	4.04	9.0					9.0	2.24	1.7					1529	1.3	19.8	Existing Topography Swale conveyance to DP 4.1
	3	EXA3	5.66	0.09	26.4	0.51	4.49	2.3															Existing Topography
	4	EXA4	50.72	0.09	33.2	4.56	3.91	17.8															Existing Topography Overland flow to DP 4.1
	10	OS1	23.82	0.34	22.4	8.19	4.89	40.1					40.1	8.19	1.9					2779	1.4	33.3	Existing Topography Overland flow to DP 4.1
	9	OS2	85.59	0.19	34.1	16.29	3.84	62.6					62.6	16.29	1.9					2577	1.4	30.8	Existing Topography Overland flow to DP 4.1
	8	OS3	6.66	0.09	20.3	0.60	5.15	3.1					3.1	0.60	2.4					1785	1.5	19.3	Existing Topography Overland flow to DP 4.1
	5	OS5	9.27	0.28	4.3	2.58	9.05	23.4					23.4	2.58	2.4					399	1.5	4.3	Existing Topography Overland flow to DP 4.1
	4.1								64.9	34.46	2.22	76.5											Sum of DP 2, DP 4, DP 5, DP8, DP 9, & DP 10, Overland flow to the Sand Creek Drainageway
	7	OS4	2.19	0.09	26.6	0.20	4.46	0.9					0.9	0.20	4.5					660	2.1	5.2	Existing Topography Overland flow to DP 6.1
	6	EXB	11.78	0.09	23.8	1.06	4.75	5.0															Existing Topography Overland flow to DP 6.1
	6.1								31.8	1.26	4.02	5.1											Sum of DP 6 & DP 7, Overland flow to the Sand Creek Drainageway

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious) Neighborhood Area (70% Impervious)				Light Industrial (80% Impervious) Commercial (95% Impervious)				Lawns (0% Impervious) School (55% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A1	2.06	0.90	0.96	0.48	23.3%	0.45	0.59	1.34	42.3%	0.59	0.70	0.00	0.0%	0.08	0.35	0.24	0.0%	0.51	0.65	65.6%
A2	0.82	0.90	0.96	0.20	24.4%	0.45	0.59	0.56	44.4%	0.59	0.70	0.00	0.0%	0.08	0.35	0.06	0.0%	0.53	0.66	68.8%
A3	6.76	0.90	0.96	1.32	19.5%	0.45	0.59	4.16	40.0%	0.59	0.70	0.00	0.0%	0.08	0.35	1.28	0.0%	0.47	0.62	59.5%
A4	1.51	0.90	0.96	0.51	33.8%	0.45	0.59	1.00	43.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.60	0.71	76.8%
A5	1.70	0.90	0.96	0.51	30.0%	0.45	0.59	1.19	45.5%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.59	0.70	75.5%
A6	1.37	0.90	0.96	0.39	28.5%	0.45	0.59	0.98	46.5%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.58	0.70	75.0%
A6A	0.53	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.81	0.88	0.53	95.0%	0.08	0.35	0.00	0.0%	0.81	0.88	95.0%
A7	19.00	0.90	0.96	0.00	0.0%	0.45	0.59	19.00	65.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.45	0.59	65.0%
A8	1.48	0.90	0.96	0.74	50.0%	0.45	0.59	0.29	12.7%	0.59	0.70	0.00	0.0%	0.08	0.35	0.45	0.0%	0.56	0.70	62.7%
A9	0.61	0.90	0.96	0.48	78.7%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.13	0.0%	0.73	0.83	78.7%
A10	2.61	0.90	0.96	2.25	86.2%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.36	0.0%	0.79	0.88	86.2%
A11	2.89	0.90	0.96	2.40	83.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.49	0.0%	0.76	0.86	83.0%
A12	3.87	0.90	0.96	0.00	0.0%	0.45	0.59	0.50	8.4%	0.59	0.70	0.00	0.0%	0.08	0.35	3.37	0.0%	0.13	0.38	8.4%
A13	9.65	0.90	0.96	0.00	0.0%	0.45	0.59	9.65	65.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.45	0.59	65.0%
A14	11.76	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.81	0.88	0.00	0.0%	0.39	0.55	11.76	0.0%	0.39	0.55	0.0%
A15	2.91	0.90	0.96	1.57	54.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	1.34	0.0%	0.52	0.68	54.0%
A16	2.34	0.90	0.96	1.30	55.6%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	1.04	0.0%	0.54	0.69	55.6%
A17	1.76	0.90	0.96	0.00	0.0%	0.45	0.59	0.64	23.6%	0.59	0.70	0.00	0.0%	0.08	0.35	1.12	0.0%	0.21	0.44	23.6%
A18	5.27	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.81	0.88	1.18	21.3%	0.08	0.35	4.09	0.0%	0.24	0.47	21.3%
A19	31.85	0.90	0.96	0.00	0.0%	0.45	0.59	31.85	65.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.45	0.59	65.0%
A20	1.83	0.90	0.96	1.63	89.1%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.20	0.0%	0.81	0.89	89.1%
A21	1.93	0.90	0.96	1.73	89.6%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.20	0.0%	0.82	0.90	89.6%
A22	8.68	0.90	0.96	0.00	0.0%	0.45	0.59	0.70	5.2%	0.59	0.70	0.00	0.0%	0.08	0.35	7.98	0.0%	0.11	0.37	5.2%
B1	2.98	0.90	0.96	2.98	100.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.90	0.96	100.0%
B2	3.89	0.90	0.96	3.89	100.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.90	0.96	100.0%
B3	2.05	0.90	0.96	2.05	100.0%	0.45	0.59	0.00	0.0%	0.81	0.88	0.00	0.0%	0.08	0.35	0.00	0.0%	0.90	0.96	100.0%
B4	1.94	0.90	0.96	1.94	100.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.90	0.96	100.0%
B5	2.91	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	2.91	0.0%	0.08	0.35	0.0%

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious) Neighborhood Area (70% Impervious)				Light Industrial (80% Impervious) Commercial (95% Impervious)				Lawns (0% Impervious) School (55% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
C1	8.01	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.81	0.88	8.01	95.0%	0.08	0.35	0.00	0.0%	0.81	0.88	95.0%
C2	5.06	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.81	0.88	5.06	95.0%	0.08	0.35	0.00	0.0%	0.81	0.88	95.0%
OS20	308.00	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	308.00	0.0%	0.09	0.36	0.0%
OS21A	20.26	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	20.26	0.0%	0.09	0.36	0.0%
OS21B	8.71	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	8.71	0.0%	0.09	0.36	0.0%
OS2	17.00	0.90	0.96	0.00	0.0%	0.49	0.62	17.00	70.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.00	0.0%	0.49	0.62	70.0%
OS3	28.70	0.90	0.96	0.00	0.0%	0.49	0.62	28.70	70.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.00	0.0%	0.49	0.62	70.0%
OS4	5.08	0.90	0.96	0.00	0.0%	0.20	0.40	5.08	20.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.00	0.0%	0.20	0.40	20.0%
TOTAL (A1-C2)	150.03																			58.1%
TOTAL (OS20-OS4)	387.75																			8.5%
TOTAL	537.78																			22.3%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					tc CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A1	2.06	A	66%	0.51	0.65	100	2.5%	7.8	388	3.0%	20.0	3.5	1.9	9.7	488.0	16.9	9.7
A2	0.82	A	69%	0.53	0.66	100	2.5%	7.6	183	1.0%	20.0	2.0	1.5	9.1	283.0	15.9	9.1
A3	6.76	A	60%	0.47	0.62	100	2.5%	8.4	1186	2.3%	20.0	3.0	6.5	15.0	1286.0	23.4	15.0
A4	1.51	A	77%	0.60	0.71	78	2.0%	6.3	795	2.9%	20.0	3.4	3.9	10.2	873.0	16.9	10.2
A5	1.70	A	76%	0.59	0.70	100	2.5%	6.9	645	3.1%	20.0	3.5	3.1	9.9	745.0	16.3	9.9
A6	1.37	A	75%	0.58	0.70	100	2.5%	7.0	632	3.1%	20.0	3.5	3.0	10.0	732.0	16.3	10.0
A6A	0.53	A	95%	0.81	0.88	100	2.0%	4.2	30	2.0%	20.0	2.8	0.2	4.3	130.0	10.0	5.0
A7	19.00	A	65%	0.45	0.59	100	2.5%	8.7	1419	1.5%	20.0	2.4	9.7	18.3	1519.0	25.6	18.3
A8	1.48	A	63%	0.56	0.70	80	2.0%	6.9	646	0.6%	20.0	1.5	7.0	13.9	726.0	23.2	13.9
A9	0.61	A	79%	0.73	0.83	15	2.0%	2.1	661	0.7%	20.0	1.7	6.6	8.7	676.0	19.2	8.7
A10	2.61	A	86%	0.79	0.88	15	2.0%	1.7	1357	3.4%	20.0	3.7	6.1	7.9	1372.0	17.2	7.9
A11	2.89	A	83%	0.76	0.86	16	2.0%	1.9	1357	2.8%	20.0	3.3	6.8	8.7	1373.0	18.4	8.7
A12	3.87	A	8%	0.13	0.38	100	5.0%	10.3	267	3.4%	15.0	2.8	1.6	11.9	367.0	26.9	11.9
A13	9.65	A	65%	0.45	0.59	100	2.5%	8.7	934	2.1%	20.0	2.9	5.4	14.0	1033.6	20.9	14.0
A14	11.76	A	0%	0.39	0.55	100	2.0%	10.2	867	2.0%	20.0	2.8	5.1	15.3	967.0	37.4	15.3
A15	2.91	A	54%	0.52	0.68	34	2.0%	4.8	1621	1.8%	20.0	2.7	10.1	14.9	1655.0	29.0	14.9
A16	2.34	A	56%	0.54	0.69	35	2.0%	4.8	1594	1.8%	20.0	2.7	9.9	14.7	1629.0	28.4	14.7
A17	1.76	A	24%	0.21	0.44	100	5.0%	9.4	403	1.1%	15.0	1.6	4.3	13.7	503.0	27.2	13.7
A18	5.27	A	21%	0.24	0.47	100	2.0%	12.3	703	2.0%	20.0	2.8	4.1	16.4	803.0	29.3	16.4
A19	31.85	A	65%	0.45	0.59	100	2.5%	8.7	2675	1.7%	20.0	2.6	17.1	25.8	2775.0	33.8	25.8
A20	1.83	A	89%	0.81	0.89	15	2.0%	1.6	936	1.5%	20.0	2.4	6.4	8.0	951.0	16.8	8.0
A21	1.93	A	90%	0.82	0.90	15	2.0%	1.6	1049	1.5%	20.0	2.4	7.1	8.7	1064.0	17.4	8.7
A22	8.68	A	5%	0.11	0.37	185	3.0%	16.9	540	0.5%	20.0	1.4	6.4	23.3	725.0	38.2	23.3
B1	2.98	A	100%	0.90	0.96	17	2.0%	1.2	2561	1.7%	20.0	2.6	16.4	17.6	2578.0	23.2	17.6
B2	3.89	A	100%	0.90	0.96	17	2.0%	1.2	2561	1.7%	20.0	2.6	16.4	17.6	2578.0	23.2	17.6
B3	2.05	A	100%	0.90	0.96	17	2.0%	1.2	1394	2.0%	20.0	2.8	8.2	9.4	1411.0	16.1	9.4
B4	1.94	A	100%	0.90	0.96	17	2.0%	1.2	1394	2.0%	20.0	2.8	8.2	9.4	1411.0	16.1	9.4

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					tc CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
B5	2.91	A	0%	0.08	0.35	170	14.0%	10.1	259	0.5%	20.0	1.4	3.1	13.1	429.0	32.8	13.1
C1	8.01	A	95%	0.81	0.88	100	2.0%	4.2	965	2.0%	20.0	2.8	5.7	9.9	1065.0	14.9	9.9
C2	5.06	A	95%	0.81	0.88	100	2.0%	4.2	627	2.0%	20.0	2.8	3.7	7.9	727.0	13.2	7.9
OS20	308.00	A	0%	0.09	0.36	300	4.0%	20.0	6670	5.0%	10.0	2.2	49.7	69.7	6970.0	81.2	69.7
OS21A	20.26	A	0%	0.09	0.36	300	2.0%	25.1	2673	2.0%	10.0	1.4	31.5	56.6	2973.0	61.0	56.6
OS21B	8.71	A	0%	0.09	0.36	100	2.0%	14.5	1167	1.5%	15.0	1.8	10.6	25.1	1267.0	43.6	25.1
OS2	17.00	A	70%	0.49	0.62	300	1.0%	19.1	3020	1.5%	15.0	1.8	27.4	46.5	3320.0	36.0	36.0
OS3	28.70	A	70%	0.49	0.62	300	1.0%	19.1	4340	1.0%	15.0	1.5	48.2	67.3	4640.0	52.6	52.6
OS4	5.08	A	20%	0.20	0.40	300	1.0%	28.1	900	5.0%	10.0	2.2	6.7	34.9	1200.0	28.3	28.3

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

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

Table 6-2. NRCS Conveyance factors, K

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

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

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

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

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

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

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
Design Storm: 5-Year

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

STREET		DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
													0.2	0.04	3.3					652	3.6	3.0	On-grade inlet, carryover flow to DP 5
	1	A1	2.06	0.51	9.7	1.05	4.17	4.4								4.2	1.01	2.0	18	5	7.2	0.0	Piped to DP 1.0
																							On-grade inlet
	2	A2	0.82	0.53	9.1	0.44	4.27	1.9								1.9	0.44	2.0	18	27	5.8	0.1	Piped to DP 1.0
	1.0								9.7	1.45	4.17	6.0				6.0	1.45	3.0	18	335	9.1	0.6	Sum of DP 1 & DP 2, piped to DP 1.2
													1.6	0.47	2.9					426	3.4	2.1	On-grade inlet, carryover flow to DP 5
	3	A3	6.76	0.47	15.0	3.16	3.53	11.1								9.5	2.69	4.7	18	36	12.2	0.0	Piped to DP 1.1
													0.1	0.03	2.9					395	3.4	1.9	On-grade inlet, carryover flow to DP 5
	4	A4	1.51	0.60	10.2	0.91	4.10	3.7								3.6	0.88	4.7	18	0	9.2	0.0	Piped to DP 1.1
	1.1								15.0	3.57	3.52	12.6				12.6	3.57	1.0	24	74	7.4	0.2	Sum of DP 3 & DP 4, piped to DP 1.2
	1.2								15.2	5.02	3.50	17.6				17.6	5.02	3.3	24	319	12.5	0.4	Sum of DP 1.0 & DP 1.1, piped to DP 1.3
	6A	A6A	0.53	0.81	5.0	0.43	5.17	2.2															Overland Flow to DP1.3A
																							On-grade inlet
	6	A6	1.37	0.58	10.0	0.79	4.14	3.3								3.3	0.79	2.0	18	0	6.7	0.0	Sum of Sub-basin A6 & Carryover flow from DP 2, Piped to DP 1.3A
	1.3A								10.0	1.22	4.14	5.0				5.0	1.22	1.0	24	36	5.7	0.1	Sum of DP 6 & DP 6A, piped to DP 1.3
																							On-grade inlet
	5	A5	1.70	0.59	9.9	0.99	4.14	4.1	17.0	1.53	3.33	5.1				5.1	1.53	2.0	18	0	7.6	0.0	Sum of Sub-basin A5 & Carryover flows from DP 1, P 3 & DP 4. Piped to DP 1.3
	1.3								17.0	7.77	3.33	25.9				25.9	7.77	1.1	36	620	9.2	1.1	Sum of DP 1.2, 1.3A & DP 5, piped to DP 1.4
																							Future storm infrastructure from Copper Chase Subdivision
	7	A7	19.00	0.45	18.3	8.55	3.22	27.5								27.5	8.55	1.5	42	20	10.3	0.0	Piped to DP 1.4
	1.4								18.4	16.32	3.22	52.5				52.5	16.32	0.5	48	26	8.2	0.1	Sum of DP 1.3 & DP 7, piped to DP 1.5
																							On-grade inlet, carryover flow to DP 11
	8	A8	1.48	0.56	13.9	0.83	3.63	3.0								3.0	0.83	2.0	18	20	6.6	0.1	Piped to DP 1.5
	1.5								18.4	17.15	3.21	55.1				55.1	17.15	0.5	48	91	8.3	0.2	Sum of DP 1.4 & DP 8, piped to DP 1.6
																							On-grade inlet
	9	A9	0.61	0.73	8.7	0.44	4.34	1.9	8.7	0.48	4.34	2.1				2.1	0.48	2.0	18	13	5.8	0.0	Sum of Sub-basin A9 & carryover flows from DP 16, piped to DP 1.6
	1.6								18.6	17.63	3.20	56.4				56.4	17.63	0.5	48	95	8.3	0.2	Sum of DP 1.5 & DP 9, piped to DP 1.8
													0.5	0.11	1.5					955	2.4	6.5	On-grade inlet, carryover flow to DP 20
	10	A10	2.61	0.79	7.9	2.05	4.49	9.2								8.7	1.94	2.5	18	118	9.5	0.2	Piped to DP 1.7
													0.6	0.15	1.5					1049	2.4	7.1	On-grade inlet, carryover flow to DP 21
	11	A11	2.89	0.76	8.7	2.20	4.34	9.5								8.9	2.05	2.5	18	0	9.4	0.0	Piped to DP 1.7
	1.7								8.7	3.99	4.34	17.3				17.3	3.99	1.0	24	8	7.9	0.0	Sum of DP 10 & DP 11, piped to DP 1.8
	1.8								18.8	21.63	3.18	68.8				68.8	21.63	2.0	54	517	14.4	0.6	Sum of DP 1.6 & DP 1.7, piped to DP 2.7
																							Future flow released from Barbarick Subdivision
	OS2	OS2	17.00	0.49	14.0	6.25	2.20	13.8								13.8	6.25	1.0	30	787	7.5	1.7	Piped to DP 2.0
																							Type C inlet
	12	A12	3.87	0.13	11.9	0.49	3.86	1.9								1.9	0.49	2.0	18	17	5.6	0.1	Piped to DP 2.0
	2.0								15.7	6.74	3.45	23.2				23.2	6.74	1.0	48	52	8.4	0.1	Sum of DP OS2 & DP 12, Piped to DP 2.1
																							Future storm infrastructure from Sterling Ranch Phase 2
	13	A13	9.65	0.45	14.0	4.34	3.62	15.7								15.7	4.34	1.5	30	200	9.1	0.4	Piped to DP 2.1

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
Design Storm: 5-Year

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	2.1								15.9	11.08	3.44	38.1				38.1	11.08	1.6	48	65	11.4	0.1	Sum of DP 2.0 & DP 13, piped to DP 2.5
	OS3	OS3	28.70	0.49	19.0	14.06	1.25	17.6								17.6	14.06	1.0	30	719	8.0	1.5	Future flow released from Barbarick Subdivision Piped to DP 2.2
	14	A14	11.76	0.39	15.3	4.59	3.49	16.0								16.0	4.59	1.0	30	20	7.8	0.0	Future flow released from School Site Piped to DP 2.2
	2.2								20.5	18.65	3.05	56.9				56.9	18.65	1.5	48	773	12.4	1.0	Sum of DP OS3 & DP 14, piped to DP 2.3
	15	A15	2.91	0.52	14.9	1.52	3.53	5.4								5.4	1.52	1.3	18	35	6.5	0.1	On-grade inlet Piped to DP 2.3
	16	A16	2.34	0.54	14.7	1.25	3.55	4.4					0.1	0.04	0.8	4.3	1.21	2.0	18	697 12	1.8 7.2	6.5 0.0	On-grade inlet, carryover flow to DP 9 Piped to DP 2.3
	2.3								15.0	2.73	3.52	9.6				9.6	2.73	1.6	48	51	7.6	0.1	Sum of DP 15 & DP 16, piped to DP 2.4
	2.4								21.5	21.38	2.98	63.7				63.7	21.38	1.6	48	19	13.1	0.0	Sum of DP 2.2 & DP 2.3, piped to DP 2.5
	2.5								21.6	32.46	2.98	96.6				96.6	32.46	2.0	60	839	15.8	0.9	Sum of DP 2.1 & DP 2.4 piped to DP 2.6
	17	A17	1.76	0.21	13.7	0.38	3.66	1.4								1.4	0.38	1.0	18	24	4.1	0.1	Type C inlet Piped to DP 2.6
	2.6								21.6	32.84	2.98	97.8				97.8	32.84	2.0	60	32	15.8	0.0	Sum of DP 2.5 & DP 17, piped to DP 2.7
	2.7								21.6	54.47	2.97	162.0				162.0	54.47	0.6	78	220	11.5	0.3	Sum of DP1.8 & DP 2.6, piped to DP 2.8
	18	A18	5.27	0.24	16.4	1.28	3.38	4.3								4.3	1.28	1.0	18	24	5.6	0.1	Area inlet Piped to DP 2.6
	19	A19	31.85	0.45	25.8	14.33	2.71	38.8								38.8	14.33	1.0	18	24	22.0	0.0	Area inlet Piped to DP 2.6
	2.8								25.8	70.08	2.71	189.8				189.8	70.08	0.6	78	145	12.1	0.2	Sum of DP 2.7, DP 18 & DP 19, piped to DP 3.0.
	3.0								25.8	70.08	2.71	189.8	189.8	70.08	0.5					584	1.4	6.9	Detention Pond Trickle channel conveyance to DP 3.2
	20	A20	1.83	0.81	8.0	1.48	4.47	6.6	8.0	1.59	4.47	7.1				7.1	1.59	1.0	24	105	6.4	0.3	On-grade inlet Sum of Sub-basin A20 & carryover flow from DP 10, piped to DP 3.0
	21	A21	1.93	0.82	8.7	1.57	4.33	6.8	8.7	1.72	4.33	7.4	0.1	0.03	1.5	7.3	1.68	2.5	18	0	9.0	0.0	On-grade inlet Sum of Sub-basin A21 & carryover flow from DP 11, piped to DP 2.9
	2.9								8.7	3.27	4.33	14.2				14.2	3.27	2.0	24	58	9.8	0.1	Sum of DP 20 & DP 21,piped to DP 3.1
	3.1								8.7	3.27	4.33	14.2	14.2	3.27	0.5					568	1.4	6.7	Detention Pond Trickle channel conveyance to DP 3.2
	22	A22	8.68	0.11	23.3	0.95	2.86	2.7															Detention Pond Overland flow to DP 3.2
	OS4	OS4	5.08	0.20	28.3	1.02	2.57	2.6					2.6	1.02	13.0					113	5.4	0.3	Existing topography Overland flow to DP 4.1
	3.2								28.6	75.32	2.55	192.2											Outlet Structure Sum of DP 3.0, DP 3.1, DP 22 & DP OS4, outlet structure release to DP 4.8
	Pond A								28.6	1.45	2.55	3.7				3.7	1.45	2.0	48	58	6.1	0.2	Outlet structure release to DP 4.8
	23	B1	2.98	0.90	17.6	2.68	3.29	8.8					0.4	0.12	2.0	8.4	2.56	0.5	30	1399 88	2.0 5.1	12.0 0.3	On-grade inlet Piped to DP 4.0

SCS calculation for this basin?

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
Design Storm: 5-Year

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	24	B2	3.89	0.90	17.6	3.50	3.29	11.5					1.4	0.43	2.0	10.1	3.07	2.0	30	1399 0	2.0 8.8	12.0 0.0	On-grade inlet Piped to DP 4.0
	4.0								17.8	5.63	3.26	18.4				18.4	5.63	3.0	30	40	12.1	0.1	Sum of DP 23 & DP 24, piped to DP 4.1
	25	OS20	308.00	0.09	69.7	27.72	1.22	33.7					33.7	27.72	2.0					24	2.1	0.2	Existing topography Overland flow to DP 4.1
	4.1								69.9	33.35	1.21	40.4	40.4	33.35	1.0					1263	1.5	14.0	Sum of DP 4.0 & DP 25, piped to DP 4.3
	26	OS21A	20.26	0.09	56.6	1.82	1.53	2.8					2.8	1.82	1.0					0	2.0	0.0	Existing topography Overland flow to DP 4.3
	27	B3	2.05	0.90	9.4	1.85	4.22	7.8	9.4	1.97	4.22	8.3				8.3	1.97	1.0	30	70	6.5	0.2	Sump inlet Piped to DP 4.2
	28	B4	1.94	0.90	9.4	1.75	4.22	7.4	12.0	2.18	3.86	8.4				8.4	2.18	1.0	30	0	6.5	0.0	Sump inlet Piped to DP 4.2
	4.2								12.0	4.15	3.86	16.0				16.0	4.15	1.0	30	110	7.8	0.2	Sum of DP 27 & DP 28, piped to DP 4.3
	4.3								83.9	39.32	0.94	36.9	36.9	39.32	0.5					192	1.1	3.0	Sum of DP 4.1, DP 4.2, & DP 26, piped to DP 4.5
	29	OS21B	8.71	0.09	25.1	0.78	2.75	2.1								2.1	0.78	1.0	30	719	4.4	2.7	Type D Inlet Piped to DP 4.4
	4.4								25.1	0.78	2.75	2.1	2.1	0.78	0.5					289	1.4	3.4	Detention Pond Trickle channel conveyance to DP 4.5
	30	B5	2.91	0.08	13.1	0.23	3.72	0.9															Detention Pond Overland flow to DP 4.5
	4.5								83.9	40.33	0.94	37.8				37.8	40.33						Outlet Structure Sum of DP 4.3, DP 4.4, & DP 30, outlet structure release to DP 4.6
	Pond B								83.9	10.09	0.94	9.5				9.5	10.09	1.7	66	311	7.5	0.7	Outlet structure release to DP 4.6
	31	C1	8.01	0.81	9.9	6.49	0.32	2.0								2.0	6.49	2.0	36	52	5.3	0.2	Future Commercial Site, Full spectrum pond release Piped to DP 4.6
	4.6								84.6	46.82	0.93	43.3				43.3	46.82	2.5	60	1598	13.5	2.0	Sum of Pond B & DP 31, piped to DP 4.7
	32	C2	5.06	0.81	7.9	2.00	0.70	1.4								1.4	2.00	2.0	36	52	4.7	0.2	Future Commercial Site, Full spectrum pond release Piped to DP 4.7
	4.7								84.6	48.82	0.93	45.2				45.2	48.82	0.5	66	1004	7.7	2.2	Sum of DP 4.6 & DP 32, piped to DP 4.8
	4.8								84.6	50.27	0.93	46.5				46.5	50.27	0.5	72				Sum of DP DP 4.7 & Pond A, Outfall to Sandcreek Drainageway

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
Design Storm: 100-Year

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

		DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			
Description	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
													2.8	0.40	3.3					652	3.6	3.0	On-grade inlet, carryover flow to DP 5
	1	A1	2.06	0.65	9.7	1.34	7.01	9.4								6.6	0.94	2.0	18	5	8.2	0.0	Piped to DP 1.0
													0.1	0.01	3.3					639	3.6	2.9	On-grade inlet, carryover flow to DP 6
	2	A2	0.82	0.66	9.1	0.54	7.17	3.9								3.8	0.53	2.0	18	27	7.0	0.1	Piped to DP 1.0
	1.0								9.7	1.47	7.00	10.3				10.3	1.47	3.0	18	335	10.6	0.5	Sum of DP 1 & DP 2, piped to DP 1.2
													10.0	1.69	2.9					426	3.4	2.1	On-grade inlet, carryover flow to DP 5
	3	A3	6.76	0.62	15.0	4.17	5.92	24.7								14.7	2.48	4.7	18	36	13.6	0.0	Piped to DP 1.1
													1.6	0.24	2.9					395	3.4	1.9	On-grade inlet, carryover flow to DP 5
	4	A4	1.51	0.71	10.2	1.08	6.88	7.4								5.8	0.84	4.7	18	0	10.7	0.0	Piped to DP 1.1
	1.1								15.0	3.33	5.91	19.7				19.7	3.33	1.0	24	74	8.1	0.2	Sum of DP 3 & DP 4, piped to DP 1.2
	1.2								15.1	4.80	5.89	28.2				28.2	4.80	3.3	24	319	13.9	0.4	Sum of DP 1.0 & DP 1.1, piped to DP 1.3
	6A	A6A	0.53	0.88	5.0	0.47	8.68	4.1															Overland Flow to DP1.3A
													1.3	0.18	0.7					696	1.7	7.0	On-grade inlet, carryover flow to DP 8
	6	A6	1.37	0.70	10.0	0.95	6.94	6.6	10.0	0.96	6.94	6.7				5.4	0.78	2.0	18	0	7.7	0.0	Sum of Sub-basin A6 & Carryover flow from DP 2, Piped to DP 1.3A
	1.3A								10.0	1.25	6.94	8.7				8.7	1.25	1.0	24	36	6.7	0.1	Sum of DP 6 & DP 6A, piped to DP 1.3
													6.5	1.17	0.7					664	1.7	6.6	On-grade inlet, carryover flow to DP 8
	5	A5	1.70	0.70	9.9	1.19	6.95	8.3	17.0	3.51	5.59	19.6				13.1	2.34	2.0	18	0	9.4	0.0	Sum of Sub-basin A5 & Carryover flows from DP 1, P 3 & DP 4. Piped to DP 1.3
	1.3								17.0	8.39	5.59	46.9				46.9	8.39	1.1	36	620	10.7	1.0	Sum of DP 1.2, 1.3A & DP 5, piped to DP 1.4
																							Future storm infrastructure from Copper Chase Subdivision
	7	A7	19.00	0.59	18.3	11.21	5.41	60.6								60.6	11.21	1.5	42	20	12.7	0.0	Piped to DP 1.4
	1.4								18.4	19.60	5.40	105.9				105.9	19.60	0.5	48	26	9.2	0.0	Sum of DP 1.3 & DP 7, piped to DP 1.5
													1.9	0.41	0.7					195	1.7	1.9	On-grade inlet, carryover flow to DP 11
	8	A8	1.48	0.70	13.9	1.04	6.10	6.3	23.7	2.63	4.76	12.5				10.6	2.23	2.0	18	20	9.1	0.0	Sum of Sub-basin A8 & Carryover flows from DP5, DP 6 & DP 15, Piped to DP 1.5
	1.5								23.7	21.83	4.76	103.9				103.9	21.83	0.5	48	91	9.2	0.2	Sum of DP 1.4 & DP 8, piped to DP 1.6
													0.3	0.05	0.7					140	1.7	1.4	On-grade inlet, carryover flow to DP 11
	9	A9	0.61	0.83	8.7	0.51	7.29	3.7	21.2	0.95	5.04	4.8				4.5	0.89	2.0	18	13	7.3	0.0	Sum of Sub-basin A9 & carryover flows from DP 16, piped to DP 1.6
	1.6								23.9	22.72	4.74	107.7				107.7	22.72	0.5	48	95	9.1	0.2	Sum of DP 1.5 & DP 9, piped to DP 1.8
													4.5	0.59	1.5					955	2.4	6.5	On-grade inlet, carryover flow to DP 20
	10	A10	2.61	0.88	7.9	2.29	7.53	17.3								12.8	1.70	2.5	18	118	10.3	0.2	Piped to DP 1.7
													6.1	0.90	1.5					1049	2.4	7.1	On-grade inlet, carryover flow to DP 21
	11	A11	2.89	0.86	8.7	2.48	7.28	18.1	10.6	2.94	6.77	19.9				13.8	2.04	2.5	18	0	10.4	0.0	Sum of Sub-basin A11 & carryover flows from DP 8 & DP 9, piped to DP 1.7
	1.7								10.6	3.74	6.77	25.3				25.3	3.74	1.0	24	8	8.1	0.0	Sum of DP 10 & DP 11, piped to DP 1.8
	1.8								24.0	26.45	4.72	125.0				125.0	26.45	2.0	54	517	17.0	0.5	Sum of DP 1.6 & DP 1.7, piped to DP 2.7
																							Future flow released from Barbarick Subdivision
	OS2	OS2	17.00	0.62	12.0	10.54	3.71	39.1								39.1	10.54	1.0	30	787	9.5	1.4	Piped to DP 2.0
																							Type C inlet
	12	A12	3.87	0.38	11.9	1.47	6.49	9.5								9.5	1.47	2.0	18	17	8.9	0.0	Piped to DP 2.0
	2.0								13.4	12.01	6.20	74.5				74.5	12.01	1.0	48	52	11.6	0.1	Sum of DP OS2 & DP 12, Piped to DP 2.1
																							Future storm infrastructure from Sterling Ranch Phase 2
	13	A13	9.65	0.59	14.0	5.69	6.08	34.6								34.6	5.69	1.5	30	200	11.0	0.3	Piped to DP 2.1

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
esign Storm: 100-Year

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	2.1								14.3	17.70	6.02	106.6				106.6	17.70	1.6	48	65	15.1	0.1	Sum of DP 2.0 & DP 13, piped to DP 2.5
	OS3	OS3	28.70	0.62	15.0	17.79	2.75	48.9								48.9	17.79	1.0	30	719	10.0	1.2	Future flow released from Barbarick Subdivision Piped to DP 2.2
	14	A14	11.76	0.55	15.3	6.47	5.86	37.9								37.9	6.47	1.0	30	20	9.5	0.0	Future flow released from School Site Piped to DP 2.2
	2.2								16.2	24.26	5.72	138.7				138.7	24.26	1.5	48	773	15.5	0.8	Sum of DP OS3 & DP 14, piped to DP 2.3
	15	A15	2.91	0.68	14.9	1.98	5.93	11.7					1.4	0.24	0.7	10.3	1.74	1.3	18	724 35	1.7 7.6	7.2 0.1	On-grade inlet, carryover flow to DP 8 Piped to DP 2.3
	16	A16	2.34	0.69	14.7	1.61	5.96	9.6					2.6	0.44	0.8	7.0	1.17	2.0	18	697 12	1.8 8.2	6.5 0.0	On-grade inlet, carryover flow to DP 9 Piped to DP 2.3
	2.3								15.0	2.91	5.91	17.2				17.2	2.91	1.6	48	15	9.0	0.0	Sum of DP 15 & DP 16, piped to DP 2.4
	2.4								17.0	27.17	5.59	151.9				151.9	27.17	1.6	48	19	16.2	0.0	Sum of DP 2.2 & DP 2.3, piped to DP 2.5
	2.5								17.1	44.87	5.59	250.7				250.7	44.87	2.0	60	839	20.1	0.7	Sum of DP 2.1 & DP 2.4 piped to DP 2.6
	17	A17	1.76	0.44	13.7	0.77	6.14	4.7								4.7	0.77	1.0	18	24	5.7	0.1	Type C inlet Piped to DP 2.6
	2.6								17.7	45.64	5.49	250.4				250.4	45.64	2.0	60	32	20.2	0.0	Sum of DP 2.5 & DP 17, piped to DP 2.7
	2.7								24.5	72.10	4.67	336.8				336.8	72.10	0.6	78	220	13.7	0.3	Sum of DP1.8 & DP 2.6, piped to DP 2.8
	18	A18	5.27	0.47	16.4	2.47	5.68	14.0								14.0	2.47	1.0	18	24	7.9	0.1	Area inlet Piped to DP 2.6
	19	A19	31.85	0.59	25.8	18.79	4.55	85.4								85.4	18.79	1.0	18	24	48.4	0.0	Area inlet Piped to DP 2.6
	2.8								25.8	93.36	4.55	424.4				424.4	93.36	0.6	78	145	13.9	0.2	Sum of DP 2.7, DP 18 & DP 19, piped to DP 3.0.
	3.0								25.8	93.36	4.55	424.4	424.4	93.36	0.5					564	1.4	6.6	Detention Pond Trickle channel conveyance to DP 3.2
	20	A20	1.83	0.89	8.0	1.63	7.50	12.2	14.4	2.22	6.02	13.4	2.3	0.38	1.5	11.1	1.84	1.0	24	105	7.2	0.2	On-grade inlet Sum of Sub-basin A20 & carryover flow from DP 10, piped to DP 3.0
	21	A21	1.93	0.90	8.7	1.73	7.28	12.6	15.8	2.63	5.77	15.2	3.3	0.57	1.5	11.9	2.06	2.5	18	0	10.2	0.0	On-grade inlet Sum of Sub-basin A21 & carryover flow from DP 11, piped to DP 2.9
	2.9								15.8	3.91	5.77	22.5				22.5	3.91	2.0	24	58	11.0	0.1	Sum of DP 20 & DP 21,piped to DP 3.1
	3.1								15.8	3.91	5.77	22.5	22.5	3.91	0.5					568	1.4	6.7	Detention Pond Trickle channel conveyance to DP 3.2
	22	A22	8.68	0.37	23.3	3.21	4.80	15.4															Detention Pond Overland flow to DP 3.2
	OS4	OS4	5.08	0.40	28.3	2.03	4.31	8.8					8.8	2.03	13.0					113	5.4	0.3	Existing topography Overland flow to DP 3.2
	3.2								28.6	102.50	4.28	438.9											Outlet Structure Sum of DP 3.0, DP 3.1, DP 22 & DP OS4, outlet structure release to DP 4.8
	Pond A								28.6	34.84	4.28	149.2				149.2	34.84	2.0	48	58	17.6	0.1	Outlet structure release to DP 4.8
	23	B1	2.98	0.96	17.6	2.86	5.51	15.8					3.6	0.65	2.0	12.2	2.21	0.5	30	1394 88	2.1 5.7	11.0 0.3	On-grade inlet Piped to DP 4.0
	24	B2	3.89	0.96	17.6	3.73	5.51	20.6					6.5	1.17	2.0	14.1	2.56	2.0	30	1394 0	2.1 9.7	11.0 0.0	On-grade inlet Piped to DP 4.0

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Filing No. 2
Location: El Paso County
Design Storm: 100-Year

Project Name: Sterling Ranch Subdivision
Project No.: 25188.01
Calculated By: AAM
Checked By:
Date: 5/15/20

Description	Design Point	DIRECT RUNOFF: Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	TOTAL RUNOFF: *tc* (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	STREET/SWALE: $Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	PIPE: Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	TRAVEL TIME: Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	4.0								17.8	4.77	5.48	26.1				26.1	4.77	3.0	30	40	13.4	0.0	Sum of DP 23 & DP 24, piped to DP 4.1
	25	OS20	308.00	0.36	69.7	110.88	2.04	226.1					226.1	110.88	2.0					24	2.1	0.2	Existing topography Overland flow to DP 4.1
	4.1								69.7	115.65	2.04	235.9	235.9	115.65	1.0					1263	1.5	14.0	Sum of DP 4.0 & DP 25, piped to DP 4.3
	26	OS21A	20.26	0.36	56.6	7.29	2.56	18.7					18.7	7.29	1.0					0	2.0	0.0	Existing topography Overland flow to DP 4.3
	27	B3	2.05	0.96	9.4	1.97	7.09	14.0	17.6	2.62	5.51	14.4				14.4	2.62	1.0	30	70	7.6	0.2	Sump inlet Piped to DP 4.2
	28	B4	1.94	0.96	9.4	1.86	7.09	13.2	17.6	3.03	5.51	16.7				16.7	3.03	1.0	30	0	8.0	0.0	Sump inlet Piped to DP 4.2
	4.2								17.7	5.65	5.49	31.0				31.0	5.65	1.0	30	110	9.2	0.2	Sum of DP 27 & DP 28, piped to DP 4.3
	4.3								69.7	128.59	2.04	262.3	262.3	128.59	0.5					192	1.1	3.0	Sum of DP 4.1, DP 4.2, & DP 26, piped to DP 4.5
	29	OS21B	8.71	0.36	25.1	3.14	4.61	14.5								14.5	3.14	1.0	30	719	7.6	1.6	Type D Inlet Piped to DP 4.4
	4.4								25.1	3.14	4.61	14.5	14.5	3.14	0.5					289	1.4	3.4	Detention Pond Trickle channel conveyance to DP 4.5
	30	B5	2.91	0.35	13.1	1.02	6.25	6.4															Detention Pond Overland flow to DP 4.5
	4.5								69.7	132.75	2.04	270.7				270.7	132.75						Outlet Structure Sum of DP 4.3, DP 4.4, & DP 30, outlet structure release to DP 4.6
	Pond B								69.7	112.40	2.04	229.2				229.2	112.40	1.7	66	311	18.6	0.3	Outlet structure release to DP 4.6
	31	C1	8.01	0.88	9.9	7.05	2.13	15.0								15.0	7.05	2.0	36	52	9.8	0.1	Future Commercial Site, Full spectrum pond release Piped to DP 4.6
	4.6							`	70.0	119.45	2.03	242.4				242.4	119.45	2.5	60	1598	21.8	1.2	Sum of Pond B & DP 31, piped to DP 4.7
	32	C2	5.06	0.88	7.9	1.32	7.54	10.0								10.0	1.32	2.0	36	52	8.6	0.1	Future Commercial Site, Full spectrum pond release Piped to DP 4.7
	4.7								70.0	120.77	2.03	245.1				245.1	120.77	0.5	66	1004	11.4	1.5	Sum of DP 4.6 & DP 32, piped to DP 4.8
	4.8								70.0	155.61	2.03	315.8				315.8	155.61	0.5	72				Sum of DP DP 4.7 & Pond A, Outfall to Sandcreek Drainageway

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

(Inlet calculations not checked on this review.)

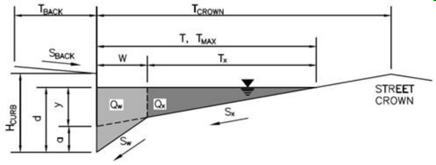
Version 4.05 Released March 2017

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

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

Project: Sterling Ranch Filing No. 2

Inlet ID: A1



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	1.17	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 =	0.027	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

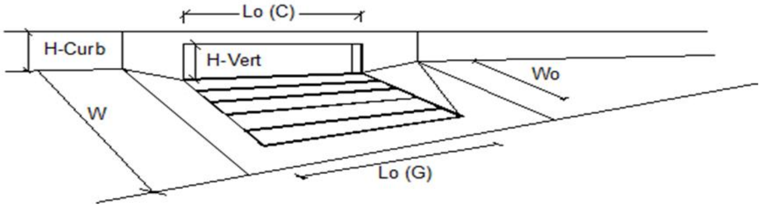
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.1**	**16.7**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**4.2**	**6.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.2**	**2.8**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**95**	**70**	**%**

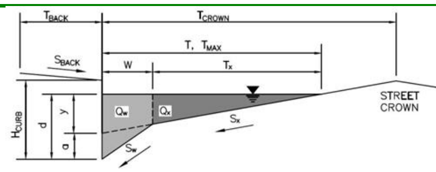
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A2**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	1.17	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 =	0.027	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐		check = yes

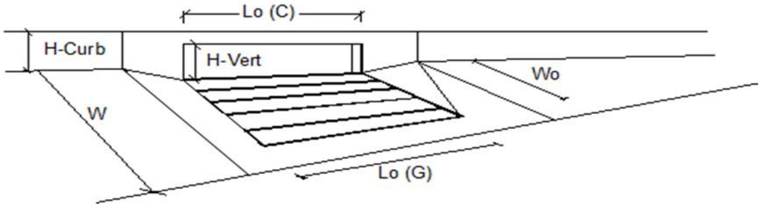
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.1**	**16.7**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.9**	**3.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**97**	**%**

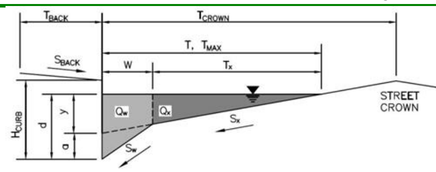
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A3**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	1.17	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 =	0.026	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

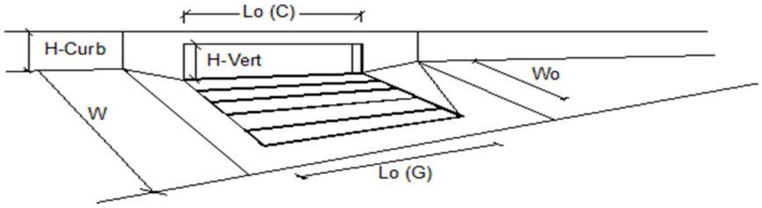
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**12.9**	**41.5**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.5**	**14.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.6**	**10.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**86**	**60**	**%**

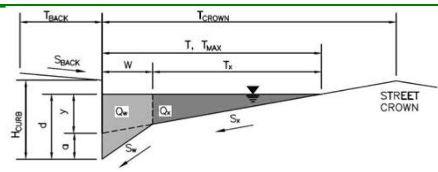
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A4**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	1.17	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 =	0.026	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

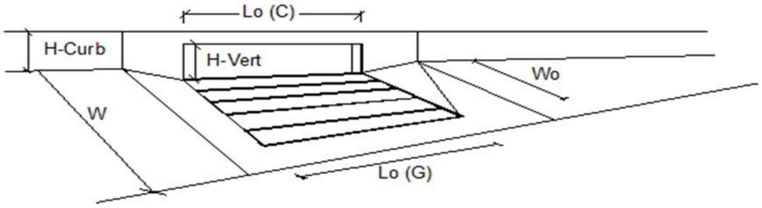
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**12.9**	**41.5**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.6**	**5.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**1.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**78**	**%**

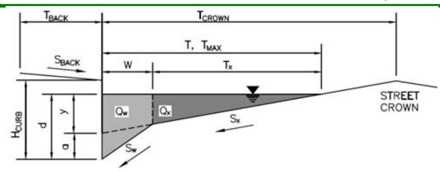
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A6**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		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} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	1.17		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 =	0.026		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

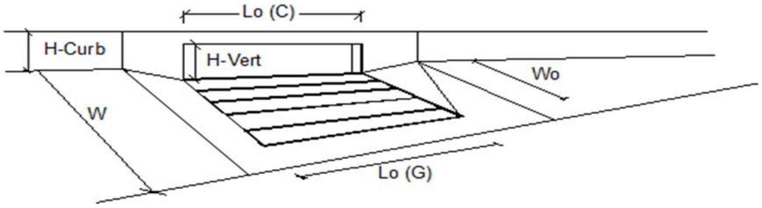
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.9**	**41.5**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.3**	**5.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**81**	**%**

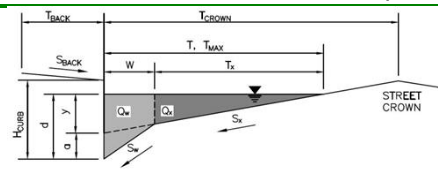
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A5**



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	1.17	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 =	0.029	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

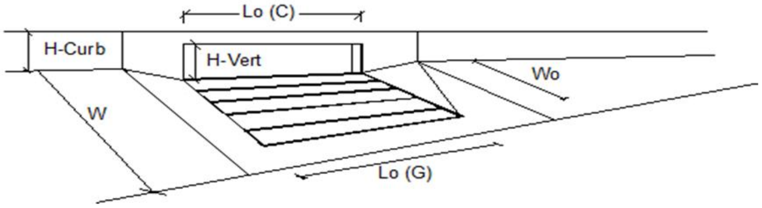
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.6**	**40.2**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.1**	**13.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**6.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**67**	**%**

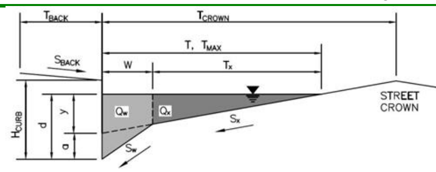
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A8**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	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 =	0.007	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

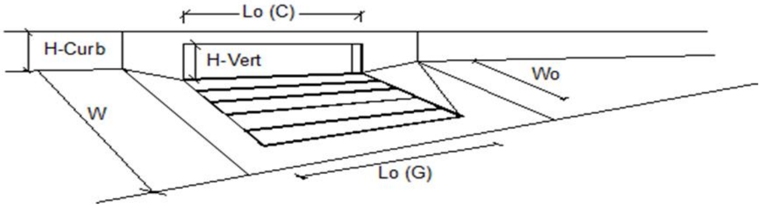
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	19.3	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.7	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**11.5**	**26.7**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.0**	**10.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

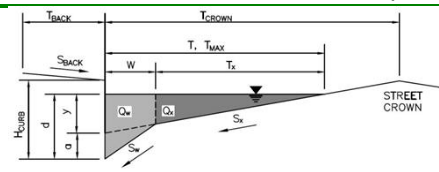
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A15**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	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 =	0.023	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

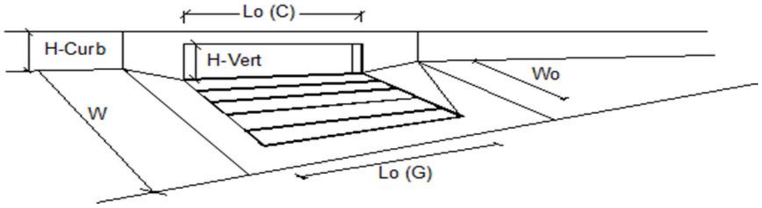
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	19.3	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.7	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**19.2**	**36.4**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.4**	**10.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**88**	**%**

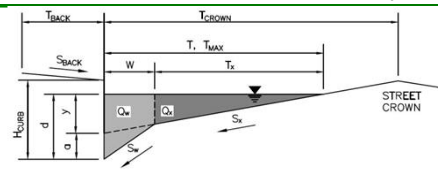
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A16**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	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 =	0.023	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	19.3	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.7	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

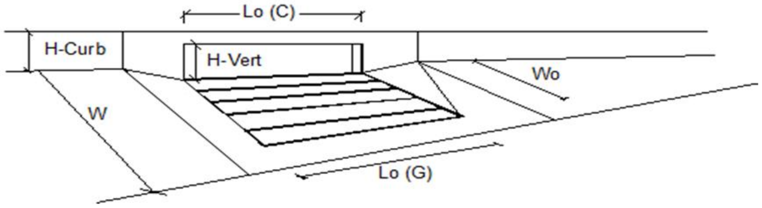
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**19.2**	**36.4**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.3**	**7.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**2.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**97**	**73**	**%**

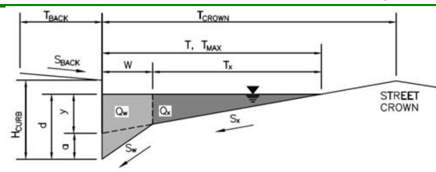
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A9**



Gutter Geometry (Enter data in the blue cells)

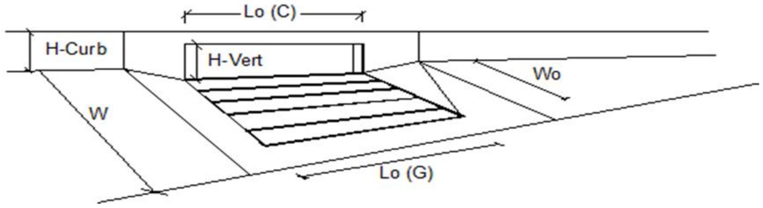
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0		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 =	0.007		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	19.3	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.7	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**11.5**	**26.9**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.1**	**4.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**94**	**%**

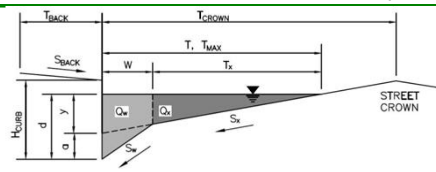
Version 4.05 Released March 2017

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

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

Project: Sterling Ranch Filing No. 2

Inlet ID: A10



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	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 =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.1	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

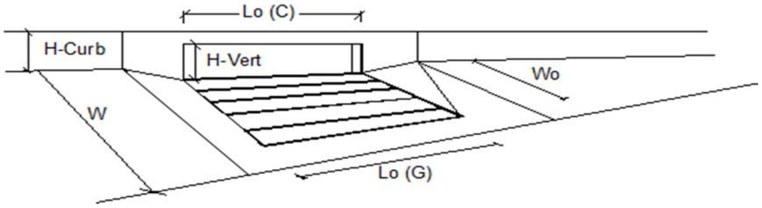
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**15.2**	**63.8**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.7**	**12.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.5**	**4.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**94**	**74**	**%**

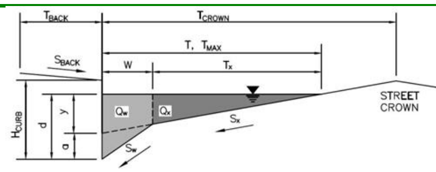
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A11**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	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 =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

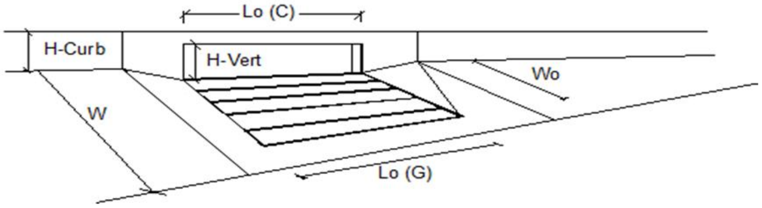
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.1	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**15.1**	**63.3**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.9**	**13.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.6**	**6.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**69**	**%**

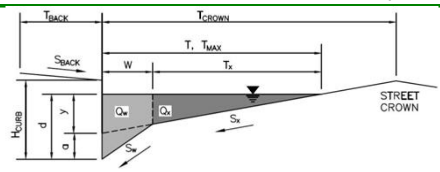
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A20**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.1	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

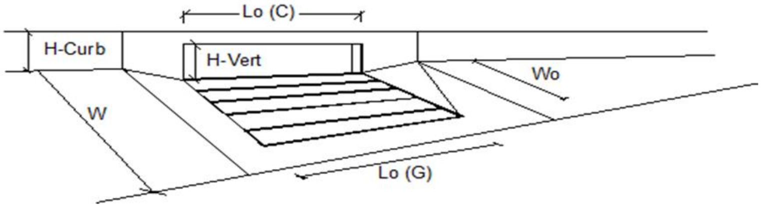
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**16.9**	**70.8**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**7.1**	**11.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**83**	**%**

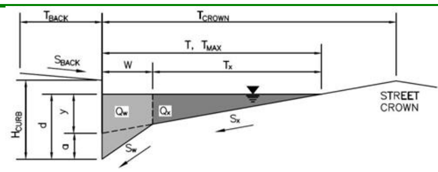
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **A21**



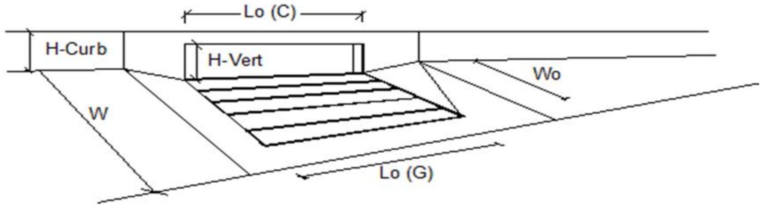
Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0		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 =	0.015		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.1	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**16.9**	**70.8**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



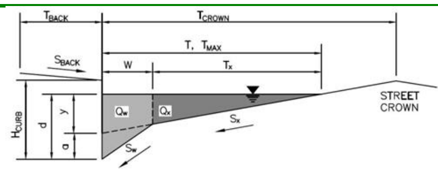
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**7.3**	**11.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.1**	**3.3**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**99**	**79**	**%**

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

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

Project: Sterling Ranch Filing No. 2

Inlet ID: B1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	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 =	0.017	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

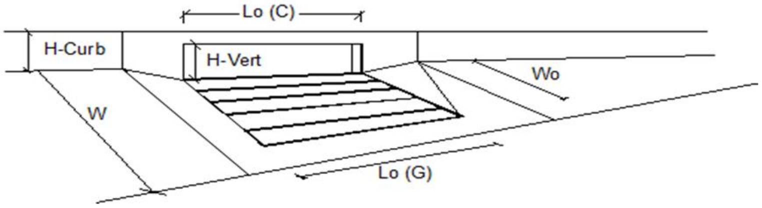
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	28.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**18.0**	**85.4**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.4**	**12.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.4**	**3.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**96**	**77**	**%**

Type of Inlet selection: CDOT Type R Curb Opening

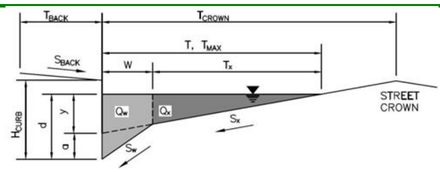
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **B2**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	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 =	0.017	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	28.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

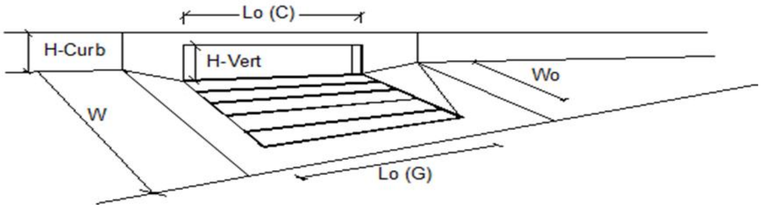
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**18.0**	**85.4**	**cfs**

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'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**10.1**	**14.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.4**	**6.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**88**	**68**	**%**

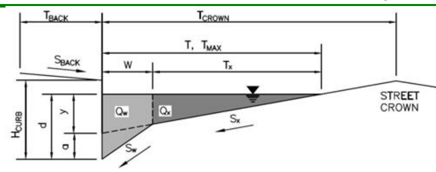
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **B3**



Gutter Geometry (Enter data in the blue cells)

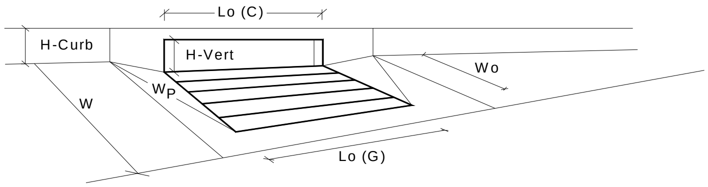
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	28.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



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	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
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	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 (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.34	0.50	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.75	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.94	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.4**	**16.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	8.3	14.4	cfs

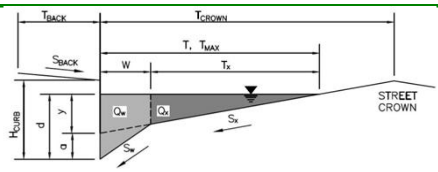
Version 4.05 Released March 2017

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

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

Project: **Sterling Ranch Filing No. 2**

Inlet ID: **B4**



Gutter Geometry (Enter data in the blue cells)

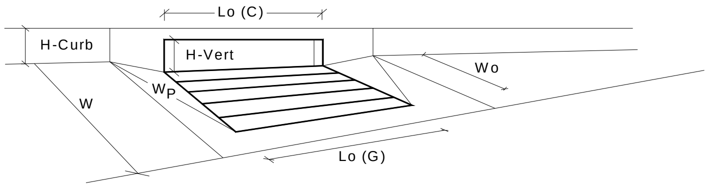
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	28.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	9.4	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
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	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 (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.34	0.62	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	0.89	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.94	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**8.5**	**21.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	8.4	16.7	cfs

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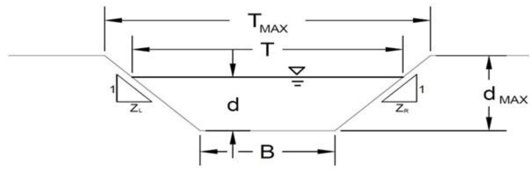
AREA INLET IN A SWALE

Sterling Ranch Filing No. 2

A12



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	A	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	18.00	18.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	2.00	2.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	13.2	13.2	cfs
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	2.00	2.00	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	1.9	9.5	cfs
Water Depth	d =	0.85	1.79	feet

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

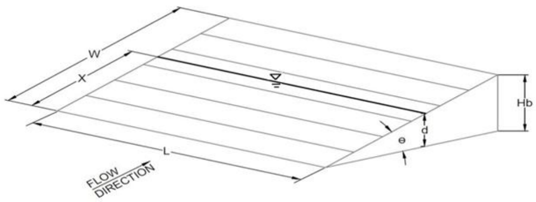
AREA INLET IN A SWALE

Sterling Ranch Filing No. 2

A12

Inlet Design Information (Input)

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



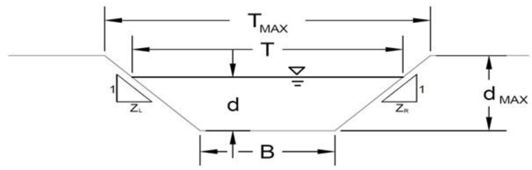
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.85	1.79	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**14.5**	**21.6**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Sterling Ranch Filing No. 2

A17



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	A		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below		
Channel Invert Slope	S_O =	0.0130		ft/ft
Bottom Width	B =	2.00		ft
Left Side Slope	Z1 =	4.00		ft/ft
Right Side Slope	Z2 =	4.00		ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	18.00	18.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	2.00	2.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	9.9	9.9	cfs
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	2.00	2.00	ft

Water Depth in Channel Based On Design Peak Flow

		Minor Storm	Major Storm	
Design Peak Flow	Q_o =	1.4	4.7	cfs
Water Depth	d =	0.79	1.46	feet

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

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

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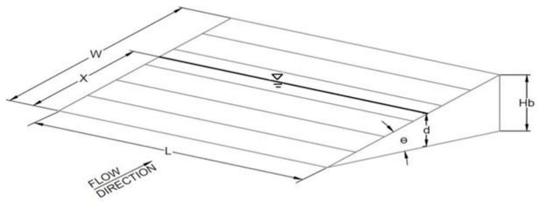
AREA INLET IN A SWALE

Sterling Ranch Filing No. 2

A17

Inlet Design Information (Input)

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



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.79	1.46	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**13.1**	**19.5**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

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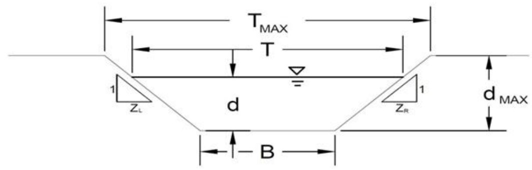
AREA INLET IN A SWALE

Sterling Ranch Filing No. 2

OS21B



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	A		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below		
Channel Invert Slope	S_O =	0.0200		ft/ft
Bottom Width	B =	10.00		ft
Left Side Slope	Z1 =	4.00		ft/ft
Right Side Slope	Z2 =	4.00		ft/ft

Check one of the following soil types:

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

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

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	26.00	26.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	2.00	2.00	feet

Allowable Channel Capacity Based On Channel Geometry		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	56.1	56.1	cfs
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	2.00	2.00	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	2.1	14.5	cfs
Water Depth	d =	0.47	1.45	feet

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

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

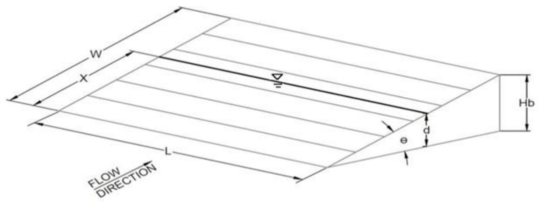
AREA INLET IN A SWALE

Sterling Ranch Filing No. 2

OS21B

Inlet Design Information (Input)

Type of Inlet	CDOT Type D (In Series)	Inlet Type =	CDOT Type D (In Series)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	feet
Length of Grate		L =	6.00	feet
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	feet
Clogging Factor		C_f =	0.38	
Grate Discharge Coefficient		C_d =	0.78	
Orifice Coefficient		C_o =	0.52	
Weir Coefficient		C_w =	1.67	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.47	1.45	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.5**	**39.6**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Some velocities are too high.

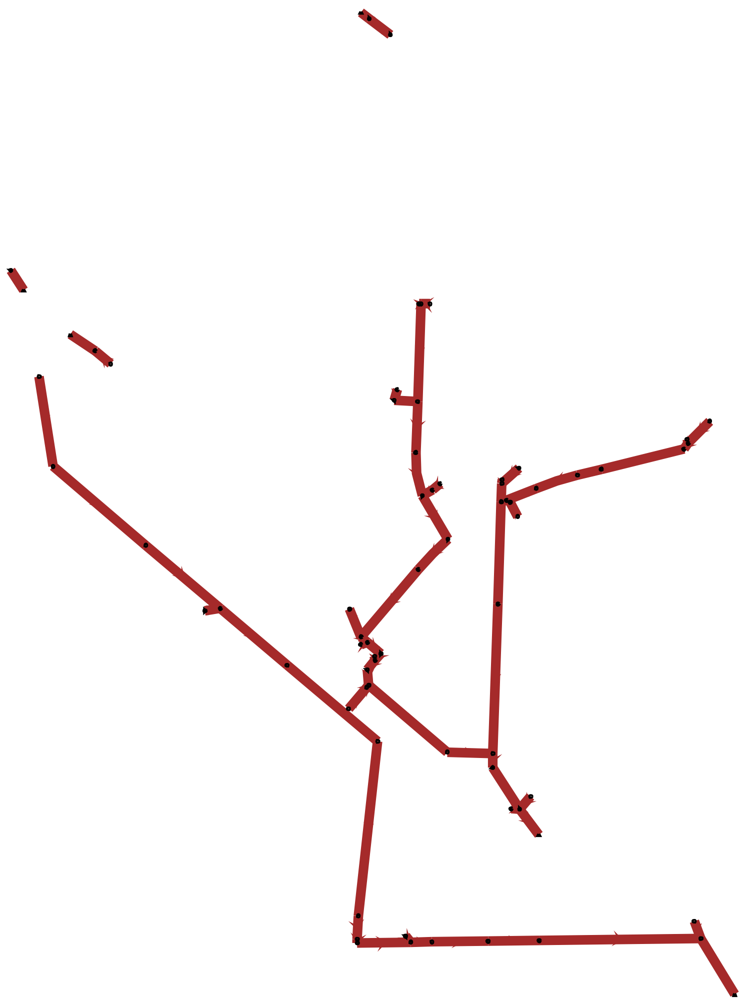
Scenario: 5-YEAR
Current Time Step: 0.000Hr
Conduit FlexTable: Combined Pipe/Node Report

Upstream Structure	Label	Flow (cfs)	Diameter (in)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	HGL (Up) (ft)	HGL (Down) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Velocity (ft/s)	Upstream Structure Headloss Coefficient	Length (User Defined) (ft)
Structure - (850) (SR-F2 Storm)	CO-1	38.80	42.0	-0.009	6,969.24	6,969.77	6,978.85	6,973.34	6,971.70	6,970.85	6,972.49	6,972.10	9.45	0.000	-
Storm_18_Inlet_1 (SR-F2 Storm)	CO-2	17.30	30.0	-0.013	6,977.52	6,977.65	6,987.83	6,988.08	6,979.52	6,979.43	6,979.78	6,979.76	3.52	0.500	-
Structure - (849) (SR-F2 Storm)	CO-3	16.00	36.0	-0.029	7,000.88	7,004.00	7,010.52	7,007.35	7,005.28	7,001.65	7,005.76	7,003.61	11.35	0.000	-
Storm_19_Lat_2_Inlet_2 (SR-F2 Storm)	CO-5	9.50	18.0	-0.014	7,005.77	7,006.30	7,010.20	7,010.21	7,007.49	7,006.78	7,008.11	7,007.66	7.71	0.000	-
Structure - (845) (SR-F2 Storm)	CO-6	23.20	48.0	-0.092	6,987.11	6,988.38	6,994.13	6,993.12	6,989.80	6,989.67	6,990.32	6,989.79	18.42	0.000	-
VT2_Inlet_2 (SR-F2 Storm)	CO-7	8.40	30.0	-0.007	7,042.60	7,043.24	7,046.08	7,049.26	7,044.40	7,044.46	7,044.62	7,044.53	5.75	0.000	-
Structure - (842) (SR-F2 Storm)	Pipe - (28) (SR-F2 Storm)	0.50	24.0	-0.030	6,991.05	6,995.39	6,998.83	7,002.50	6,995.63	6,992.68	6,995.71	6,992.68	4.31	0.000	144.7
STRM_MH_24 (SR-F2 Storm)	Pipe - (29) (1) (1) (SR-F2 Storm)	6.00	18.0	-0.030	7,000.89	7,011.08	7,008.01	7,020.06	7,012.02	7,002.58	7,012.43	7,002.76	9.23	1.000	339.5
STRM_MH_23 (SR-F2 Storm)	Pipe - (29) (SR-F2 Storm)	17.60	24.0	-0.030	6,995.39	7,000.69	7,002.50	7,008.01	7,002.21	6,996.33	7,002.95	6,998.62	12.14	0.500	177.0
Storm_19_Lat_1_Inlet_1 (SR-F2 Storm)	Pipe - (35) (SR-F2 Storm)	5.00	24.0	-0.030	6,991.56	6,992.65	6,998.83	6,999.02	6,993.44	6,992.68	6,993.73	6,992.80	8.56	0.500	36.4
Structure - (65) (SR-F2 Storm)	Pipe - (39) (SR-F2 Storm)	2.20	18.0	-0.030	6,992.84	6,993.85	6,999.02	6,995.57	6,994.41	6,993.59	6,994.61	6,993.68	6.96	0.000	33.7
Storm_19_Lat_3_Inlet_1 (SR-F2 Storm)	Pipe - (47) (SR-F2 Storm)	4.20	18.0	0.030	7,011.47	7,011.29	7,020.35	7,020.06	7,012.32	7,012.43	7,012.58	7,012.56	8.38	0.000	6.0
Storm_19_Lat_3_Inlet_2 (SR-F2 Storm)	Pipe - (50) (SR-F2 Storm)	1.90	18.0	-0.030	7,011.29	7,012.17	7,020.06	7,020.45	7,012.69	7,012.43	7,012.88	7,012.45	6.67	0.000	29.3
Storm_19_Lat_2_Inlet_1 (SR-F2 Storm)	Pipe - (53) (SR-F2 Storm)	12.60	24.0	-0.040	7,001.71	7,004.77	7,008.01	7,010.20	7,006.05	7,002.45	7,006.60	7,004.66	12.33	0.500	76.7
STRM_MH_12 (SR-F2 Storm)	Pipe - (602) (SR-F2 Storm)	43.30	72.0	-0.020	6,952.66	6,956.17	6,969.77	6,969.86	6,957.91	6,953.76	6,958.54	6,956.07	12.31	1.000	175.7
STRM_MH_104 (SR-F2 Storm)	Pipe - (605) (SR-F2 Storm)	43.30	72.0	-0.020	6,958.93	6,970.99	6,970.00	6,985.32	6,972.73	6,960.85	6,973.35	6,961.33	12.31	0.250	602.8
Structure - (855) (SR-F2 Storm)	Pipe - (615) (SR-F2 Storm)	68.80	54.0	-0.025	6,967.81	6,976.52	6,983.21	6,988.08	6,978.94	6,972.04	6,979.91	6,972.35	15.70	0.500	348.6
Structure - (866) (SR-F2 Storm)	Pipe - (618) (SR-F2 Storm)	56.40	48.0	-0.020	6,976.91	6,977.92	6,988.08	6,982.35	6,980.18	6,979.43	6,981.10	6,980.14	13.85	0.500	50.4
Structure - (867) (SR-F2 Storm)	Pipe - (619) (SR-F2 Storm)	56.40	48.0	-0.020	6,977.92	6,978.77	6,982.35	6,983.20	6,981.03	6,980.64	6,981.95	6,981.24	13.83	0.500	42.5
STRM_MH_09 (SR-F2 Storm)	Pipe - (620) (SR-F2 Storm)	55.10	48.0	-0.020	6,978.77	6,979.31	6,983.20	6,991.38	6,981.54	6,981.49	6,982.45	6,982.06	13.74	1.000	26.8
Structure - (552) (SR-F2 Storm)	Pipe - (623) (SR-F2 Storm)	55.10	48.0	-0.030	6,980.28	6,982.00	6,991.38	6,986.43	6,984.23	6,981.75	6,985.14	6,984.44	15.91	0.500	57.3
STRM_MH_08 (SR-F2 Storm)	Pipe - (624) (SR-F2 Storm)	52.50	48.0	-0.030	6,982.00	6,982.77	6,986.43	6,990.70	6,984.95	6,984.69	6,985.83	6,985.22	15.69	1.000	25.8
Structure - (868) (SR-F2 Storm)	Pipe - (627) (SR-F2 Storm)	27.50	42.0	-0.005	6,983.49	6,984.00	6,990.70	6,987.89	6,985.78	6,985.83	6,986.27	6,986.08	6.92	0.000	101.2
Structure - (838) (SR-F2 Storm)	Pipe - (632) (SR-F2 Storm)	25.90	36.0	-0.007	6,983.00	6,985.27	6,990.70	6,992.50	6,986.91	6,985.83	6,987.57	6,986.05	7.95	0.500	302.2
STRM_MH_22 (SR-F2 Storm)	Pipe - (633) (SR-F2 Storm)	25.90	36.0	-0.008	6,985.27	6,986.35	6,992.50	6,994.17	6,987.99	6,987.24	6,988.66	6,987.67	7.95	1.000	144.5
Structure - (841) (SR-F2 Storm)	Pipe - (634) (SR-F2 Storm)	43.30	72.0	0.020	6,958.95	6,957.33	6,970.00	6,970.00	6,960.69	6,959.23	6,961.32	6,959.72	12.31	0.250	81.0
Structure - (851) (SR-F2 Storm)	Pipe - (635) (SR-F2 Storm)	43.30	72.0	0.020	6,957.33	6,957.18	6,970.00	6,969.86	6,959.07	6,958.65	6,959.70	6,959.66	12.31	0.250	7.2
Structure - (865) (SR-F2 Storm)	Pipe - (638) (SR-F2 Storm)	1.40	30.0	0.050	6,953.86	6,952.68	6,956.65	6,969.77	6,954.25	6,953.62	6,954.38	6,953.63	6.81	0.000	23.6
Structure - (807) (SR-F2 Storm)	Pipe - (642) (SR-F2 Storm)	2.10	24.0	-0.010	7,016.00	7,016.81	7,018.26	7,029.97	7,017.31	7,016.41	7,017.49	7,016.73	4.50	0.500	80.7
Structure - (858) (SR-F2 Storm)	Pipe - (647) (SR-F2 Storm)	15.70	36.0	-0.020	6,988.48	6,990.00	6,994.13	6,993.35	6,991.27	6,989.33	6,991.74	6,990.73	9.89	0.000	76.3
Structure - (864) (SR-F2 Storm)	Pipe - (656) (SR-F2 Storm)	56.90	48.0	-0.020	6,985.24	6,987.46	6,994.75	6,998.89	6,989.73	6,988.37	6,990.65	6,988.82	13.87	0.250	111.1
STRM_MH_11 (SR-F2 Storm)	Pipe - (658) (SR-F2 Storm)	68.80	42.0	0.010	6,968.08	6,966.58	6,983.21	6,981.55	6,971.94	6,971.77	6,972.14	6,971.97	3.58	0.500	149.4
Structure - (820) (SR-F2 Storm)	Storm_14_48in_08 (SR-F2 Storm)	38.10	48.0	-0.005	6,987.18	6,987.48	6,994.41	6,994.13	6,989.32	6,988.88	6,990.02	6,989.75	7.51	0.500	59.3
STRM_MH_16 (SR-F2 Storm)	Storm_14_66in_05 (1) (1) (SR-F2 Storm)	96.60	66.0	-0.030	6,974.45	6,984.96	6,985.88	6,994.41	6,987.67	6,977.23	6,988.73	6,978.23	18.13	0.500	350.2
Structure - (854) (SR-F2 Storm)	Storm_14_66in_05 (1) (SR-F2 Storm)	96.60	66.0	-0.015	6,966.57	6,974.25	6,981.55	6,985.88	6,976.97	6,971.77	6,978.03	6,972.03	14.14	0.250	512.4
STRM_MH_14 (SR-F2 Storm)	Storm_14_78in_03 (SR-F2 Storm)	162.00	72.0	0.000	6,966.31	6,966.36	6,978.85	6,980.19	6,971.00	6,970.55	6,971.74	6,971.44	5.73	0.250	166.0
STRM_MH_15 (SR-F2 Storm)	Storm_14_78in_04 (SR-F2 Storm)	162.00	72.0	0.000	6,966.36	6,966.37	6,980.19	6,981.55	6,971.27	6,971.19	6,971.93	6,971.87	5.73	0.750	39.7
STRM_MH_13 (SR-F2 Storm)	Storm_14_84in_02 (SR-F2 Storm)	189.80	84.0	-0.001	6,966.00	6,966.09	6,973.74	6,978.85	6,970.31	6,969.59	6,971.26	6,971.01	5.50	0.250	107.3
Structure - (860) (SR-F2 Storm)	Storm_15_24in_02-W (SR-F2 Storm)	4.30	24.0	-0.050	6,970.74	6,972.01	6,978.85	6,974.27	6,972.74	6,971.16	6,973.01	6,972.38	9.81	0.000	25.5
Structure - (861) (SR-F2 Storm)	Storm_17_48in_05 (SR-F2 Storm)	17.60	36.0	-0.020	6,999.61	6,999.81	7,010.52	7,003.15	7,001.15	7,001.34	7,001.66	7,001.61	10.21	0.000	9.8
Structure - (856) (SR-F2 Storm)	Storm_17_54in_01 (SR-F2 Storm)	63.70	48.0	-0.005	6,985.16	6,985.23	6,994.41	6,994.75	6,988.21	6,988.20	6,988.83	6,988.80	8.40	0.250	14.0
Structure - (863) (SR-F2 Storm)	Storm_17_54in_02 (SR-F2 Storm)	56.90	48.0	-0.020	6,987.46	6,990.46	6,998.89	6,998.89	6,992.73	6,989.96	6,993.66	6,990.69	13.87	0.250	150.3
STRM_MH_20 (SR-F2 Storm)	Storm_17_54in_03 (SR-F2 Storm)	56.90	48.0	-0.020	6,990.46	6,992.12	6,998.89	7,001.05	6,994.39	6,992.96	6,995.32	6,993.70	13.87	0.250	82.9
Structure - (862) (SR-F2 Storm)	Storm_17_54in_04 (SR-F2 Storm)	56.90	48.0	-0.020	6,992.31	6,998.16	7,001.05	7,002.59	7,000.43	6,994.62	7,001.36	6,995.51	13.87	0.500	292.3
STRM_MH_FUTR_02 (SR-F2 Storm)	Storm_17_54in_05 (SR-F2 Storm)	56.90	48.0	-0.020	6,998.16	6,998.61	7,002.59	7,010.52	7,000.88	7,000.89	7,001.81	7,001.49	13.86	0.500	22.6
Storm_17_Lat_1_Inlet_1 (SR-F2 Storm)	Storm_17_Lat_1_24in_01 (SR-F2 Storm)	9.60	24.0	-0.050	6,986.23	6,986.87	6,994.75	6,994.51	6,988.28	6,988.37	6,988.54	6,988.51	12.40	0.250	12.7
Storm_17_Lat_1_Inlet_2 (SR-F2 Storm)	Storm_17_Lat_1_24in_02 (SR-F2 Storm)	4.30	24.0	-0.030	6,987.37	6,988.97	6,994.51	6,994.24	6,989.70	6,988.35	6,989.97	6,988.47	8.20	0.000	53.4
Storm_18_Inlet_2 (SR-F2 Storm)	Storm_18_18in_05 (SR-F2 Storm)	8.70	18.0	-0.030	6,978.65	6,981.48	6,987.83	6,987.96	6,982.63	6,979.38	6,983.19	6,981.00	10.18	0.000	94.4
Storm_21_Lat_1_Inlet_1 (SR-F2 Storm)	Storm_18_Lat_1_18in_02 (SR-F2 Storm)	3.00	18.0	-0.050	6,983.25	6,984.22	6,986.43	6,989.81	6,984.88	6,984.69	6,985.13	6,984.73	9.12	0.000	19.4
Storm_16_Lat_1_Inlet_1 (SR-F2 Storm)	Storm_18_Lat_1_24in_01 (SR-F2 Storm)	2.10	18.0	-0.050	6,980.32	6,980.98	6,983.20	6,989.41	6,981.53	6,981.49	6,981.73	6,981.52	8.22	0.000	13.2
Storm_19_Inlet_1 (SR-F2 Storm)	Storm_19_36in_04 (SR-F2 Storm)	25.90	30.0	-0.020	6,987.25	6,990.55	6,994.17	6,998.83	6,992.28	6,988.42	6,993.07	6,990.47	11.48	0.500	165.0
Storm_20_Outfall (SR-F2 Storm)	Storm_20_54in_02 (SR-F2 Storm)	0.00	48.0	-0.050	6,946.78	6,949.67	6,971.24	6,966.01	6,949.67	6,947.95	6,949.67	6,947.95	0.00	0.000	57.9
Storm_22_Inlet_2 (SR-F2 Storm)	Storm_22_24in_04 (SR-F2 Storm)	8.30	30.0	0.010	7,015.99	7,015.30	7,023.12	7,023.34	7,016.95	7,016.71	7,017.30	7,016.84	6.55	0.000	68.8
Structure - (826) (SR-F2 Storm)	Storm_22_30in_02 (SR-F2 Storm)	16.00	30.0	-0.009	7,014.17	7,015.09	7,016.98	7,023.34	7,016.44	7,015.29	7,016.98	7,016.18	7.56	0.500	100.7
Structure - (793) (SR-F2 Storm)	Storm_23_78in_01 (1) (SR-F2 Storm)	46.50	84.0	-0.003	6,945.31	6,945.88	6,953.05	6,971.24	6,947.67	6,947.04	6,948.23	6,947.65	5.98	0.500	222.1
STRM_MH_101 (SR-F2 Storm)	Storm_23_78in_02 (1) (1) (1) (SR-F2 Storm)	45.20	72.0	-0.015	6,950.65	6,951.67	6,965.00	6,969.77	6,953.46	6,952.59	6,954.10	6,953.10	11.27	0.250	68.3
Structure - (872) (SR-F2 Storm)	Storm_23_78in_02 (1) (1) (3) (SR-F2 Storm)	45.20	72.0	-0.015	6,947.80	6,950.65	6,966.24	6,965.00	6,952.43	6,950.08	6,953.07	6,950.40	11.27	0.250	190.2
Structure - (852) (SR-F2 Storm)	Storm_23_78in_02 (1) (1) (SR-F2 Storm)	45.20	72.0	-0.001	6,947.43	6,947.60	6,965.15	6,966.24	6,950.00	6,949.84	6,950.29	6,950.12	4.28	0.250	167.7
STRM_MH_102 (SR-F2 Storm)	Storm_23_78in_02 (SR-F2 Storm)	45.20	72.0	-0.001	6,946.88	6,947.43	6,971.24	6,965.15	6,949.76	6,948.66	6,950.07	6,949.30	4.27	0.250	549.0
Structure - (840) (SR-F2 Storm)	Storm_23_78in_06 (SR-F2 Storm)	43.30	72.0	-0.020	6,971.95	6,979.99	6,985.32	6,992.18	6,981.73	6,973.04	6,982.36	6,975.40	12.31	0.250	402.6
STRM_MH_105 (SR-F2 Storm)	Storm_23_78in_07 (SR-F2 Storm)	43.30	72.0	-0.020	6,981.00	6,986.90	6,992.18	7,000.17	6,988.64	6,982.09	6,989.27	6,984.45	12.31	0.250	295.1
Structure - (839) (SR-F2 Storm)	Storm_23_78in_08 (SR-F2 Storm)	37.80	66.0	-0.020	6,987.91	6,994.57	7,000.17	7,004.67	6,996.24	6,988.96	6,996.84	6,991.18	11.95	0.250	333.0
STRM_MH_106 (SR-F2 Storm)	Storm_23_78in_09 (SR-F2 Storm)	37.80	66.0	-0.030	6,994.57	7,006.85	7,004.67	7,018.17	7,008.51	6,996.39	7,009.12	6,996.86	13.78	0.250	409.4
Outfall Box 100 (SR-F2 Storm)	Storm_23_78in_11 (SR-F2 Storm)	37.80	66.0	-0.005	7,007.78	7,009.34	7,018.17	7,018.01	7,011.01	7,009.26	7,011.61	7,010.10	7.33	0.000	310.6
Structure - (857) (SR-F2 Storm)	Storm_24_36in_01 (SR-F2 Storm)	2.00	36.0	-0.050	6,987.90	6,990.41	7,000.17	6,993.75	6,990.85	6,988.80	6,991.00	6,988.82	7.40	0.000	50.2
VT2_Inlet_3 (SR-F2 Storm)	Storm_VT2_30in_02 (SR-F2 Storm)	18.40	30.0	0.004	7,042.60	7,042.47	0.00	7,046.08	7,044.46	7,044.06	7,044.76	7,044.66	3.75	0.000	35.4

Scenario: 100-YEAR
Current Time Step: 0.000Hr
Conduit FlexTable: Combined Pipe/Node Report

Upstream Structure	Label	Flow (cfs)	Diameter (in)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	HGL (Up) (ft)	HGL (Down) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Velocity (ft/s)	Upstream Structure Headloss Coefficient	Length (User Defined) (ft)
Structure - (850) (SR-F2 Storm)	CO-1	85.40	42.0	-0.009	6,969.24	6,969.77	6,978.85	6,973.34	6,973.50	6,973.08	6,974.72	6,974.30	8.88	0.000	-
Storm_18_Inlet_1 (SR-F2 Storm)	CO-2	25.30	30.0	-0.013	6,977.52	6,977.65	6,987.83	6,988.08	6,980.64	6,980.59	6,981.05	6,981.01	5.15	0.500	-
Structure - (849) (SR-F2 Storm)	CO-3	37.90	36.0	-0.029	7,000.88	7,004.00	7,010.52	7,007.35	7,006.00	7,003.75	7,006.89	7,004.21	14.46	0.000	-
Storm_19_Lat_2_Inlet_2 (SR-F2 Storm)	CO-5	14.70	18.0	-0.014	7,005.77	7,006.30	7,010.20	7,010.21	7,007.97	7,007.17	7,009.05	7,008.31	8.32	0.000	-
Structure - (845) (SR-F2 Storm)	CO-6	74.50	48.0	-0.092	6,987.11	6,988.38	6,994.13	6,993.12	6,991.11	6,991.56	6,992.14	6,992.11	25.90	0.000	-
VT2_Inlet_2 (SR-F2 Storm)	CO-7	12.20	30.0	-0.007	7,042.60	7,043.24	7,046.08	7,049.26	7,044.81	7,044.82	7,045.03	7,044.93	6.37	0.000	-
Structure - (842) (SR-F2 Storm)	Pipe - (28) (SR-F2 Storm)	30.00	24.0	-0.030	6,991.05	6,995.39	6,998.83	7,002.50	6,997.25	6,993.59	6,998.76	6,995.01	13.74	0.000	144.7
STRM_MH_24 (SR-F2 Storm)	Pipe - (29) (1) (1) (SR-F2 Storm)	10.30	18.0	-0.030	7,000.89	7,011.08	7,008.01	7,020.06	7,012.31	7,003.31	7,012.99	7,003.84	10.61	1.000	339.5
STRM_MH_23 (SR-F2 Storm)	Pipe - (29) (SR-F2 Storm)	30.00	24.0	-0.030	6,995.39	7,000.69	7,002.50	7,008.01	7,002.56	6,996.70	7,004.06	6,999.63	13.74	0.500	177.0
Storm_19_Lat_1_Inlet_1 (SR-F2 Storm)	Pipe - (35) (SR-F2 Storm)	8.70	24.0	-0.030	6,991.56	6,992.65	6,998.83	6,999.02	6,993.70	6,993.59	6,994.12	6,993.71	10.03	0.500	36.4
Structure - (65) (SR-F2 Storm)	Pipe - (39) (SR-F2 Storm)	4.10	18.0	-0.030	6,992.84	6,993.85	6,999.02	6,995.57	6,994.62	6,993.91	6,994.93	6,994.05	8.31	0.000	33.7
Storm_19_Lat_3_Inlet_1 (SR-F2 Storm)	Pipe - (47) (SR-F2 Storm)	6.60	18.0	0.030	7,011.47	7,011.29	7,020.35	7,020.06	7,013.02	7,012.99	7,013.23	7,013.21	3.73	0.000	6.0
Storm_19_Lat_3_Inlet_2 (SR-F2 Storm)	Pipe - (50) (SR-F2 Storm)	3.80	18.0	-0.030	7,011.29	7,012.17	7,020.06	7,020.45	7,012.91	7,012.99	7,013.21	7,013.06	8.14	0.000	29.3
Storm_19_Lat_2_Inlet_1 (SR-F2 Storm)	Pipe - (53) (SR-F2 Storm)	19.70	24.0	-0.040	7,001.71	7,004.77	7,008.01	7,010.20	7,006.37	7,003.31	7,007.20	7,004.14	13.90	0.500	76.7
STRM_MH_12 (SR-F2 Storm)	Pipe - (602) (SR-F2 Storm)	242.40	72.0	-0.020	6,952.66	6,956.17	6,969.77	6,969.86	6,960.44	6,955.57	6,962.41	6,960.51	20.06	1.000	175.7
STRM_MH_104 (SR-F2 Storm)	Pipe - (605) (SR-F2 Storm)	242.40	72.0	-0.020	6,958.93	6,970.99	6,970.00	6,985.32	6,975.25	6,963.71	6,977.23	6,965.28	20.06	0.250	602.8
Structure - (855) (SR-F2 Storm)	Pipe - (615) (SR-F2 Storm)	125.00	54.0	-0.025	6,967.81	6,976.52	6,983.21	6,988.08	6,979.81	6,977.49	6,981.38	6,978.45	18.48	0.500	348.6
Structure - (866) (SR-F2 Storm)	Pipe - (618) (SR-F2 Storm)	107.70	48.0	-0.020	6,976.91	6,977.92	6,988.08	6,982.35	6,981.06	6,980.59	6,982.67	6,981.82	16.42	0.500	50.4
Structure - (867) (SR-F2 Storm)	Pipe - (619) (SR-F2 Storm)	107.70	48.0	-0.020	6,977.92	6,978.77	6,982.35	6,983.20	6,981.91	6,981.87	6,983.52	6,983.01	16.40	0.500	42.5
STRM_MH_09 (SR-F2 Storm)	Pipe - (620) (SR-F2 Storm)	103.90	48.0	-0.020	6,978.77	6,979.31	6,983.20	6,991.38	6,982.39	6,982.72	6,983.94	6,983.78	16.25	1.000	26.8
Structure - (552) (SR-F2 Storm)	Pipe - (623) (SR-F2 Storm)	103.90	48.0	-0.030	6,980.28	6,982.00	6,991.38	6,986.43	6,985.09	6,983.94	6,986.64	6,985.10	18.91	0.500	57.3
STRM_MH_08 (SR-F2 Storm)	Pipe - (624) (SR-F2 Storm)	105.90	48.0	-0.030	6,982.00	6,982.77	6,986.43	6,990.70	6,985.89	6,985.86	6,987.47	6,986.99	18.99	1.000	25.8
Structure - (868) (SR-F2 Storm)	Pipe - (627) (SR-F2 Storm)	60.60	42.0	-0.005	6,983.49	6,984.00	6,990.70	6,987.89	6,987.84	6,987.47	6,988.45	6,988.09	6.30	0.000	101.2
Structure - (838) (SR-F2 Storm)	Pipe - (632) (SR-F2 Storm)	46.90	36.0	-0.007	6,983.00	6,985.27	6,990.70	6,992.50	6,988.96	6,987.47	6,989.65	6,988.15	6.63	0.500	302.2
STRM_MH_22 (SR-F2 Storm)	Pipe - (633) (SR-F2 Storm)	46.90	36.0	-0.008	6,985.27	6,986.35	6,992.50	6,994.17	6,990.02	6,989.31	6,990.70	6,989.99	6.63	1.000	144.5
Structure - (841) (SR-F2 Storm)	Pipe - (634) (SR-F2 Storm)	242.40	72.0	0.020	6,958.95	6,957.33	6,970.00	6,970.00	6,963.21	6,962.69	6,965.19	6,963.97	20.06	0.250	81.0
Structure - (851) (SR-F2 Storm)	Pipe - (635) (SR-F2 Storm)	242.40	72.0	0.020	6,957.33	6,957.18	6,970.00	6,969.86	6,962.33	6,962.41	6,963.77	6,963.75	20.06	0.250	7.2
Structure - (865) (SR-F2 Storm)	Pipe - (638) (SR-F2 Storm)	10.00	30.0	0.050	6,953.86	6,952.68	6,956.65	6,969.77	6,956.48	6,956.46	6,956.54	6,956.53	2.04	0.000	23.6
Structure - (807) (SR-F2 Storm)	Pipe - (642) (SR-F2 Storm)	14.50	24.0	-0.010	7,016.00	7,016.81	7,018.26	7,029.97	7,018.18	7,017.17	7,018.80	7,018.07	7.64	0.500	80.7
Structure - (858) (SR-F2 Storm)	Pipe - (647) (SR-F2 Storm)	34.60	36.0	-0.020	6,988.48	6,990.00	6,994.13	6,993.35	6,991.91	6,991.56	6,992.73	6,991.93	12.31	0.000	76.3
Structure - (864) (SR-F2 Storm)	Pipe - (656) (SR-F2 Storm)	138.70	48.0	-0.020	6,985.24	6,987.46	6,994.75	6,998.89	6,992.30	6,991.27	6,994.20	6,993.16	11.04	0.250	111.1
STRM_MH_11 (SR-F2 Storm)	Pipe - (658) (SR-F2 Storm)	125.00	42.0	0.010	6,968.08	6,966.58	6,983.21	6,981.55	6,977.16	6,976.58	6,977.82	6,977.24	6.50	0.500	149.4
Structure - (820) (SR-F2 Storm)	Storm_14_48in_08 (SR-F2 Storm)	106.60	48.0	-0.005	6,987.18	6,987.48	6,994.41	6,994.13	6,990.88	6,990.54	6,992.24	6,991.93	9.16	0.500	59.3
STRM_MH_16 (SR-F2 Storm)	Storm_14_66in_05 (1) (1) (SR-F2 Storm)	250.70	66.0	-0.030	6,974.45	6,984.96	6,985.88	6,994.41	6,989.37	6,979.73	6,991.71	6,981.51	23.57	0.500	350.2
Structure - (854) (SR-F2 Storm)	Storm_14_66in_05 (1) (SR-F2 Storm)	250.70	66.0	-0.015	6,966.57	6,974.25	6,981.55	6,985.88	6,979.26	6,976.58	6,981.15	6,978.31	18.16	0.250	512.4
STRM_MH_14 (SR-F2 Storm)	Storm_14_78in_03 (SR-F2 Storm)	336.80	72.0	0.000	6,966.31	6,966.36	6,978.85	6,980.19	6,974.13	6,973.08	6,976.33	6,975.28	11.91	0.250	166.0
STRM_MH_15 (SR-F2 Storm)	Storm_14_78in_04 (SR-F2 Storm)	336.80	72.0	0.000	6,966.36	6,966.37	6,980.19	6,981.55	6,974.93	6,974.68	6,977.14	6,976.88	11.91	0.750	39.7
STRM_MH_13 (SR-F2 Storm)	Storm_14_84in_02 (SR-F2 Storm)	424.40	84.0	-0.001	6,966.00	6,966.09	6,973.74	6,978.85	6,972.57	6,971.42	6,974.59	6,974.16	11.03	0.250	107.3
Structure - (860) (SR-F2 Storm)	Storm_15_24in_02-W (SR-F2 Storm)	14.00	24.0	-0.050	6,970.74	6,972.01	6,978.85	6,974.27	6,973.36	6,973.08	6,973.96	6,973.39	13.76	0.000	25.5
Structure - (861) (SR-F2 Storm)	Storm_17_48in_05 (SR-F2 Storm)	48.90	36.0	-0.020	6,999.61	6,999.81	7,010.52	7,003.15	7,003.80	7,003.75	7,004.54	7,004.49	6.92	0.000	9.8
Structure - (856) (SR-F2 Storm)	Storm_17_54in_01 (SR-F2 Storm)	151.90	48.0	-0.005	6,985.16	6,985.23	6,994.41	6,994.75	6,990.70	6,990.54	6,992.97	6,992.81	12.09	0.250	14.0
Structure - (863) (SR-F2 Storm)	Storm_17_54in_02 (SR-F2 Storm)	138.70	48.0	-0.020	6,987.46	6,990.46	6,998.89	6,998.89	6,993.96	6,992.78	6,996.16	6,994.67	17.40	0.250	150.3
STRM_MH_20 (SR-F2 Storm)	Storm_17_54in_03 (SR-F2 Storm)	138.70	48.0	-0.020	6,990.46	6,992.12	6,998.89	7,001.05	6,995.62	6,994.51	6,997.82	6,996.40	17.39	0.250	82.9
Structure - (862) (SR-F2 Storm)	Storm_17_54in_04 (SR-F2 Storm)	138.70	48.0	-0.020	6,992.31	6,998.16	7,001.05	7,002.59	7,001.66	6,996.17	7,003.86	6,998.11	17.39	0.500	292.3
STRM_MH_FUTR_02 (SR-F2 Storm)	Storm_17_54in_05 (SR-F2 Storm)	138.70	48.0	-0.020	6,998.16	6,998.61	7,002.59	7,010.52	7,002.80	7,002.59	7,004.69	7,004.48	11.04	0.500	22.6
Storm_17_Lat_1_Inlet_1 (SR-F2 Storm)	Storm_17_Lat_1_24in_01 (SR-F2 Storm)	17.20	24.0	-0.050	6,986.23	6,986.87	6,994.75	6,994.51	6,991.34	6,991.27	6,991.81	6,991.73	5.47	0.250	12.7
Storm_17_Lat_1_Inlet_2 (SR-F2 Storm)	Storm_17_Lat_1_24in_02 (SR-F2 Storm)	7.00	24.0	-0.030	6,987.37	6,988.97	6,994.51	6,994.24	6,991.51	6,991.46	6,991.58	6,991.53	2.23	0.000	53.4
Storm_18_Inlet_2 (SR-F2 Storm)	Storm_18_18in_05 (SR-F2 Storm)	12.80	18.0	-0.030	6,978.65	6,981.48	6,987.83	6,987.96	6,982.83	6,980.84	6,983.74	6,981.66	11.15	0.000	94.4
Storm_21_Lat_1_Inlet_1 (SR-F2 Storm)	Storm_18_Lat_1_18in_02 (SR-F2 Storm)	10.60	18.0	-0.050	6,983.25	6,984.22	6,986.43	6,989.81	6,986.06	6,985.86	6,986.62	6,986.42	6.00	0.000	19.4
Storm_16_Lat_1_Inlet_1 (SR-F2 Storm)	Storm_18_Lat_1_24in_01 (SR-F2 Storm)	4.50	18.0	-0.050	6,980.32	6,980.98	6,983.20	6,989.41	6,982.74	6,982.72	6,982.84	6,982.82	2.55	0.000	13.2
Storm_19_Inlet_1 (SR-F2 Storm)	Storm_19_36in_04 (SR-F2 Storm)	46.90	30.0	-0.020	6,987.25	6,990.55	6,994.17	6,998.83	6,992.80	6,990.70	6,994.38	6,992.12	13.15	0.500	165.0
Storm_20_Outfall (SR-F2 Storm)	Storm_20_54in_02 (SR-F2 Storm)	438.90	48.0	-0.050	6,946.78	6,949.67	6,971.24	6,966.01	6,957.37	6,951.96	6,976.32	6,970.92	34.93	0.000	57.9
Storm_22_Inlet_2 (SR-F2 Storm)	Storm_22_24in_04 (SR-F2 Storm)	14.40	30.0	0.010	7,015.99	7,015.30	7,023.12	7,023.34	7,017.27	7,017.45	7,017.77	7,017.61	7.62	0.000	68.8
Structure - (826) (SR-F2 Storm)	Storm_22_30in_02 (SR-F2 Storm)	31.00	30.0	-0.009	7,014.17	7,015.09	7,016.98	7,023.34	7,016.99	7,015.86	7,017.92	7,017.07	8.83	0.500	100.7
Structure - (793) (SR-F2 Storm)	Storm_23_78in_01 (1) (SR-F2 Storm)	315.80	84.0	-0.003	6,945.31	6,945.88	6,953.05	6,971.24	6,951.16	6,949.99	6,952.76	6,952.06	9.61	0.500	222.1
STRM_MH_101 (SR-F2 Storm)	Storm_23_78in_02 (1) (1) (1) (SR-F2 Storm)	245.10	72.0	-0.015	6,950.65	6,951.67	6,965.00	6,969.77	6,955.96	6,955.44	6,957.96	6,957.03	18.09	0.250	68.3
Structure - (872) (SR-F2 Storm)	Storm_23_78in_02 (1) (1) (3) (SR-F2 Storm)	245.10	72.0	-0.015	6,947.80	6,950.65	6,966.24	6,965.00	6,954.94	6,955.10	6,956.93	6,956.27	18.08	0.250	190.2
Structure - (852) (SR-F2 Storm)	Storm_23_78in_02 (1) (1) (SR-F2 Storm)	245.10	72.0	-0.001	6,947.43	6,947.60	6,965.15	6,966.24	6,954.81	6,954.24	6,955.97	6,955.41	8.67	0.250	167.7
STRM_MH_102 (SR-F2 Storm)	Storm_23_78in_02 (SR-F2 Storm)	245.10	72.0	-0.001	6,946.88	6,947.43	6,971.24	6,965.15	6,953.95	6,951.96	6,955.12	6,953.39	8.67	0.250	549.0
Structure - (840) (SR-F2 Storm)	Storm_23_78in_06 (SR-F2 Storm)	242.40	72.0	-0.020	6,971.95	6,979.99	6,985.32	6,992.18	6,984.26	6,974.66	6,986.23	6,980.61	20.05	0.250	402.6
STRM_MH_105 (SR-F2 Storm)	Storm_23_78in_07 (SR-F2 Storm)	242.40	72.0	-0.020	6,981.00	6,986.90	6,992.18	7,000.17	6,991.17	6,983.77	6,993.14	6,989.36	20.06	0.250	295.1
Structure - (839) (SR-F2 Storm)	Storm_23_78in_08 (SR-F2 Storm)	270.70	66.0	-0.020	6,987.91	6,994.57	7,000.17	7,004.67	6,999.14	6,990.99	7,001.70	6,997.06	20.64	0.250	333.0
STRM_MH_106 (SR-F2 Storm)	Storm_23_78in_09 (SR-F2 Storm)	270.70	66.0	-0.030	6,994.57	7,006.85	7,004.67	7,018.17	7,011.42	6,999.78	7,013.98	7,001.88	24.04	0.250	409.4
Outfall Box 100 (SR-F2 Storm)	Storm_23_78in_11 (SR-F2 Storm)	270.70	66.0	-0.005	7,007.78	7,009.34	7,018.17	7,018.01	7,014.60	7,012.35	7,016.68	7,014.91	11.39	0.000	310.6
Structure - (857) (SR-F2 Storm)	Storm_24_36in_01 (SR-F2 Storm)	15.00	36.0	-0.050	6,987.90	6,990.41	7,000.17	6,993.75	6,991.64	6,991.66	6,992.11	6,991.73	13.51	0.000	50.2
VT2_Inlet_3 (SR-F2 Storm)	Storm_VT2_30in_02 (SR-F2 Storm)	26.10	30.0	0.004	7,042.60	7,042.47	0.00	7,046.08	7,044.82	7,044.35	7,045.28	7,045.14	5.32	0.000	35.4

Scenario: 100-YEAR



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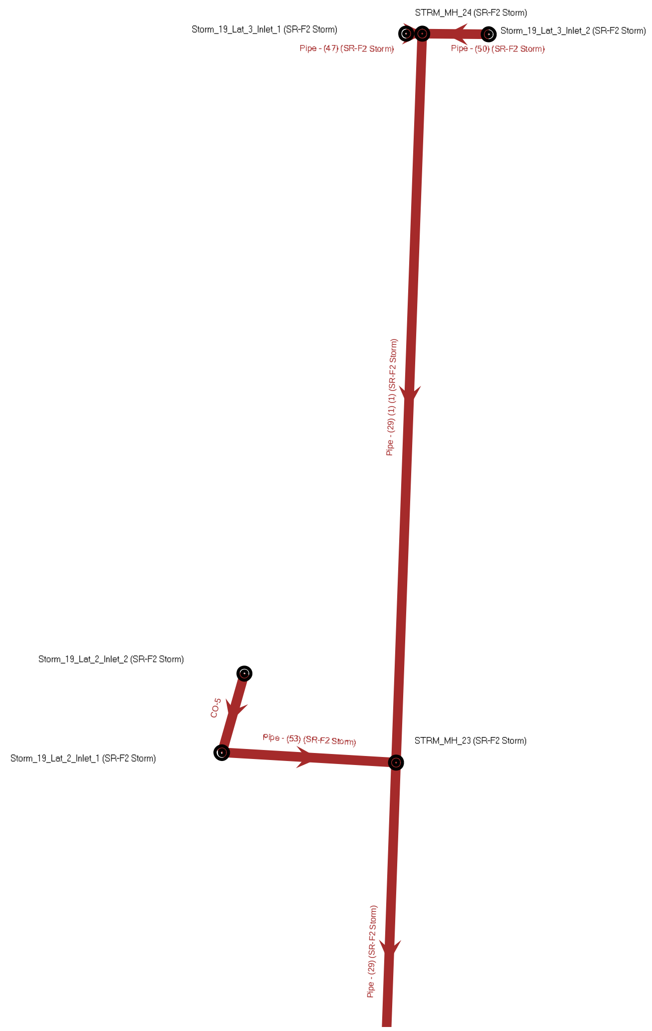

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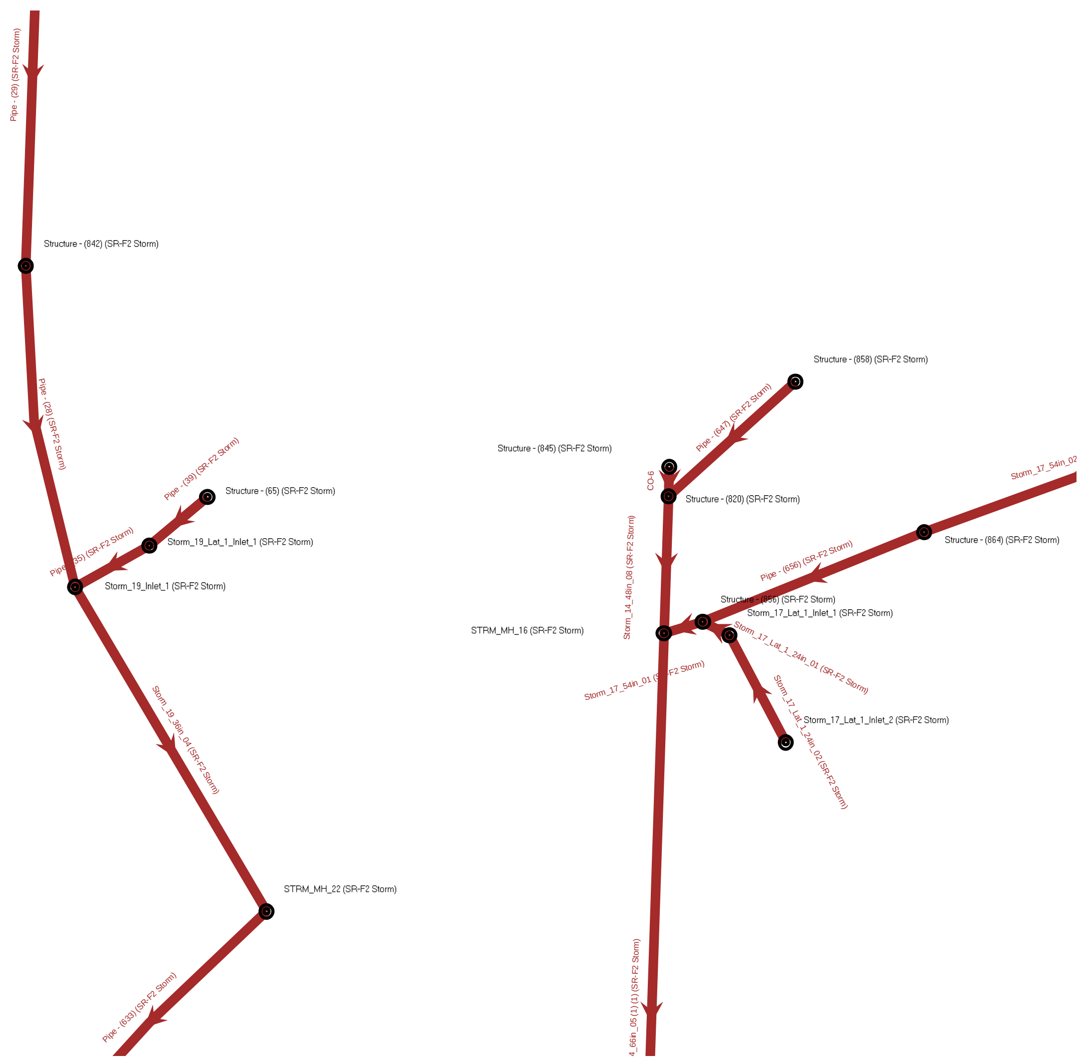

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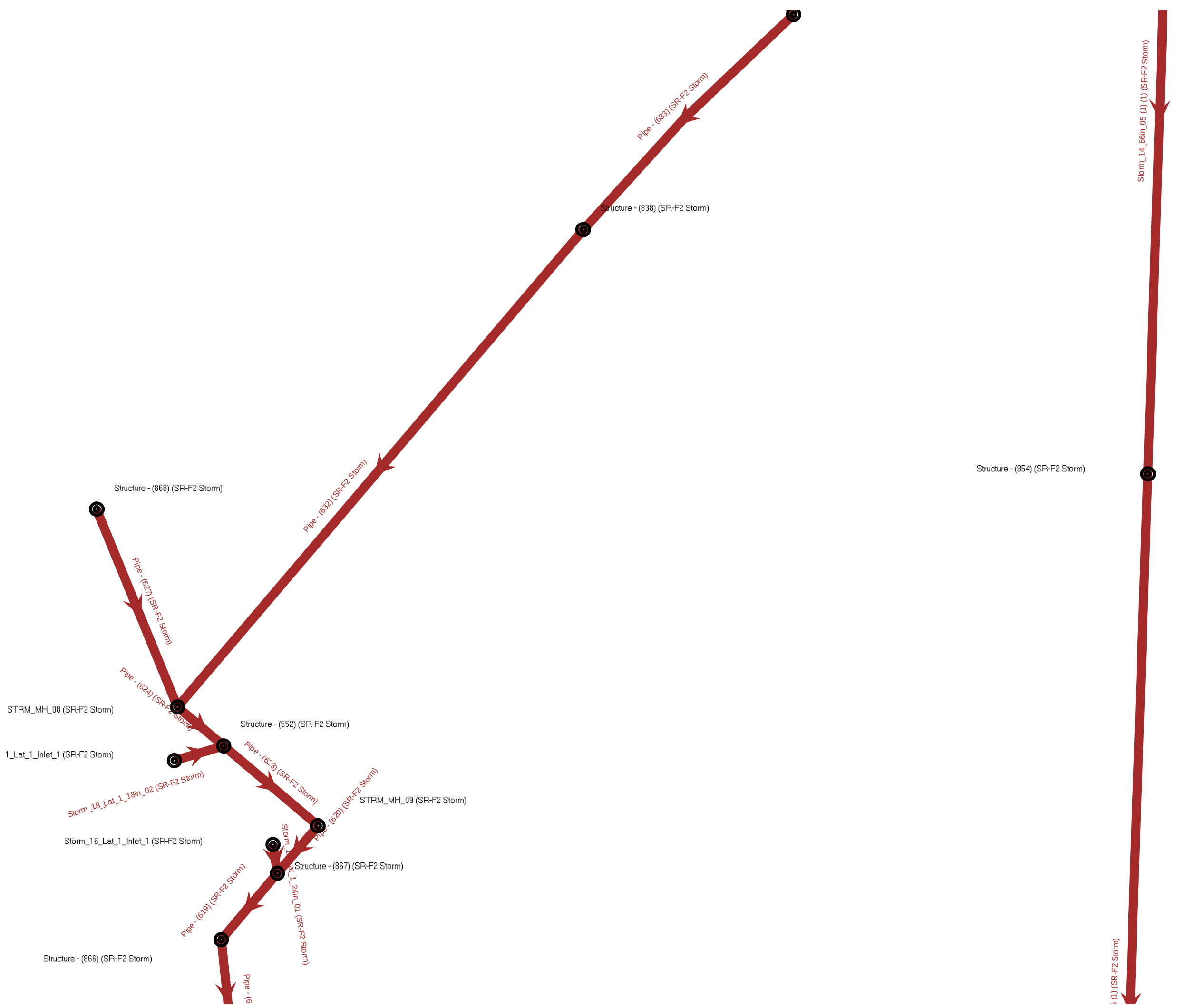

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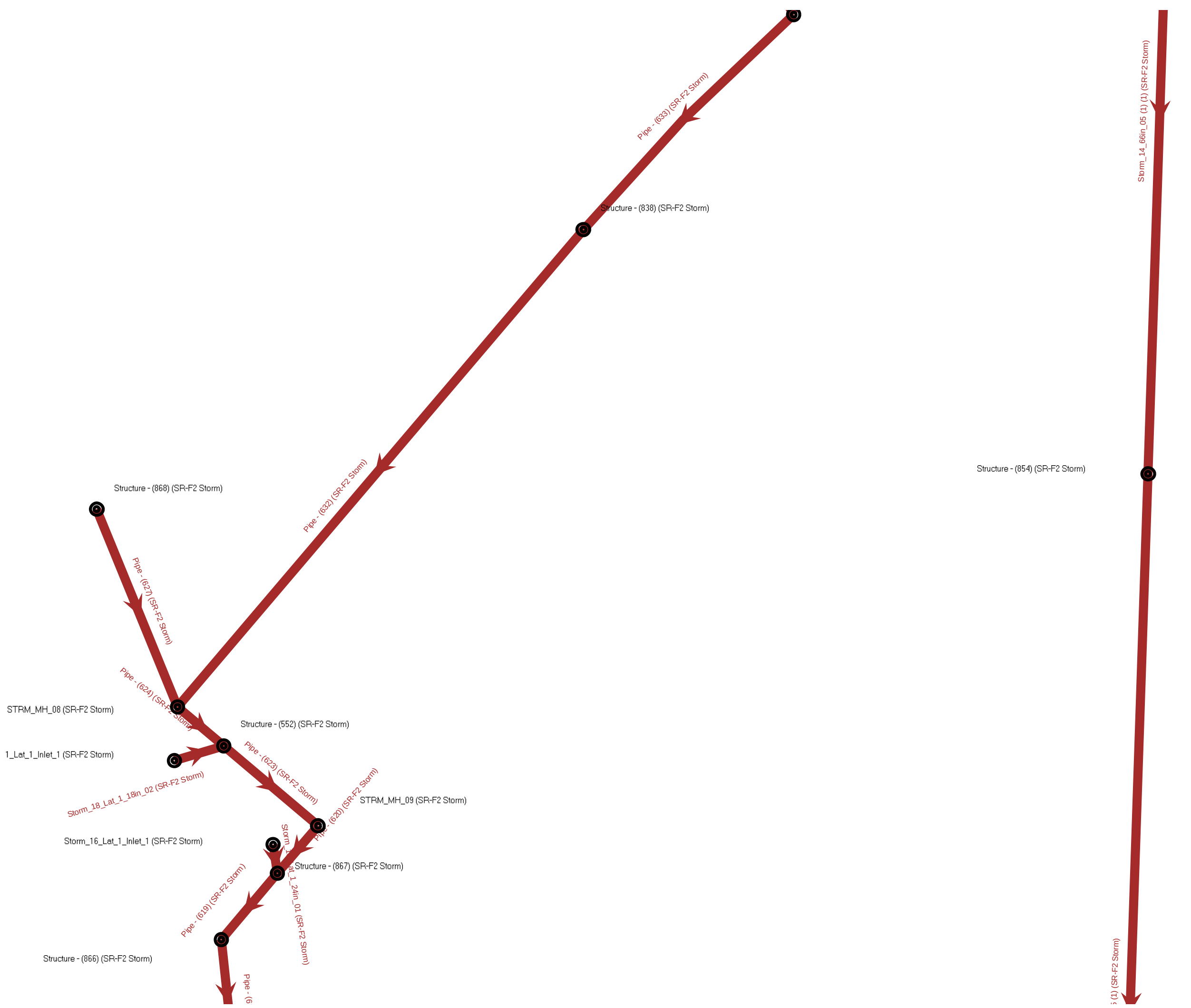

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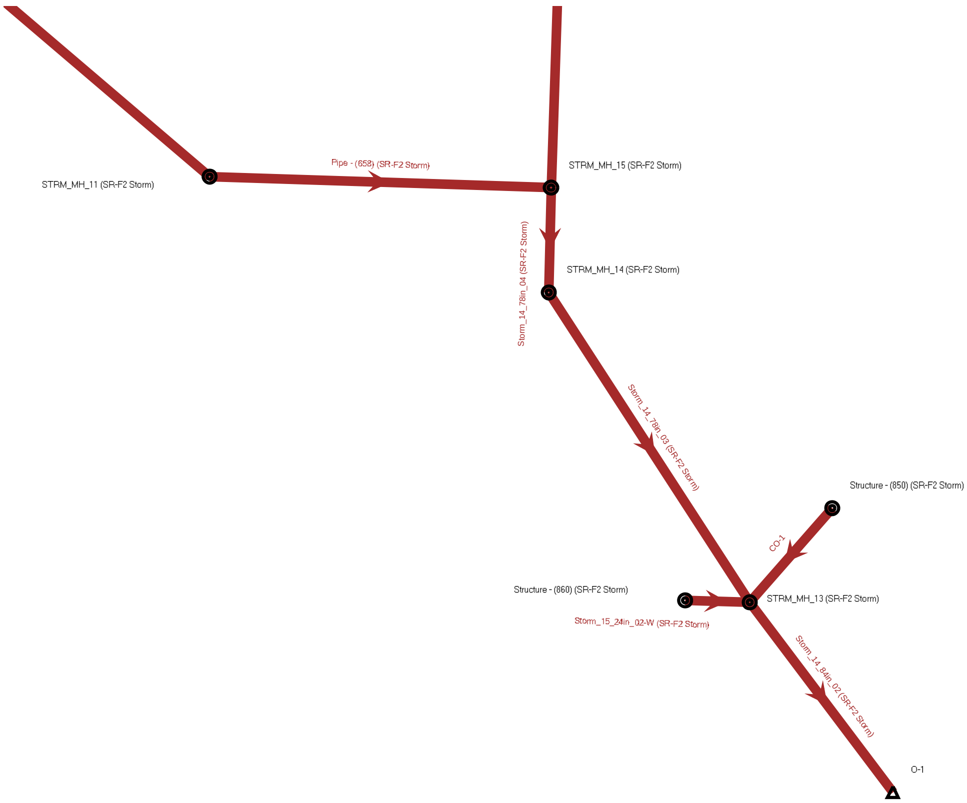

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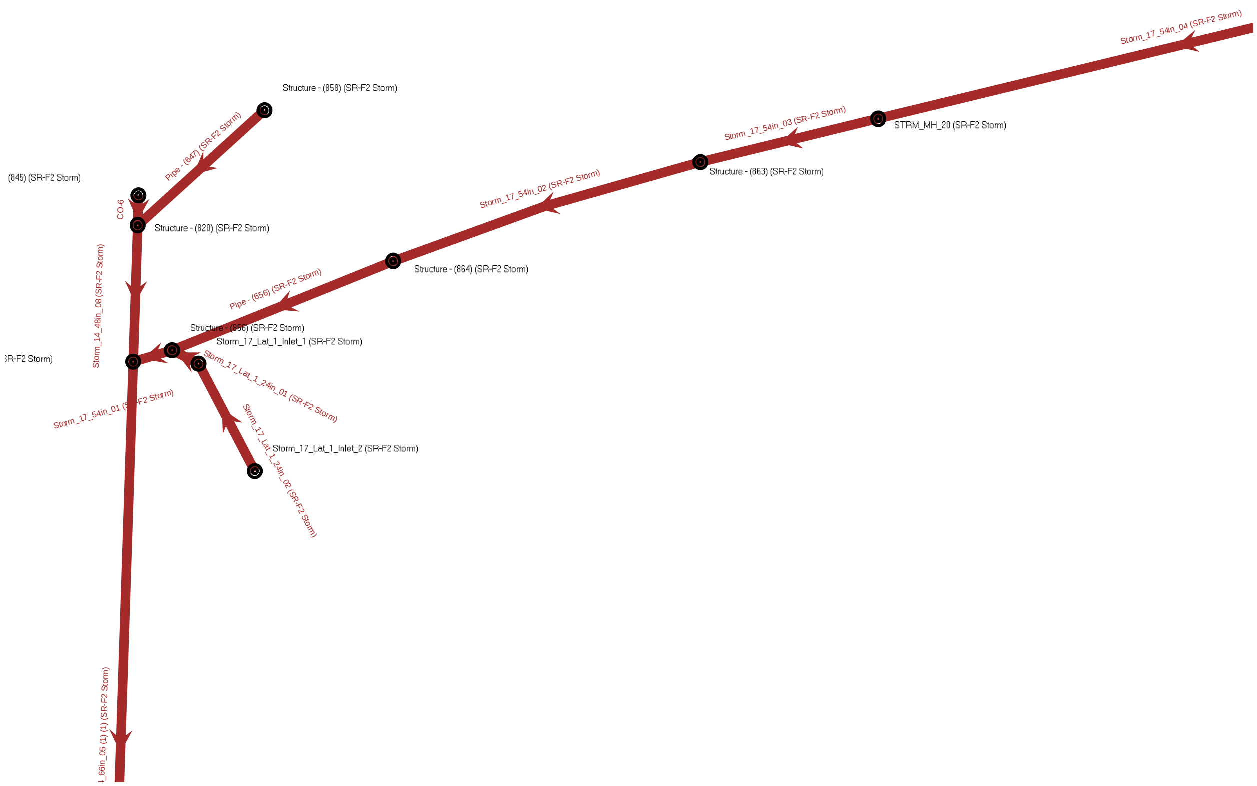

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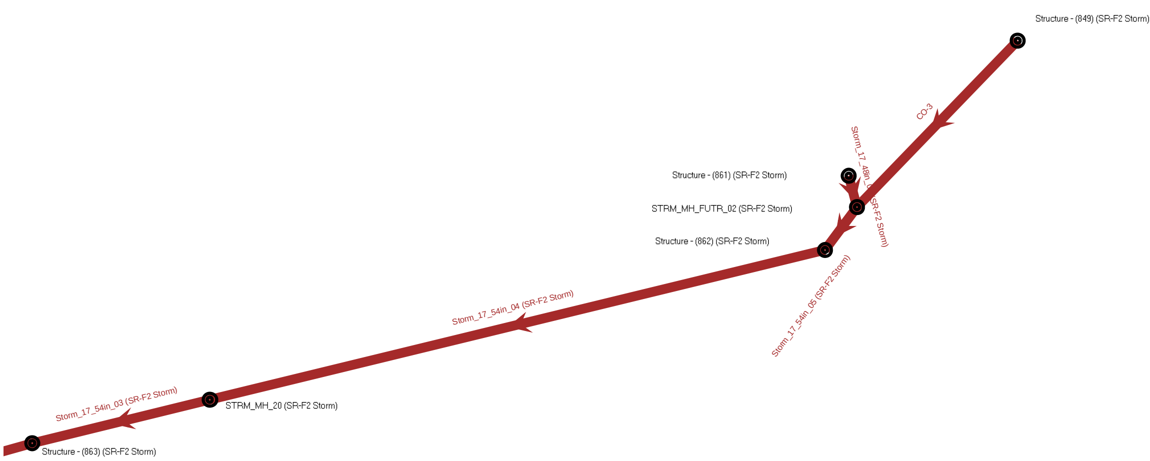

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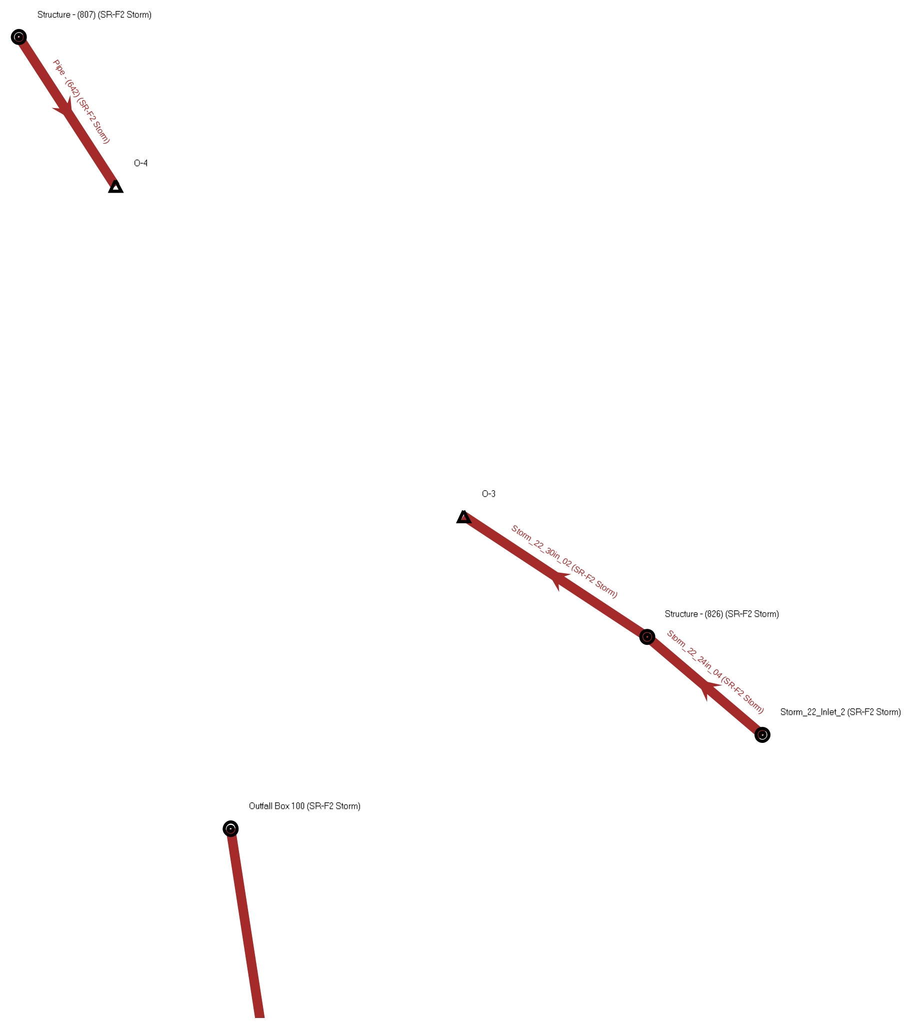

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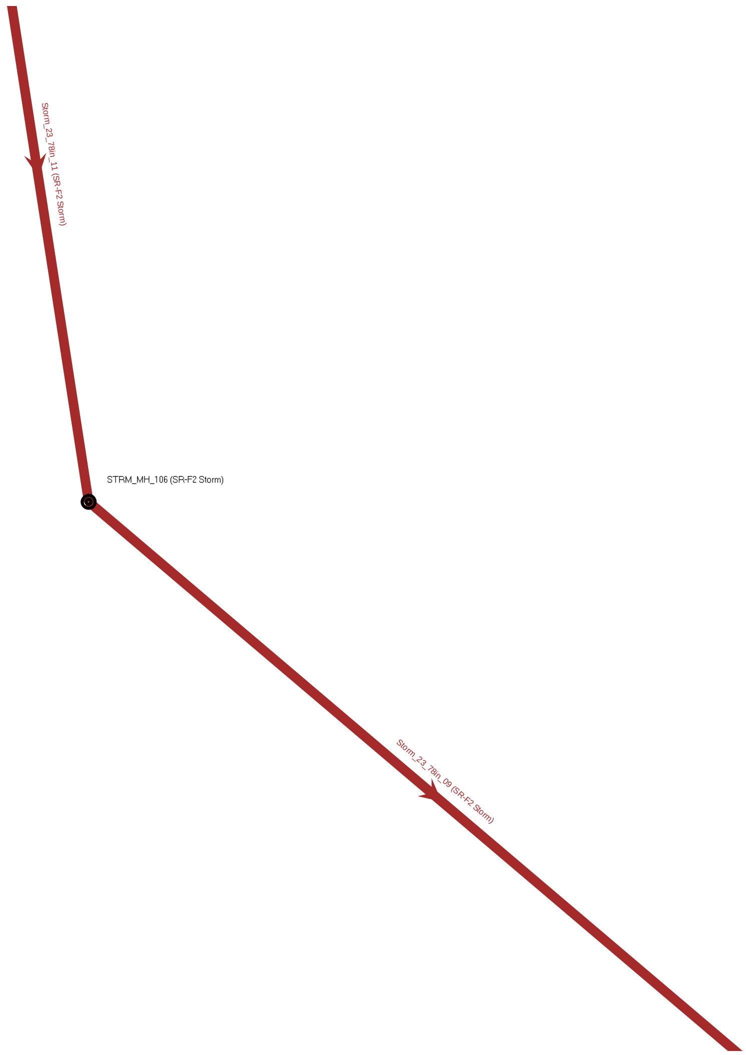

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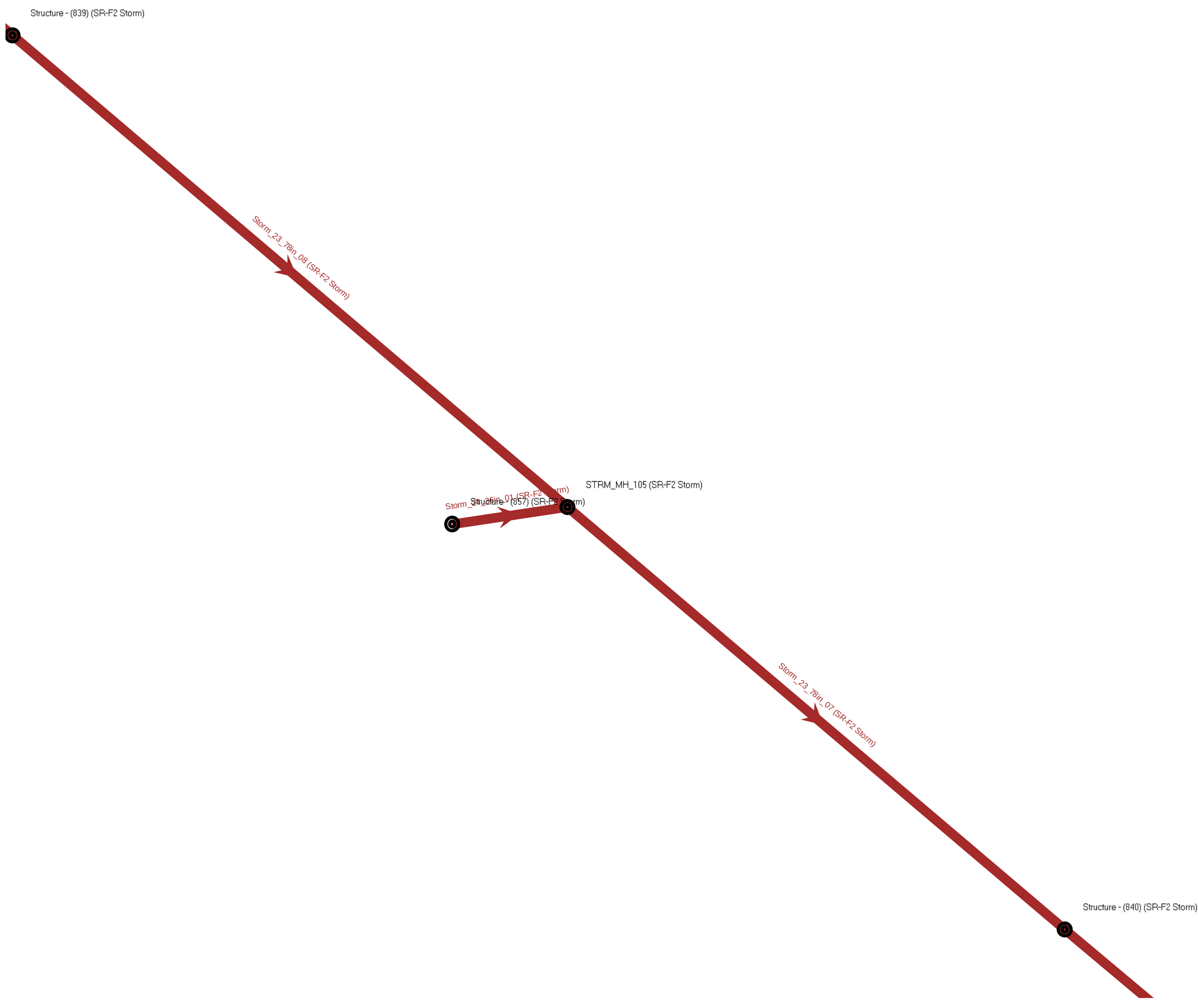

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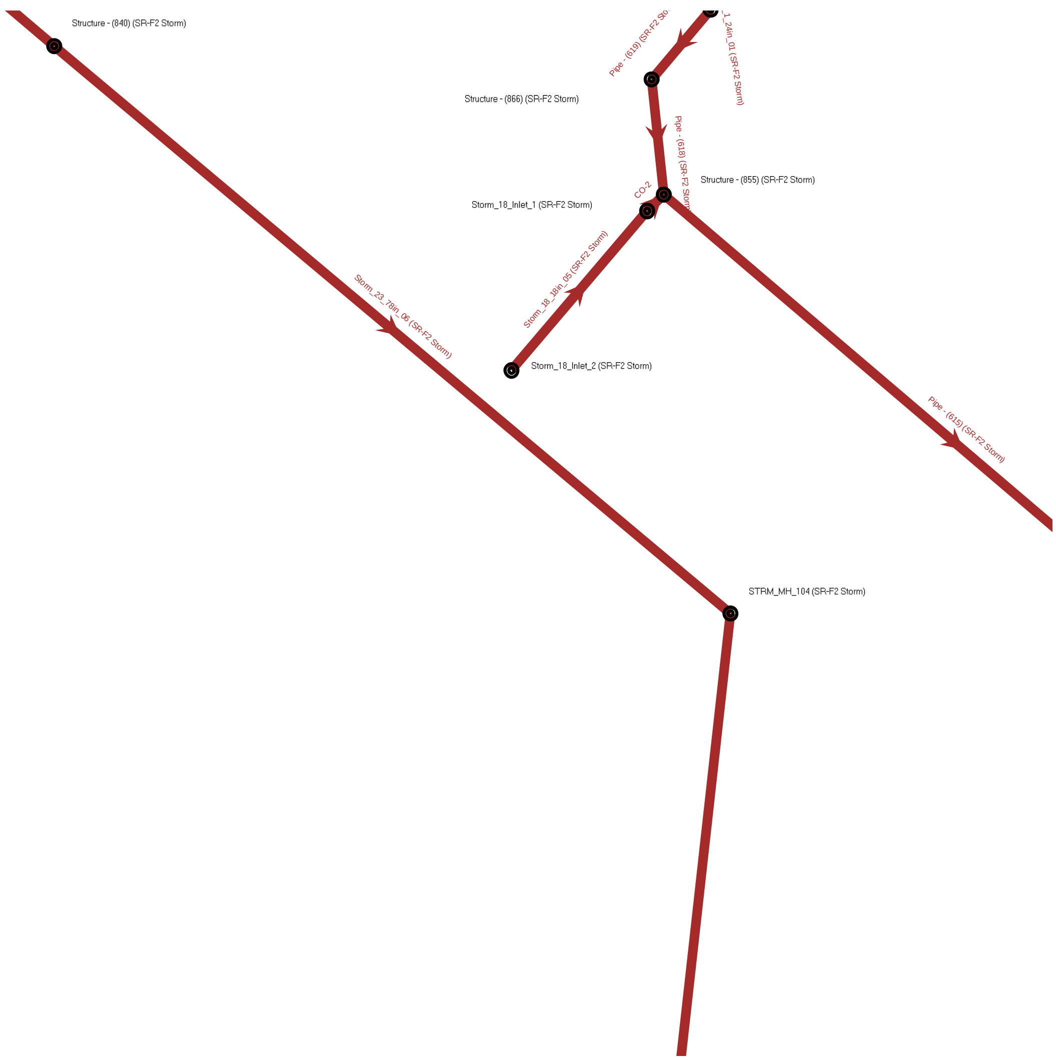

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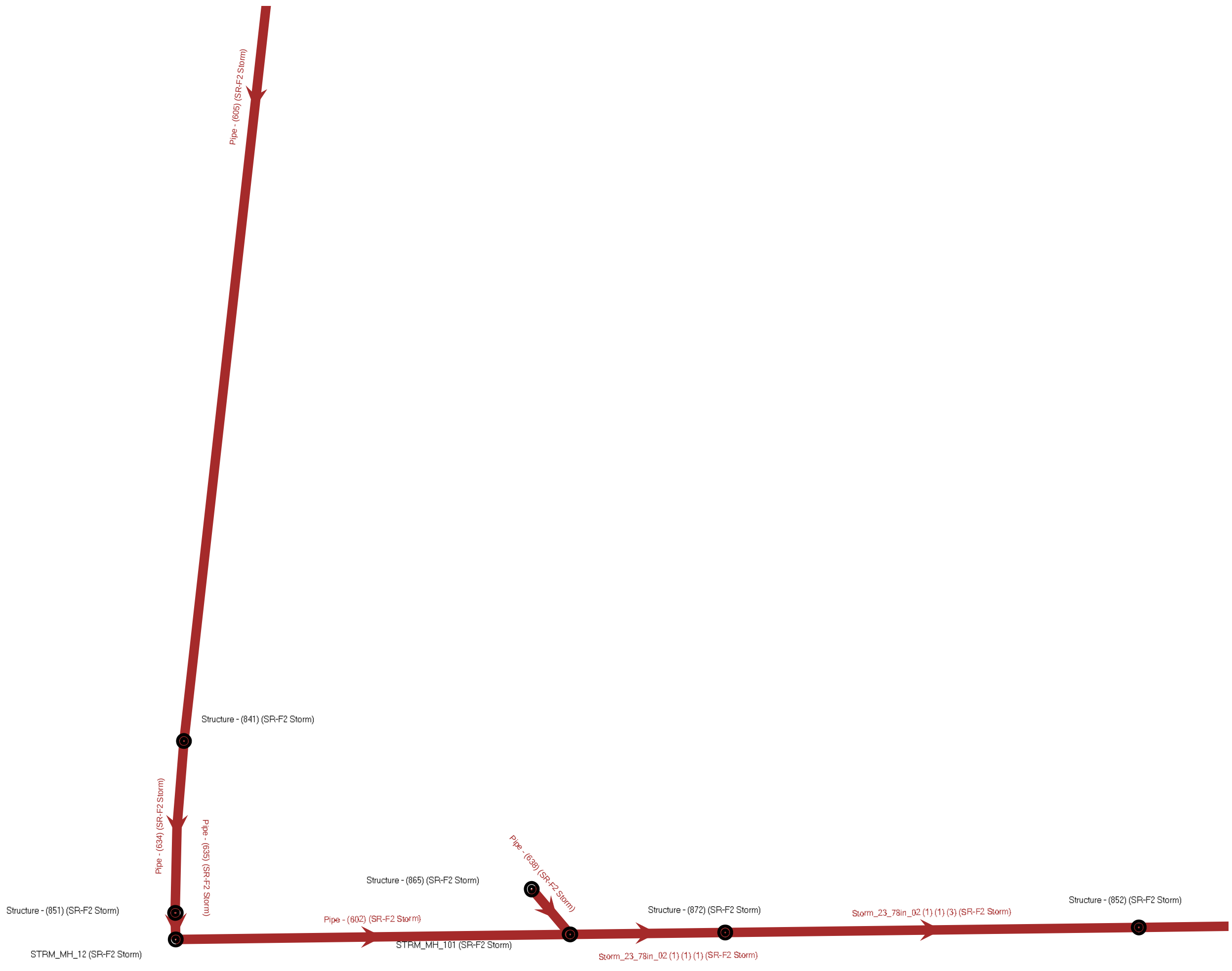

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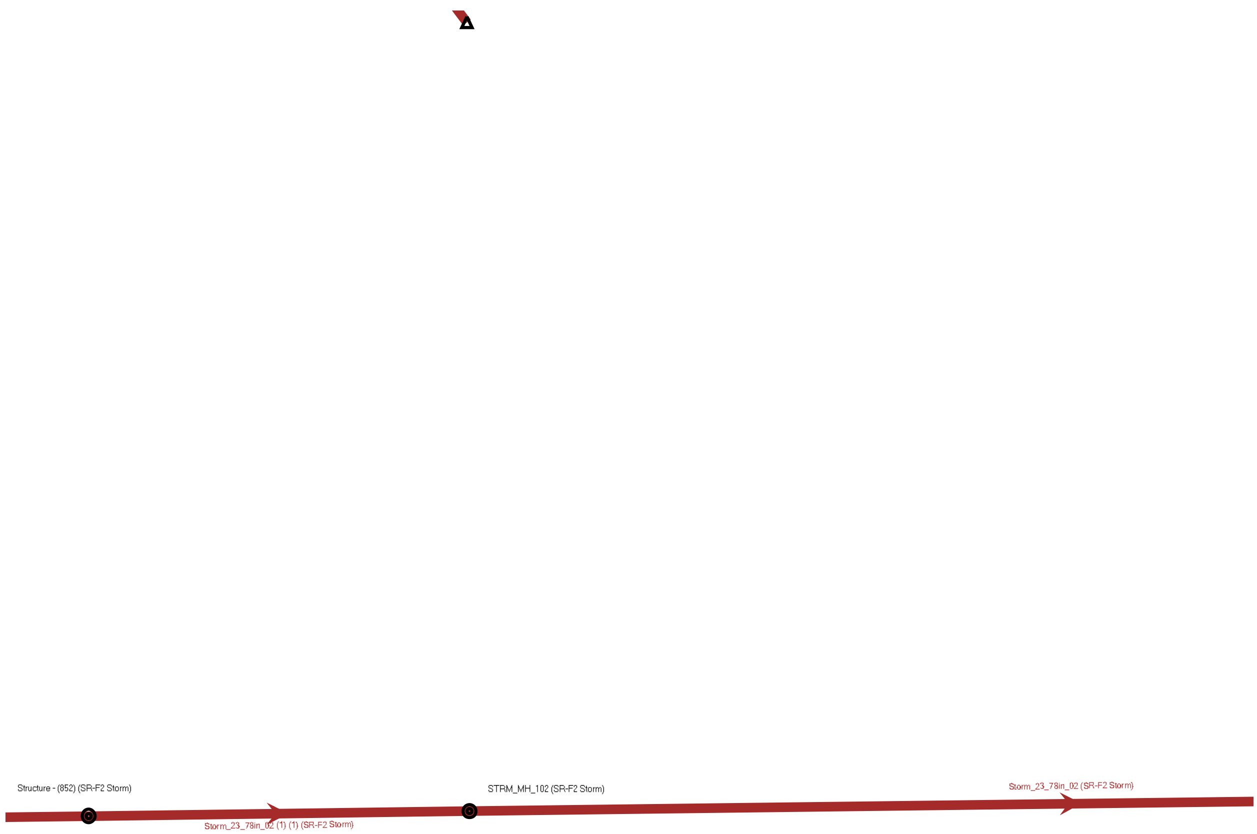

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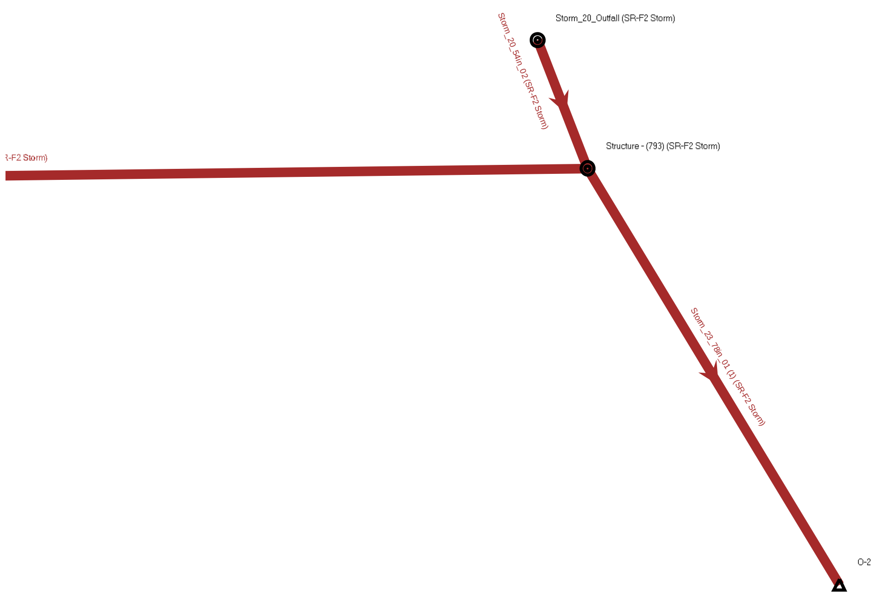


Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Tuesday, May 12 2020

Lochwinnoch Crossing

Invert Elev Dn (ft)	=	7042.00
Pipe Length (ft)	=	125.00
Slope (%)	=	1.60
Invert Elev Up (ft)	=	7044.00
Rise (in)	=	42.0
Shape	=	Elliptical
Span (in)	=	66.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Horizontal Ellipse Concrete
Culvert Entrance	=	Groove end projecting (H)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

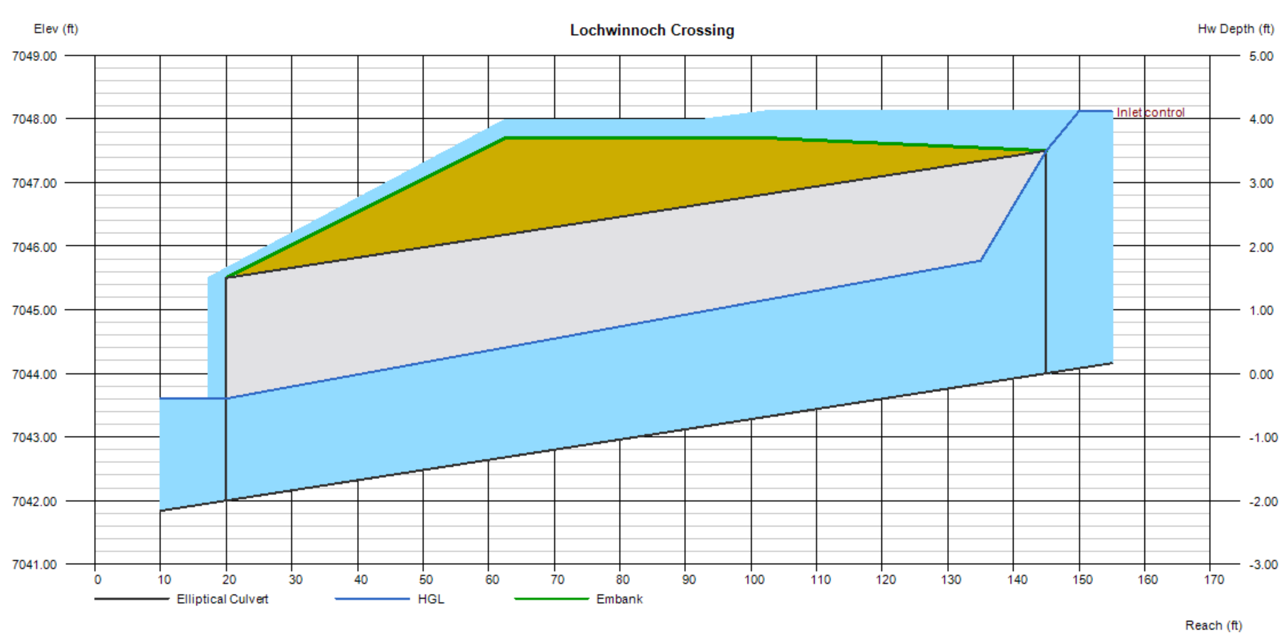
Top Elevation (ft)	=	7047.70
Top Width (ft)	=	40.00
Crest Width (ft)	=	150.00

Calculations

Qmin (cfs)	=	235.90
Qmax (cfs)	=	235.90
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	235.90
Qpipe (cfs)	=	105.79
Qovertop (cfs)	=	130.11
Veloc Dn (ft/s)	=	14.58
Veloc Up (ft/s)	=	11.96
HGL Dn (ft)	=	7043.60
HGL Up (ft)	=	7045.96
Hw Elev (ft)	=	7048.12
Hw/D (ft)	=	1.18
Flow Regime	=	Inlet Control



Channel Report

Vollmer Roadside Swale

Trapezoidal

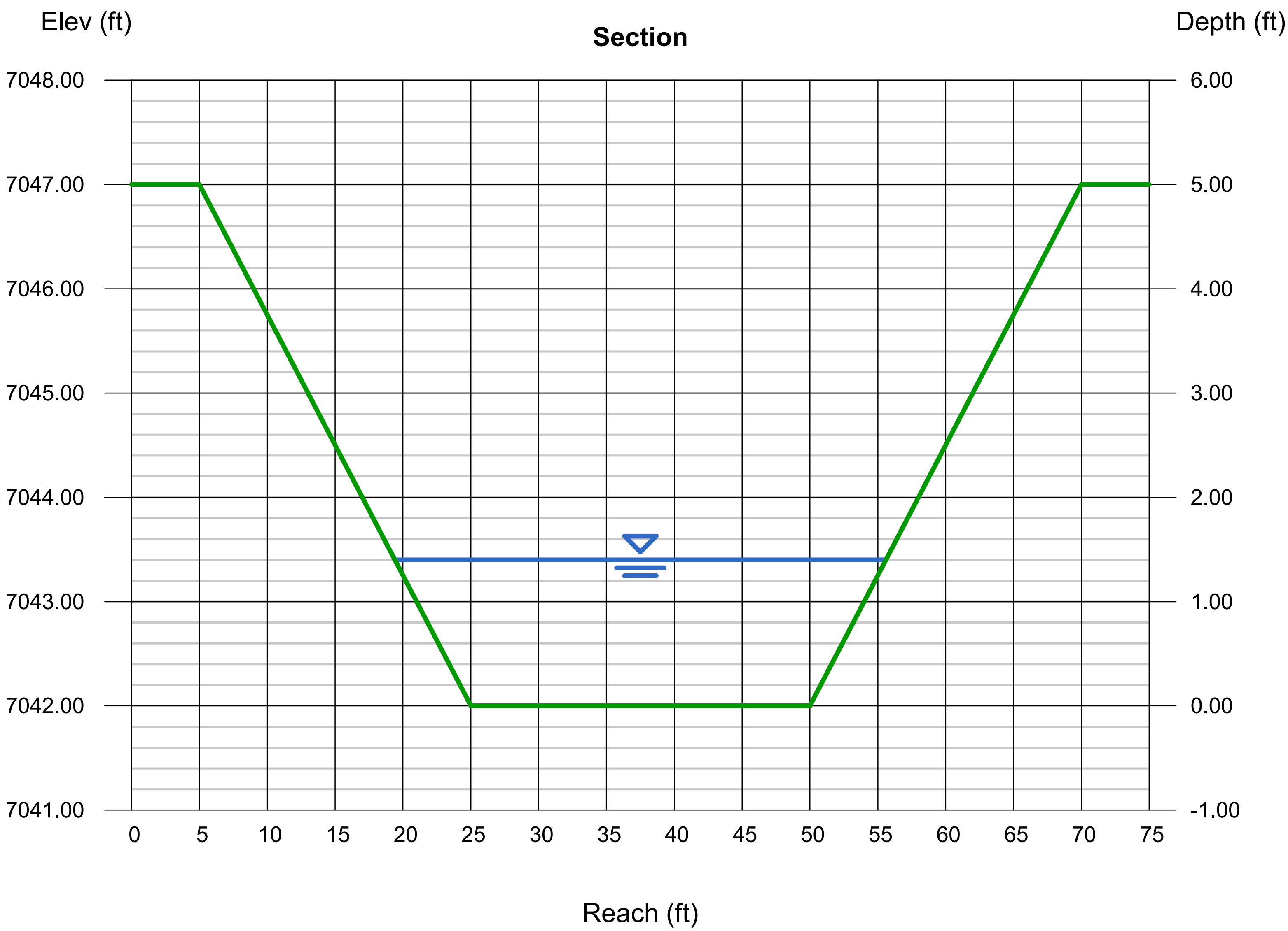
Bottom Width (ft)	= 25.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 5.00
Invert Elev (ft)	= 7042.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 235.90

Highlighted

Depth (ft)	= 1.40
Q (cfs)	= 235.90
Area (sqft)	= 42.84
Velocity (ft/s)	= 5.51
Wetted Perim (ft)	= 36.54
Crit Depth, Yc (ft)	= 1.31
Top Width (ft)	= 36.20
EGL (ft)	= 1.87



APPENDIX C

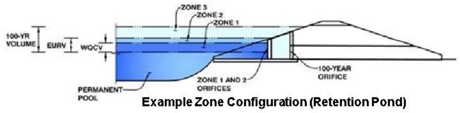
WATER QUALITY AND DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W6



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB			
Watershed Area =	173.97	acres		
Watershed Length =	3,888	ft		
Watershed Length to Centroid =	1,814	ft		
Watershed Slope =	0.025	ft/ft		
Watershed Imperviousness =	55.70%	percent		
Percentage Hydrologic Soil Group A =	63.0%	percent		
Percentage Hydrologic Soil Group B =	37.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	3.226	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	11.121	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	8.950	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	11.771	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	14.714	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	18.886	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	22.262	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	26.815	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	35.869	acre-feet		inches
Approximate 2-yr Detention Volume =	7.638	acre-feet		
Approximate 5-yr Detention Volume =	10.161	acre-feet		
Approximate 10-yr Detention Volume =	12.692	acre-feet		
Approximate 25-yr Detention Volume =	14.749	acre-feet		
Approximate 50-yr Detention Volume =	15.993	acre-feet		
Approximate 100-yr Detention Volume =	17.734	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	3.226	acre-feet
Zone 2 Volume (EURV - Zone 1) =	7.895	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	6.613	acre-feet
Total Detention Basin Volume =	17.734	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length to Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	20	0.000		
ELEV:6962	--	0.33	--	--	--	1,477	0.034	247	0.006
ELEV:6963	--	1.33	--	--	--	11,555	0.265	6,763	0.155
ELEV:6964	--	2.33	--	--	--	28,165	0.647	26,623	0.611
ELEV:6965	--	3.33	--	--	--	73,513	1.688	77,462	1.778
ELEV:6966	--	4.33	--	--	--	109,652	2.517	169,044	3.881
ELEV:6967	--	5.33	--	--	--	136,350	3.130	292,045	6.704
ELEV:6968	--	6.33	--	--	--	157,922	3.625	439,181	10.082
ELEV:6969	--	7.33	--	--	--	174,937	4.016	605,610	13.903
ELEV:6970	--	8.33	--	--	--	188,866	4.336	787,512	18.079
ELEV:6971	--	9.33	--	--	--	199,528	4.581	981,709	22.537
ELEV:6972	--	10.33	--	--	--	210,400	4.830	1,186,673	27.242
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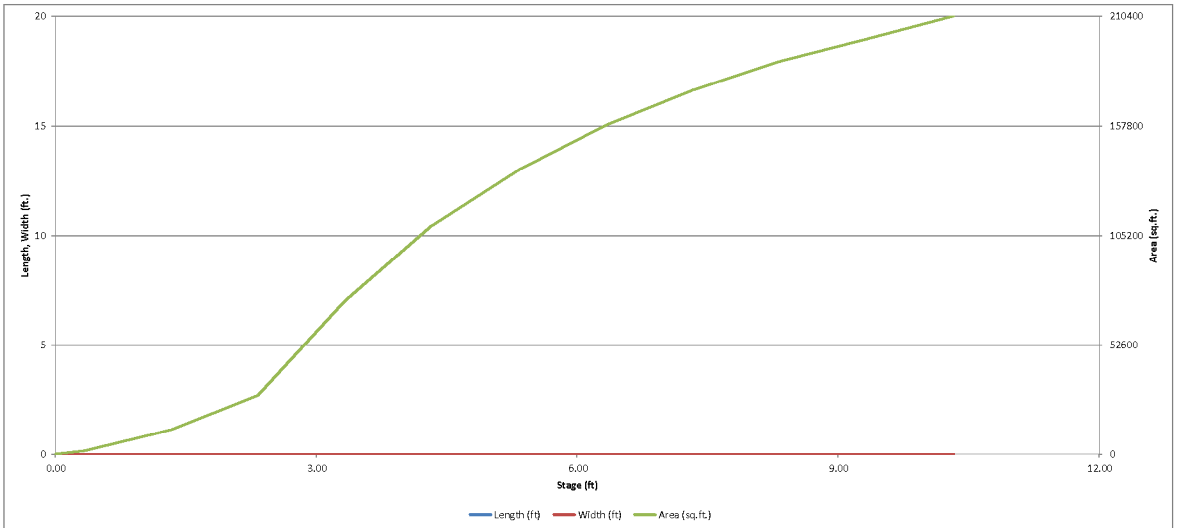
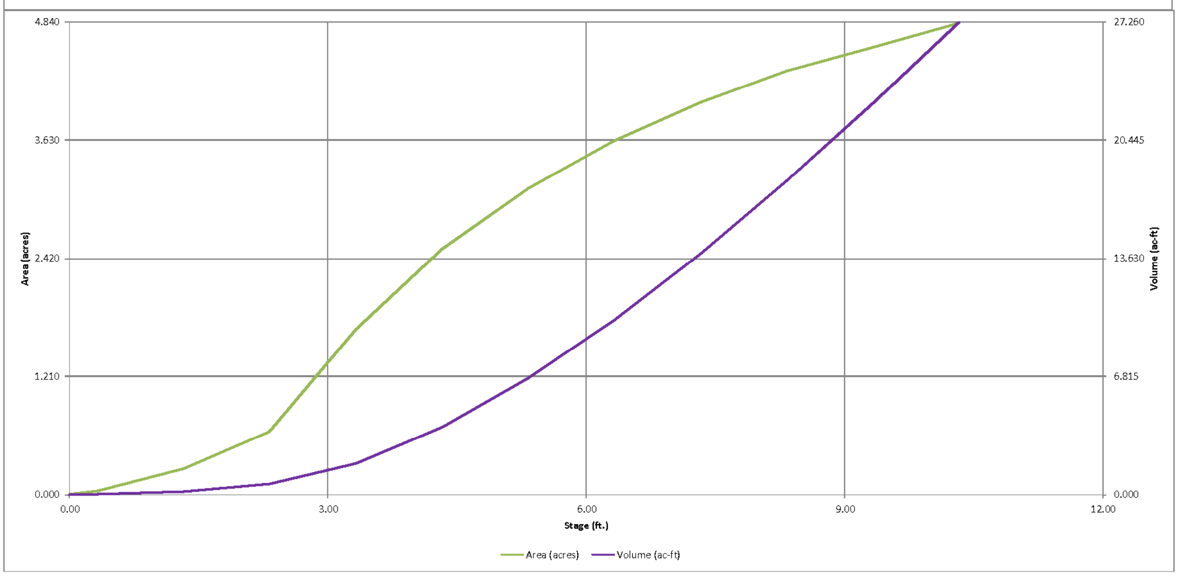
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



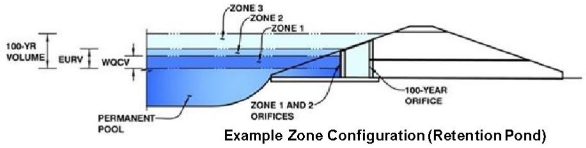


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W5



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.06	3.226	Orifice Plate
Zone 2 (EURV)	6.62	7.895	Rectangular Orifice
Zone 3 (100-year)	8.26	6.613	Weir&Pipe (Restrict)
Total (all zones)		17.734	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.06	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	16.20	inches
Orifice Plate: Orifice Area per Row =	9.32	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	6.472E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.35	2.71					
Orifice Area (sq. inches)	9.32	9.32	9.32					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	4.06	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	6.62	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	3.00	N/A	inches
Vertical Orifice Width =	9.75		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.20	N/A	ft^2
Vertical Orifice Centroid =	0.13	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.62	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	36.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	10.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	9.12	N/A	feet
Overflow Weir Slope Length =	10.31	N/A	feet
Grate Open Area / 100-yr Orifice Area =	25.51	N/A	
Overflow Grate Open Area w/o Debris =	259.76	N/A	ft^2
Overflow Grate Open Area w/ Debris =	129.88	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	54.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	33.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	10.18	N/A	ft^2
Outlet Orifice Centroid =	1.56	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.79	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.33	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	140.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.01	feet
Stage at Top of Freeboard =	10.34	feet
Basin Area at Top of Freeboard =	4.83	acres
Basin Volume at Top of Freeboard =	27.24	acre-ft

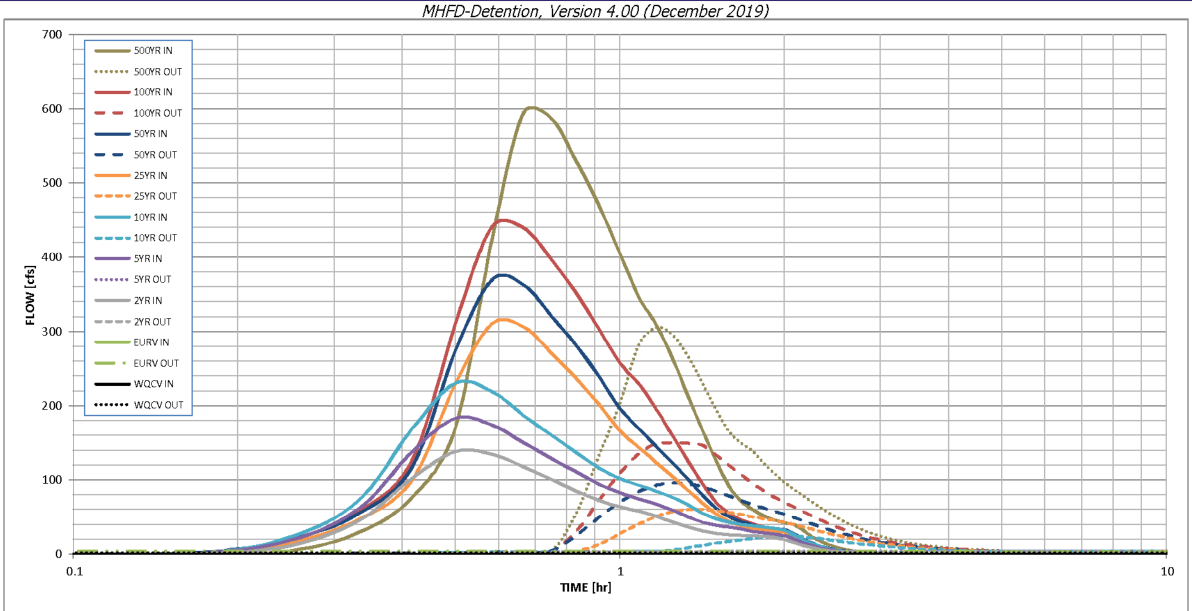
Routed Hydrograph Results

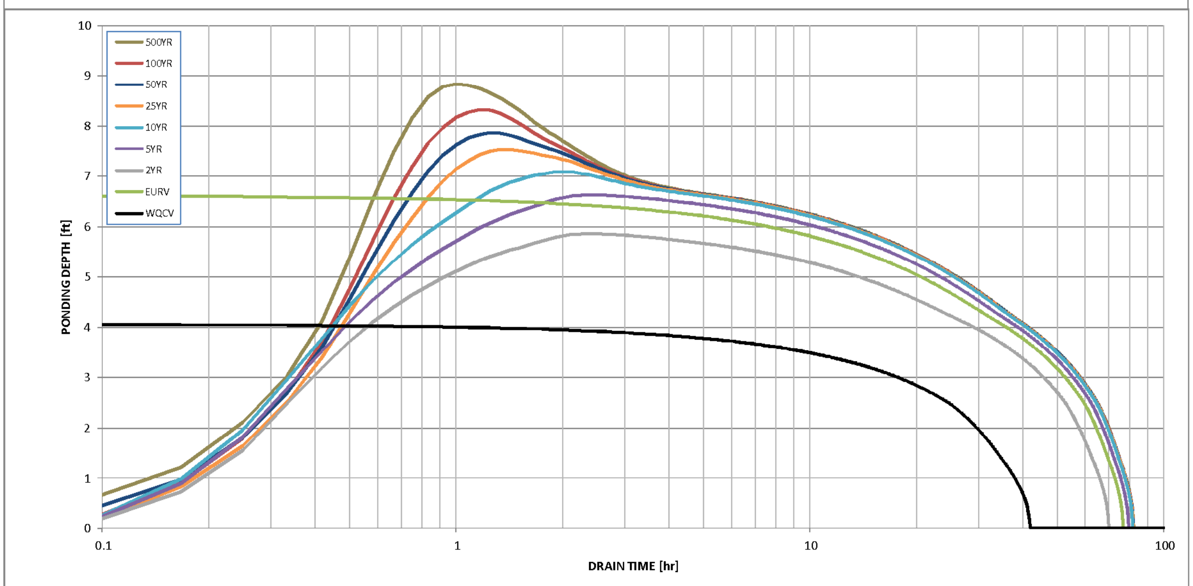
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

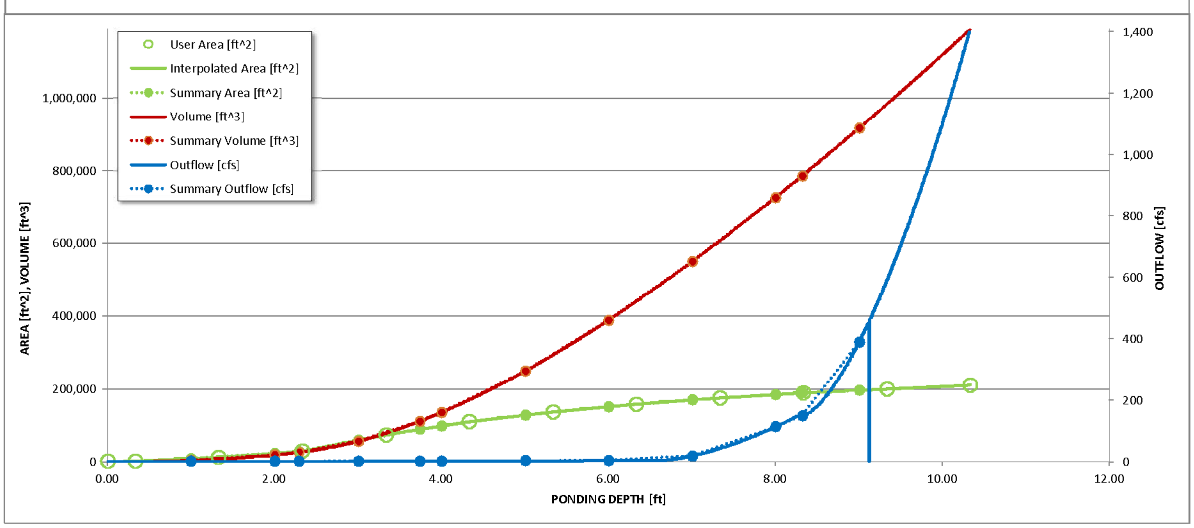
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	3.226	11.121	8.950	11.771	14.714	18.886	22.262	26.815	35.869
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	8.950	11.771	14.714	18.886	22.262	26.815	35.869
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.2	4.2	28.0	81.3	114.3	162.9	254.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.16	0.47	0.66	0.94	1.46
Peak Inflow Q (cfs) =	N/A	N/A	137.8	182.8	230.1	309.9	368.9	440.5	594.1
Peak Outflow Q (cfs) =	1.5	3.7	3.2	3.7	23.8	59.8	95.6	149.2	305.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.9	0.7	0.8	0.9	1.2
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.1	0.2	0.4	0.6	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	66	61	68	69	67	66	64	60
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	66	74	75	74	74	73	71
Maximum Ponding Depth (ft) =	4.06	6.62	5.86	6.63	7.09	7.53	7.86	8.32	8.83
Area at Maximum Ponding Depth (acres) =	2.29	3.74	3.39	3.74	3.92	4.08	4.18	4.33	4.46
Maximum Volume Stored (acre-ft) =	3.231	11.150	8.399	11.150	12.911	14.672	16.034	17.992	20.277

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	1.28	0.13	4.11
	0:15:00	0.00	0.00	11.12	18.28	22.70	15.27	19.68	18.71	28.76
	0:20:00	0.00	0.00	44.92	61.14	72.44	46.18	54.32	57.50	75.80
	0:25:00	0.00	0.00	101.80	137.35	168.30	99.39	116.95	126.25	169.69
	0:30:00	0.00	0.00	137.76	182.82	230.07	229.09	273.86	310.69	424.28
	0:35:00	0.00	0.00	133.67	173.55	218.60	309.87	368.94	440.49	594.11
	0:40:00	0.00	0.00	116.98	149.43	186.35	305.89	362.10	438.97	586.07
	0:45:00	0.00	0.00	99.89	127.87	159.50	270.29	320.18	395.68	527.57
	0:50:00	0.00	0.00	84.25	109.84	135.77	236.03	280.41	350.40	468.04
	0:55:00	0.00	0.00	71.80	93.75	115.08	200.72	238.14	301.98	404.26
	1:00:00	0.00	0.00	63.18	82.10	101.47	166.09	196.29	257.46	345.61
	1:05:00	0.00	0.00	57.20	73.94	92.29	142.92	168.55	228.66	308.38
	1:10:00	0.00	0.00	50.16	66.76	84.10	122.63	144.38	194.46	262.20
	1:15:00	0.00	0.00	42.58	58.50	75.90	103.70	121.89	157.81	212.23
	1:20:00	0.00	0.00	35.87	49.63	65.80	85.22	99.70	124.27	166.21
	1:25:00	0.00	0.00	30.48	42.26	54.46	68.34	79.33	94.22	124.82
	1:30:00	0.00	0.00	27.14	38.07	46.69	53.22	61.23	69.50	91.05
	1:35:00	0.00	0.00	25.48	35.95	42.35	43.40	49.77	54.39	70.98
	1:40:00	0.00	0.00	24.65	33.00	39.45	37.63	42.94	45.67	59.22
	1:45:00	0.00	0.00	24.14	29.90	37.34	34.06	38.68	39.81	51.13
	1:50:00	0.00	0.00	23.78	27.68	35.89	31.62	35.78	35.86	45.64
	1:55:00	0.00	0.00	21.64	26.04	34.27	30.06	33.96	33.12	41.78
	2:00:00	0.00	0.00	18.91	24.30	31.55	28.98	32.67	31.16	39.03
	2:05:00	0.00	0.00	15.08	19.62	25.21	23.76	26.75	25.15	31.35
	2:10:00	0.00	0.00	11.12	14.32	18.32	17.26	19.39	18.22	22.66
	2:15:00	0.00	0.00	8.17	10.46	13.30	12.56	14.09	13.28	16.47
	2:20:00	0.00	0.00	5.94	7.58	9.64	9.15	10.25	9.73	12.06
	2:25:00	0.00	0.00	4.27	5.34	6.89	6.52	7.30	6.97	8.62
	2:30:00	0.00	0.00	2.98	3.67	4.84	4.57	5.11	4.88	6.02
	2:35:00	0.00	0.00	2.04	2.53	3.38	3.24	3.62	3.46	4.26
	2:40:00	0.00	0.00	1.31	1.69	2.23	2.19	2.44	2.32	2.85
	2:45:00	0.00	0.00	0.75	1.03	1.32	1.34	1.49	1.41	1.72
	2:50:00	0.00	0.00	0.36	0.53	0.66	0.70	0.77	0.72	0.87
	2:55:00	0.00	0.00	0.14	0.20	0.23	0.26	0.28	0.26	0.30
	3:00:00	0.00	0.00	0.03	0.03	0.03	0.03	0.02	0.02	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]
	1.00	8,229	0.189	3,498	0.080	0.31
	2.00	22,684	0.521	18,233	0.419	0.69
WQCV	2.29	27,501	0.631	25,509	0.586	0.77
	3.00	58,548	1.344	55,672	1.278	1.11
EURV	3.74	88,330	2.028	110,639	2.540	1.40
	4.00	97,726	2.243	134,827	3.095	1.48
	5.00	127,540	2.928	248,503	5.705	2.65
	6.00	150,803	3.462	388,241	8.913	3.32
	7.00	169,322	3.887	548,808	12.599	18.31
	8.00	184,269	4.230	725,945	16.665	113.00
100-YR	8.32	188,727	4.333	785,624	18.035	149.22
	9.00	196,010	4.500	916,445	21.039	388.46

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'.

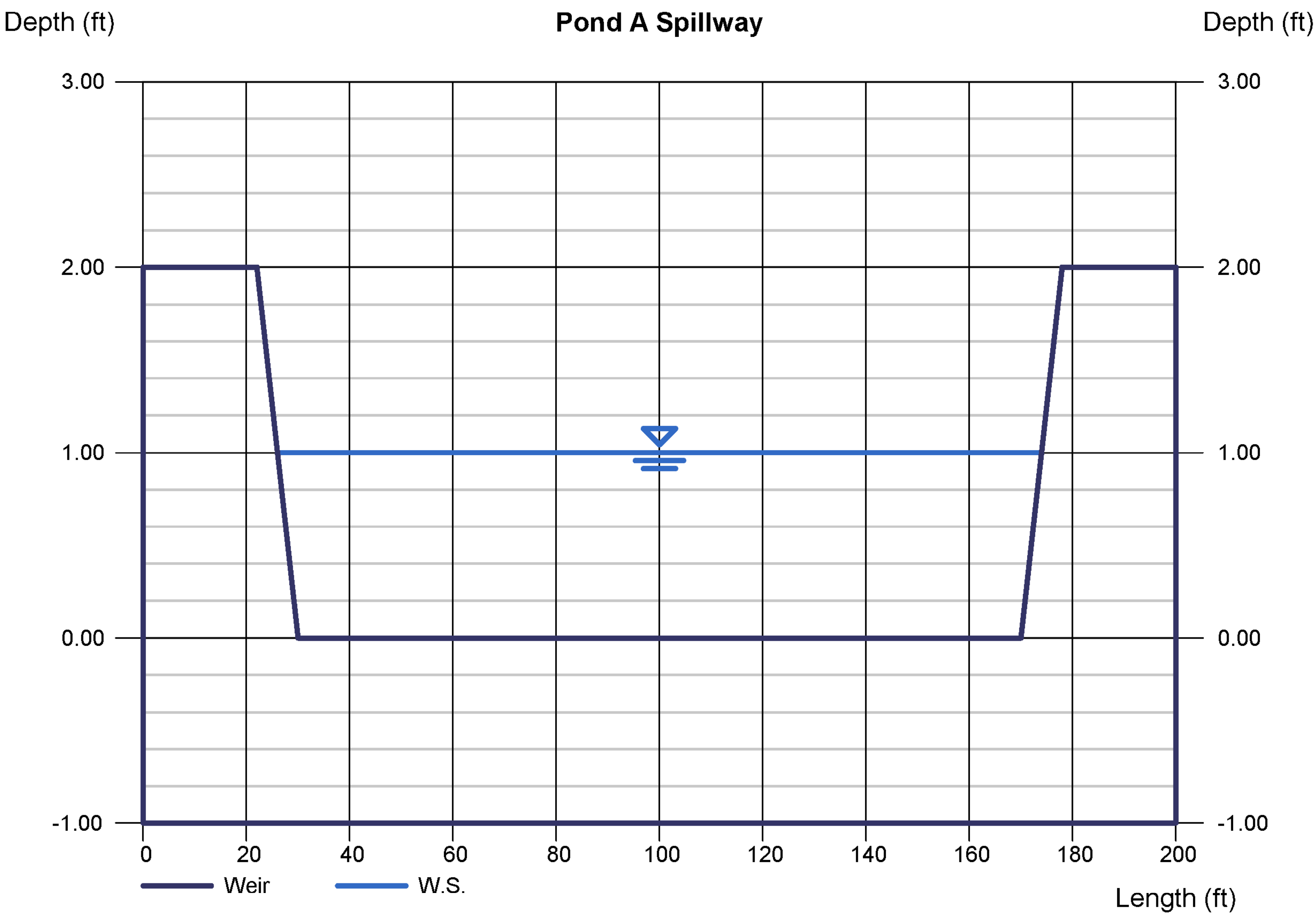
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, May 11 2020

Pond W5 Spillway

Trapezoidal Weir		**Highlighted**	
Crest	= Sharp	Depth (ft)	= 1.00
Bottom Length (ft)	= 140.00	Q (cfs)	= 440.50
Total Depth (ft)	= 2.00	Area (sqft)	= 144.00
Side Slope (z:1)	= 4.00	Velocity (ft/s)	= 3.06
		Top Width (ft)	= 148.00
Calculations			
Weir Coeff. Cw	= 3.10		
Compute by:	Known Q		
Known Q (cfs)	= 440.50		

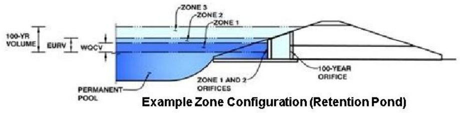


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W4 INTERIM



Example Zone Configuration (Retention Pond)

Verify - soil conditions need to match soils map

Watershed Information

Selected BMP Type =	EDB			
Watershed Area =	352.23	acres		
Watershed Length =	9,241	ft		
Watershed Length to Centroid =	4,488	ft		
Watershed Slope =	0.060	ft/ft		
Watershed Imperviousness =	6.40%	percent		
Percentage Hydrologic Soil Group A =	54.0%	percent		
Percentage Hydrologic Soil Group B =	46.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths = User Input				

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.329	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.730	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.236	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.089	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	6.774	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	15.616	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	21.451	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	31.594	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	48.570	acre-feet		inches
Approximate 2-yr Detention Volume =	1.037	acre-feet		
Approximate 5-yr Detention Volume =	1.577	acre-feet		
Approximate 10-yr Detention Volume =	3.279	acre-feet		
Approximate 25-yr Detention Volume =	4.795	acre-feet		
Approximate 50-yr Detention Volume =	5.509	acre-feet		
Approximate 100-yr Detention Volume =	8.317	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.329	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.401	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	6.587	acre-feet
Total Detention Basin Volume =	8.317	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 Increement = 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	--	--	--	20	0.000		
ELEV:7014	--	0.33	--	--	--	7,181	0.165	1,188	0.027
ELEV:7015	--	1.33	--	--	--	20,018	0.460	14,787	0.339
ELEV:7016	--	2.33	--	--	--	33,734	0.774	41,663	0.956
ELEV:7017	--	3.33	--	--	--	37,421	0.859	77,241	1.773
ELEV:7018	--	4.33	--	--	--	40,860	0.938	116,381	2.672
ELEV:7019	--	5.33	--	--	--	44,458	1.021	159,040	3.651
ELEV:7020	--	6.33	--	--	--	48,169	1.106	205,354	4.714
ELEV:7021	--	7.33	--	--	--	52,029	1.194	255,453	5.864
ELEV:7022	--	8.33	--	--	--	55,983	1.285	309,459	7.104
ELEV:7023	--	9.33	--	--	--	60,114	1.380	367,507	8.437
ELEV:7024	--	10.33	--	--	--	64,495	1.481	429,812	9.867
ELEV:7025	--	11.33	--	--	--	68,666	1.576	496,392	11.396
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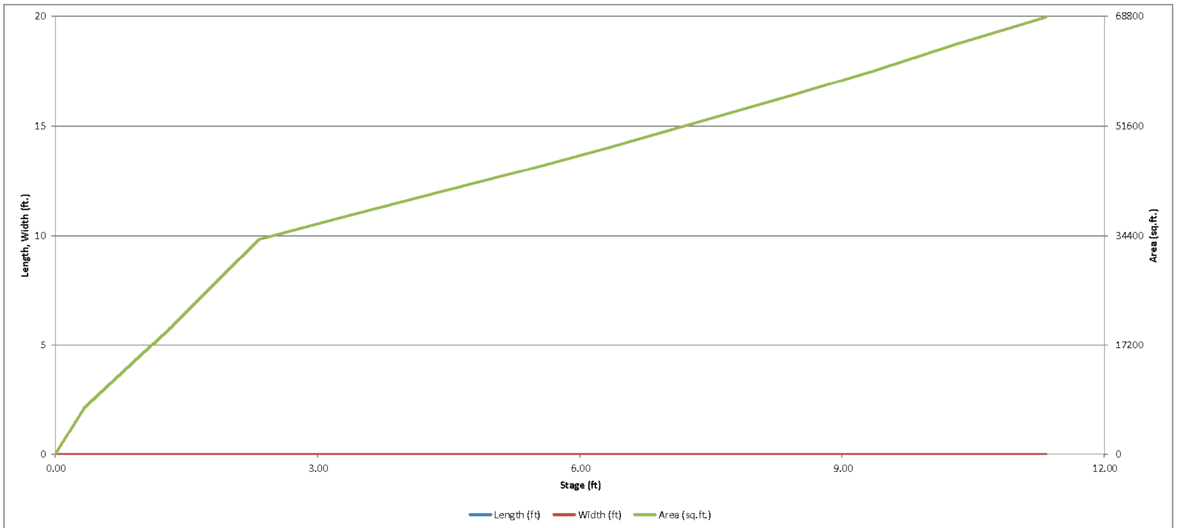
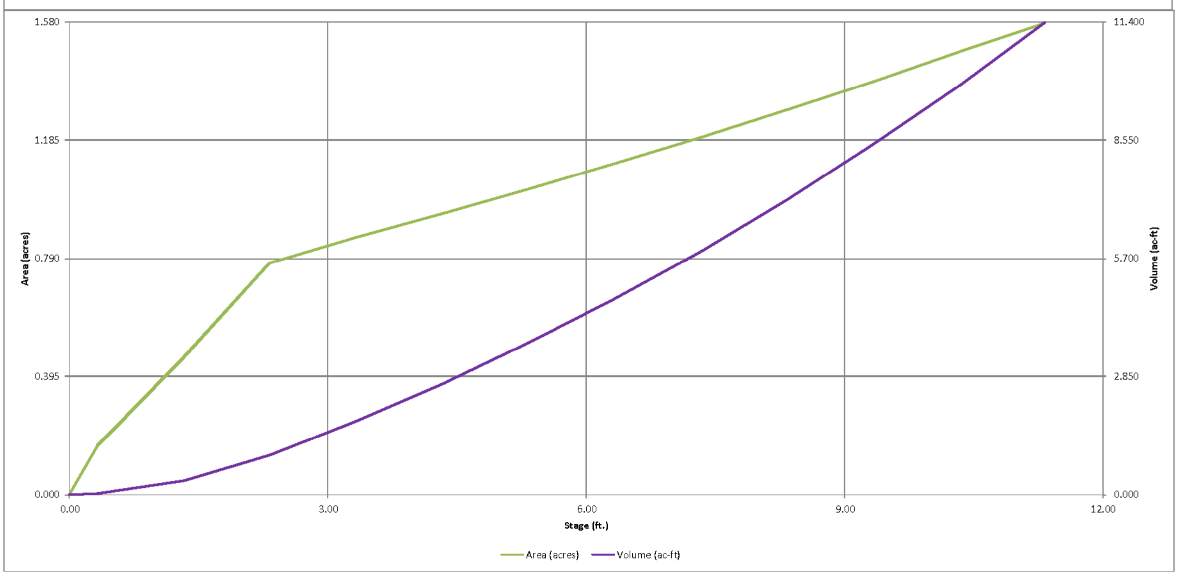
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



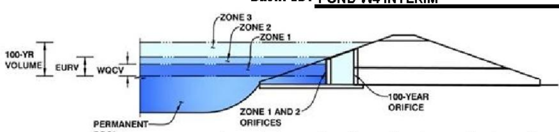


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W4 INTERIM



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.80	1.329	Orifice Plate
Zone 2 (EURV)	3.28	0.401	Orifice Plate
Zone 3 (100-year)	9.25	6.587	Weir&Pipe (Restrict)
Total (all zones)		8.317	

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

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

Calculated Parameters for Underdrain

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

Calculated Parameters for Plate

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.618E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.28	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	13.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.65	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.09	2.19					
Orifice Area (sq. inches)	6.65	6.65	6.65					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.28	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	20.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	10.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.78	N/A	feet
Overflow Weir Slope Length =	10.31	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.65	N/A	
Overflow Grate Open Area w/o Debris =	144.31	N/A	ft^2
Overflow Grate Open Area w/ Debris =	72.15	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	60.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	55.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	18.85	N/A	ft^2
Outlet Orifice Centroid =	2.41	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.56	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage=	9.33	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.00	feet
Spillway Crest Length =	85.00	feet	Stage at Top of Freeboard =	11.33	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.58	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	11.40	acre-ft

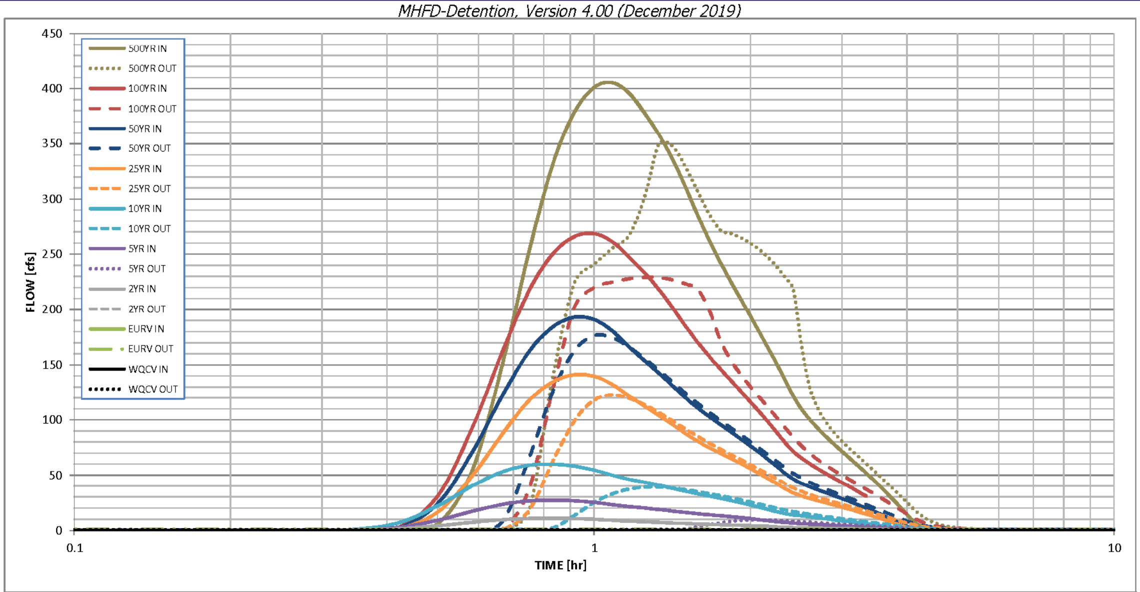
Routed Hydrograph Results

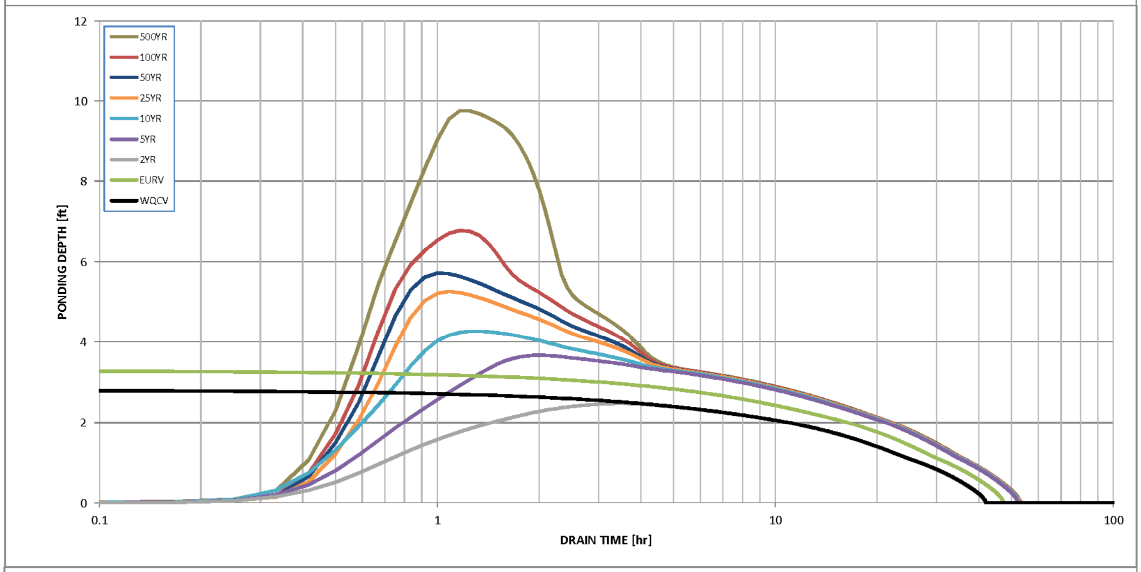
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

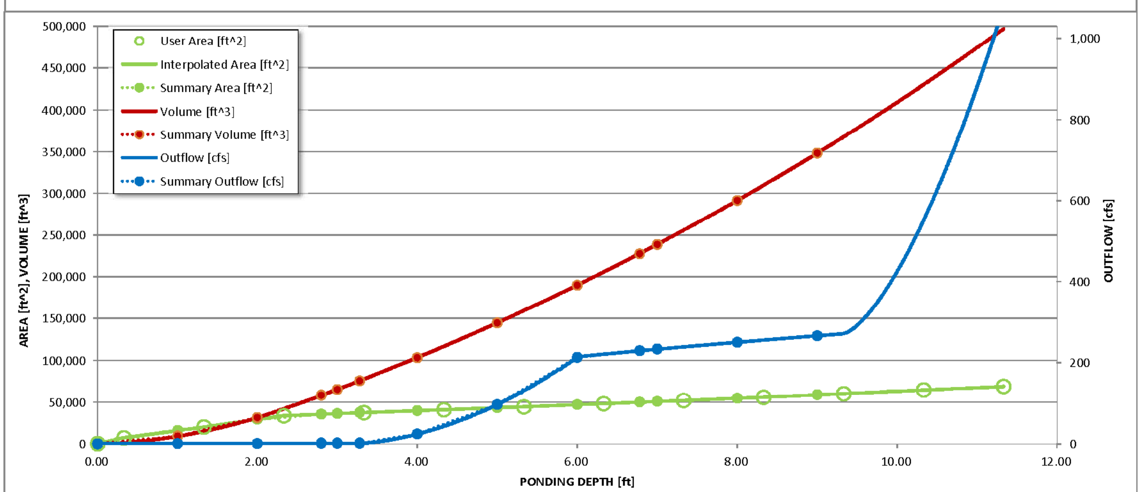
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.329	1.730	1.236	3.089	6.774	15.616	21.451	31.594	48.570
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.236	3.089	6.774	15.616	21.451	31.594	48.570
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	3.3	16.2	47.9	127.8	179.4	256.3	393.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.05	0.14	0.36	0.51	0.73	1.12
Peak Inflow Q (cfs) =	N/A	N/A	10.9	27.1	59.7	141.0	192.9	268.3	405.4
Peak Outflow Q (cfs) =	0.8	1.0	0.7	9.5	39.0	122.6	176.2	229.2	350.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.8	1.0	1.0	0.9	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.8	1.2	1.6	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	42	38	44	37	28	24	17	9
Time to Drain 99% of Inflow Volume (hours) =	**40**	45	40	48	46	40	37	33	28
Maximum Ponding Depth (ft) =	2.80	3.28	2.48	3.67	4.27	5.26	5.71	6.78	9.76
Area at Maximum Ponding Depth (acres) =	0.81	0.85	0.79	0.89	0.93	1.01	1.05	1.14	1.42
Maximum Volume Stored (acre-ft) =	1.330	1.730	1.066	2.061	2.616	3.570	4.045	5.209	9.025

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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.

Time Interval: 5.00 min

SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
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]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
0:15:00	0.00	0.00	0.03	0.05	0.06	0.04	0.06	0.05	0.10
0:20:00	0.00	0.00	0.17	0.24	0.46	0.19	0.24	0.24	0.45
0:25:00	0.00	0.00	1.41	2.44	6.33	1.27	1.78	2.07	5.87
0:30:00	0.00	0.00	4.15	8.99	21.97	16.31	24.05	30.73	54.50
0:35:00	0.00	0.00	7.19	17.20	40.18	49.45	70.89	93.08	150.94
0:40:00	0.00	0.00	9.46	23.32	52.99	87.46	122.19	162.18	252.83
0:45:00	0.00	0.00	10.61	26.41	58.87	117.53	161.96	217.28	331.85
0:50:00	0.00	0.00	10.86	27.12	59.70	134.51	184.25	250.33	378.56
0:55:00	0.00	0.00	10.58	26.60	57.99	140.96	192.92	265.70	400.90
1:00:00	0.00	0.00	9.92	25.17	54.43	139.46	190.85	268.30	405.37
1:05:00	0.00	0.00	9.06	23.15	49.82	132.12	180.62	261.08	395.99
1:10:00	0.00	0.00	8.35	21.35	46.04	121.60	166.25	247.44	377.74
1:15:00	0.00	0.00	7.76	20.07	43.38	112.17	153.69	233.22	357.95
1:20:00	0.00	0.00	7.19	18.72	40.67	103.65	142.08	217.89	335.22
1:25:00	0.00	0.00	6.64	17.30	37.76	95.47	130.84	201.37	310.07
1:30:00	0.00	0.00	6.17	15.97	35.03	87.38	119.77	184.67	284.56
1:35:00	0.00	0.00	5.79	14.92	32.79	80.46	110.46	169.87	262.00
1:40:00	0.00	0.00	5.46	14.00	30.73	74.69	102.61	157.18	242.44
1:45:00	0.00	0.00	5.15	13.10	28.67	69.58	95.55	145.88	224.92
1:50:00	0.00	0.00	4.83	12.20	26.62	64.76	88.88	135.54	208.86
1:55:00	0.00	0.00	4.52	11.31	24.60	60.11	82.47	125.61	193.46
2:00:00	0.00	0.00	4.19	10.43	22.61	55.55	76.17	115.94	178.50
2:05:00	0.00	0.00	3.84	9.55	20.62	51.00	69.89	106.47	163.89
2:10:00	0.00	0.00	3.49	8.65	18.62	46.45	63.62	97.19	149.60
2:15:00	0.00	0.00	3.13	7.75	16.64	41.90	57.36	87.98	135.43
2:20:00	0.00	0.00	2.83	6.96	14.97	37.40	51.17	78.86	121.56
2:25:00	0.00	0.00	2.61	6.42	13.87	33.69	46.18	71.30	110.23
2:30:00	0.00	0.00	2.44	6.02	13.04	31.02	42.59	65.64	101.59
2:35:00	0.00	0.00	2.29	5.65	12.24	28.95	39.73	60.97	94.31
2:40:00	0.00	0.00	2.15	5.29	11.47	27.13	37.22	56.84	87.81
2:45:00	0.00	0.00	2.01	4.94	10.71	25.46	34.92	53.06	81.86
2:50:00	0.00	0.00	1.87	4.61	9.97	23.87	32.73	49.51	76.29
2:55:00	0.00	0.00	1.74	4.28	9.24	22.29	30.56	46.14	71.05
3:00:00	0.00	0.00	1.60	3.95	8.53	20.73	28.42	42.96	66.13
3:05:00	0.00	0.00	1.47	3.64	7.84	19.19	26.30	39.87	61.36
3:10:00	0.00	0.00	1.35	3.33	7.16	17.66	24.19	36.78	56.61
3:15:00	0.00	0.00	1.22	3.02	6.48	16.14	22.09	33.70	51.86
3:20:00	0.00	0.00	1.09	2.71	5.82	14.61	20.00	30.62	47.12
3:25:00	0.00	0.00	0.97	2.40	5.15	13.09	17.91	27.55	42.39
3:30:00	0.00	0.00	0.84	2.10	4.49	11.57	15.82	24.47	37.65
3:35:00	0.00	0.00	0.72	1.79	3.82	10.05	13.73	21.40	32.92
3:40:00	0.00	0.00	0.60	1.49	3.16	8.53	11.64	18.32	28.19
3:45:00	0.00	0.00	0.48	1.19	2.50	7.01	9.56	15.25	23.46
3:50:00	0.00	0.00	0.36	0.89	1.85	5.49	7.47	12.18	18.74
3:55:00	0.00	0.00	0.24	0.59	1.20	3.98	5.39	9.12	14.03
4:00:00	0.00	0.00	0.14	0.34	0.67	2.49	3.35	6.09	9.44
4:05:00	0.00	0.00	0.10	0.20	0.41	1.31	1.77	3.68	5.89
4:10:00	0.00	0.00	0.08	0.16	0.33	0.68	0.95	2.29	3.82
4:15:00	0.00	0.00	0.06	0.13	0.27	0.38	0.54	1.46	2.49
4:20:00	0.00	0.00	0.06	0.10	0.21	0.22	0.31	0.90	1.57
4:25:00	0.00	0.00	0.05	0.08	0.17	0.14	0.19	0.53	0.93
4:30:00	0.00	0.00	0.04	0.06	0.12	0.10	0.14	0.28	0.49
4:35:00	0.00	0.00	0.03	0.05	0.09	0.07	0.09	0.12	0.21
4:40:00	0.00	0.00	0.03	0.04	0.06	0.05	0.06	0.05	0.10
4:45:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.07
4:50:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.05
4:55:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.04
5:00:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
5:05:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
5:10:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
5:15:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	20	0.000	0	0.000	0.00
	1.00	15,782	0.362	8,880	0.204	0.22
	2.00	29,208	0.671	31,278	0.718	0.53
WQCV	2.80	35,467	0.814	57,925	1.330	0.84
EURV	3.00	36,204	0.831	65,092	1.494	0.89
	3.28	37,237	0.855	75,374	1.730	0.96
	4.00	39,725	0.912	103,085	2.366	23.73
	5.00	43,271	0.993	144,565	3.319	96.75
	6.00	46,944	1.078	189,660	4.354	213.03
100-YR	6.78	49,906	1.146	227,420	5.221	229.18
	7.00	50,755	1.165	238,493	5.475	233.10
	8.00	54,678	1.255	291,199	6.685	250.15
	9.00	58,751	1.349	347,894	7.987	266.11

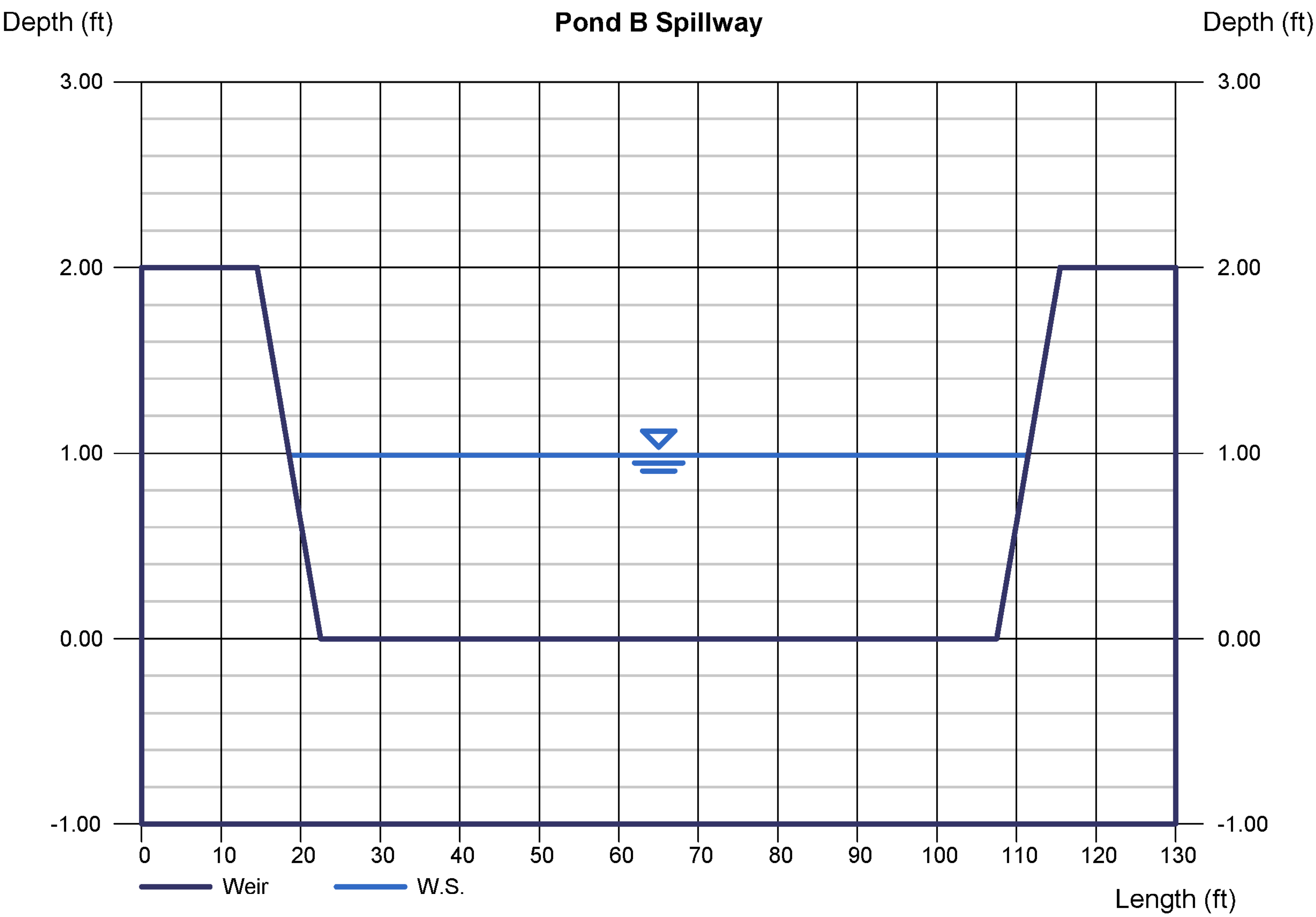
For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

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

Weir Report

Pond W4 Spillway

Trapezoidal Weir		**Highlighted**	
Crest	= Sharp	Depth (ft)	= 0.99
Bottom Length (ft)	= 85.00	Q (cfs)	= 268.30
Total Depth (ft)	= 2.00	Area (sqft)	= 88.07
Side Slope (z:1)	= 4.00	Velocity (ft/s)	= 3.05
		Top Width (ft)	= 92.92
Calculations			
Weir Coeff. Cw	= 3.10		
Compute by:	Known Q		
Known Q (cfs)	= 268.30		



FOREBAY VOLUME REQUIREMENTS

Equation 3-1 $WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$

a=1 (40 hour drain time)

Forebay @ DP 3.0	*I=.549*	*WQCV=* 0.22013
Future Forebay @ DP 3.1	*I= .894*	*WQCV=* 0.39644
Forebay @ DP 4.3	*I= .066*	*WQCV=* 0.046558

Equation 3-3 V=(WQCV/12)A

Forebay @ DP 3.0	A= 170.21 Acres	V= 3.122
Future Forebay @ DP 3.1	A= 3.76 Acres	V= 0.124
Forebay @ DP 4.3	A= 355.10 Acres	V= 1.378

3% OF WQCV

FOREBAY TOTAL VOLUME= .03(V)

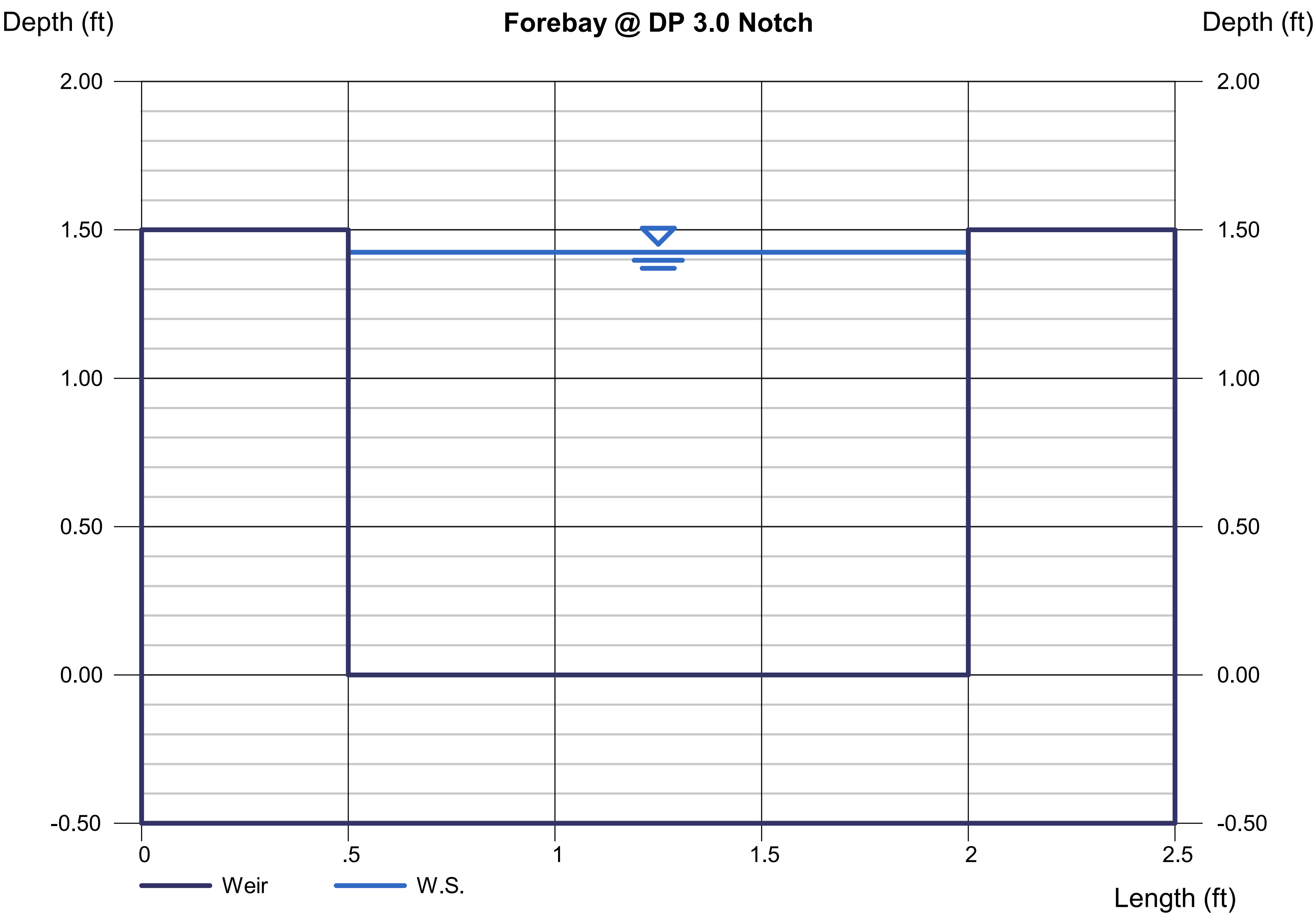
Volume Required for Forebay @ DP 3.0 =	0.094	AC-FT	4080	CF
Volume Required for Future Forebay @ DP 3.1 =	0.004	AC-FT	162	CF
Volume Required for Forebay @ DP 4.3 =	0.041	AC-FT	1801	CF

Q_{100} Discharges	2% OF Q_{100}
Q_{100} Forebay @ DP 3.0=	.02*424.4 CFS= 8.49 CFS
Q_{100} Future Forebay @ DP 3.1 =	.02*22.5 CFS= 0.45 CFS
Q_{100} Forebay @ DP 4.3=	.02*262.3 CFS= 5.25 CFS

Weir Report

Forebay @ DP 3.0 Notch

Rectangular Weir		**Highlighted**	
Crest	= Sharp	Depth (ft)	= 1.42
Bottom Length (ft)	= 1.50	Q (cfs)	= 8.490
Total Depth (ft)	= 1.50	Area (sqft)	= 2.14
		Velocity (ft/s)	= 3.97
Calculations		Top Width (ft)	= 1.50
Weir Coeff. Cw	= 3.33		
Compute by:	Known Q		
Known Q (cfs)	= 8.49		



Weir Report

Future Forebay @ DP 3.1

Rectangular Weir

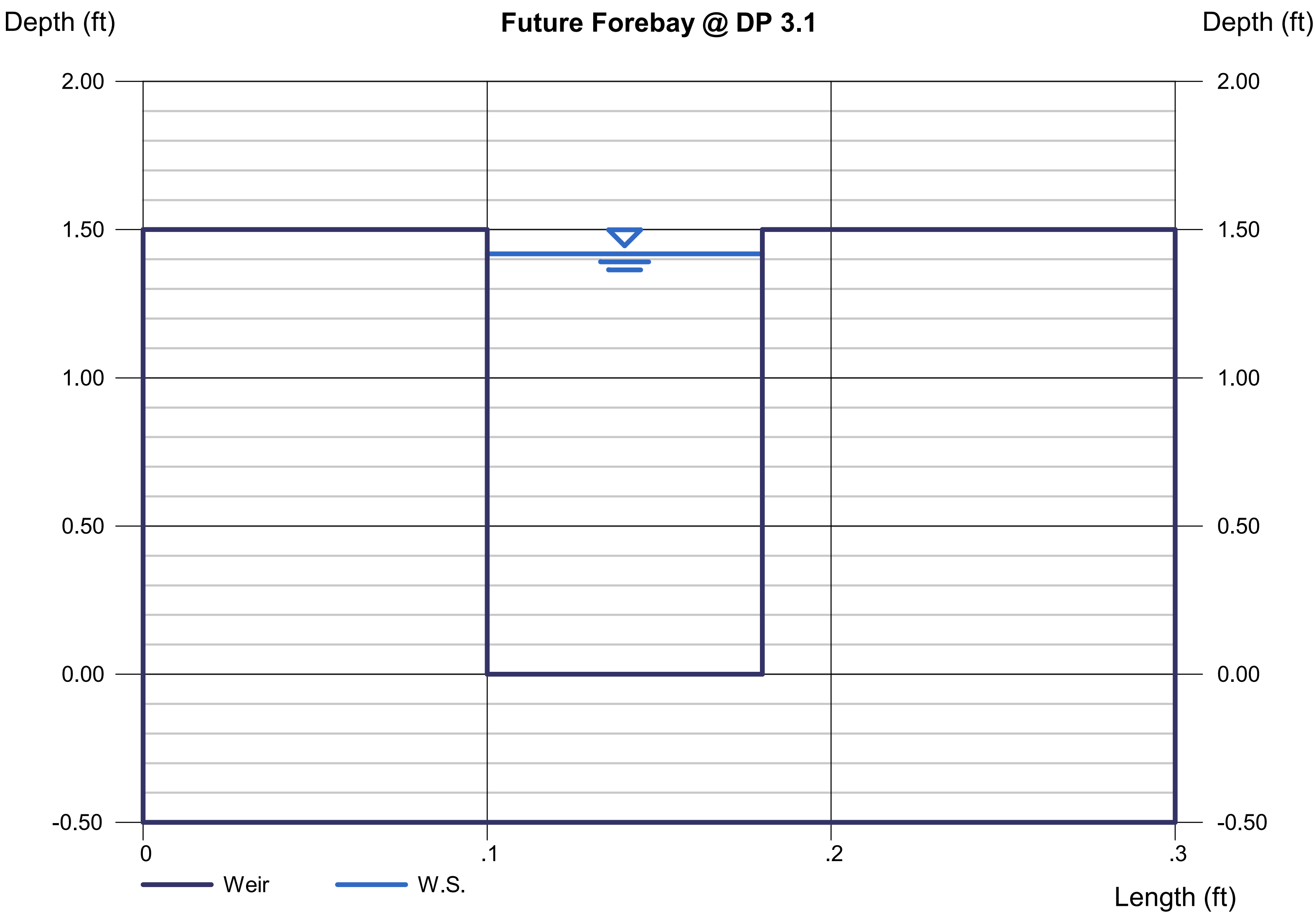
Crest	= Sharp
Bottom Length (ft)	= 0.08
Total Depth (ft)	= 1.50

Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Q
Known Q (cfs)	= 0.45

Highlighted

Depth (ft)	= 1.42
Q (cfs)	= 0.450
Area (sqft)	= 0.11
Velocity (ft/s)	= 3.97
Top Width (ft)	= 0.08



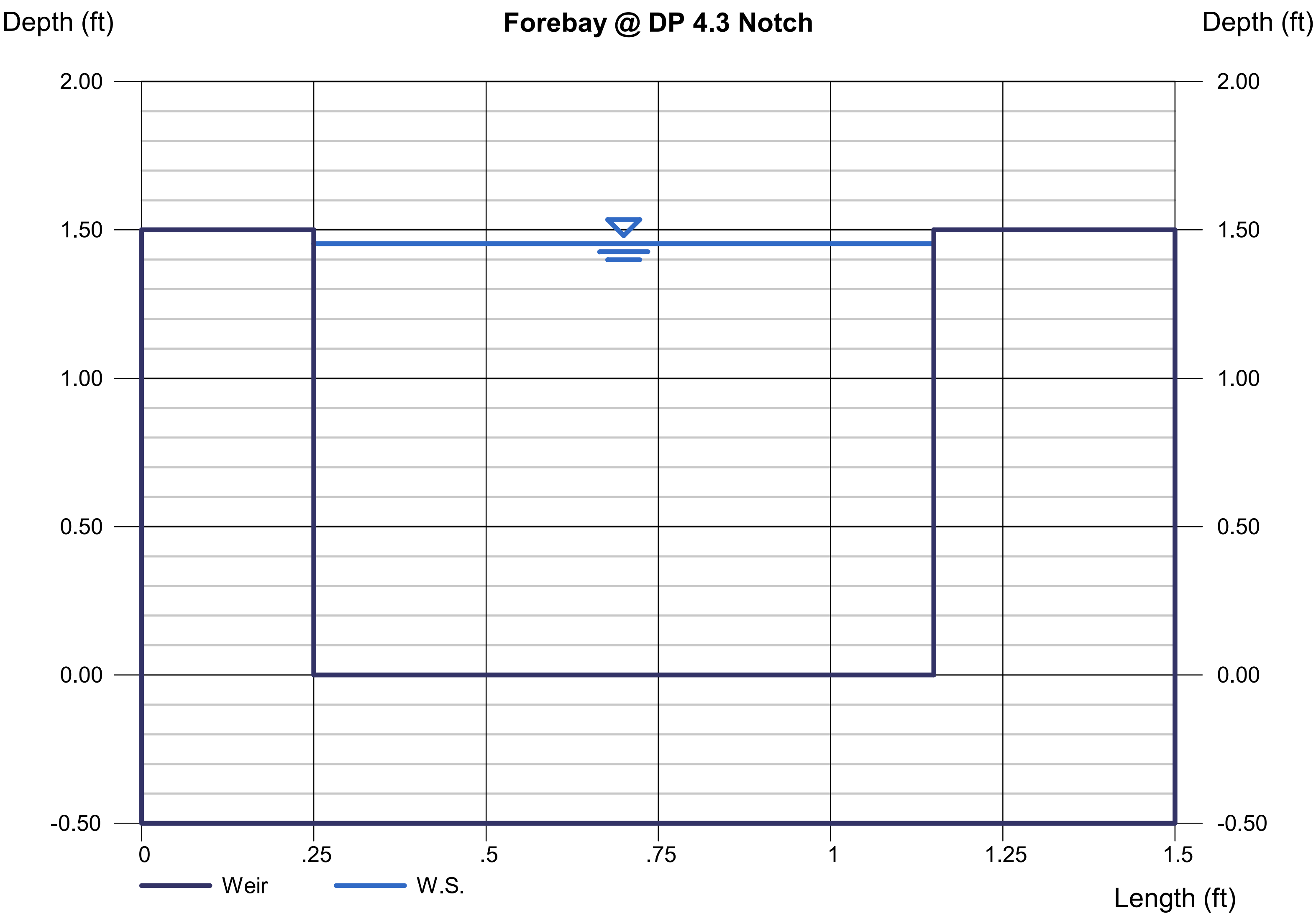
Weir Report

Forebay @ DP 4.3 Notch

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 0.90
Total Depth (ft) = 1.50

Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 5.25

Highlighted
Depth (ft) = 1.45
Q (cfs) = 5.250
Area (sqft) = 1.31
Velocity (ft/s) = 4.01
Top Width (ft) = 0.90

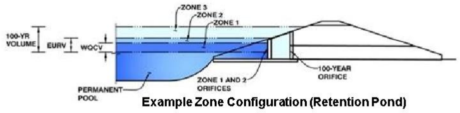


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W4



Example Zone Configuration (Retention Pond)

Verify - soil conditions need to match soils map

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	352.23	acres
Watershed Length =	9,241	ft
Watershed Length to Centroid =	4,488	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	54.0%	percent
Percentage Hydrologic Soil Group B =	46.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	2.291	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.619	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.590	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.037	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	9.064	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	17.896	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	23.888	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	33.958	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	51.136	acre-feet		inches
Approximate 2-yr Detention Volume =	2.272	acre-feet		
Approximate 5-yr Detention Volume =	3.320	acre-feet		
Approximate 10-yr Detention Volume =	5.486	acre-feet		
Approximate 25-yr Detention Volume =	7.400	acre-feet		
Approximate 50-yr Detention Volume =	8.409	acre-feet		
Approximate 100-yr Detention Volume =	11.591	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	2.291	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.329	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	7.972	acre-feet
Total Detention Basin Volume =	11.591	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 Increement = | | 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	--	--	--	20	0.000		
	--	1.00	--	--	--	7,181	0.165	3,600	0.083
	--	2.00	--	--	--	30,115	0.691	22,248	0.511
	--	3.00	--	--	--	49,313	1.132	61,962	1.422
	--	4.00	--	--	--	52,785	1.212	113,011	2.594
	--	5.00	--	--	--	74,559	1.712	176,683	4.056
	--	6.00	--	--	--	79,051	1.815	253,488	5.819
	--	7.00	--	--	--	84,185	1.933	335,106	7.693
	--	8.00	--	--	--	88,917	2.041	421,657	9.680
	--	9.00	--	--	--	94,245	2.164	513,238	11.782
	--	10.00	--	--	--	99,228	2.278	609,975	14.003
	--	11.00	--	--	--	104,318	2.395	711,748	16.339
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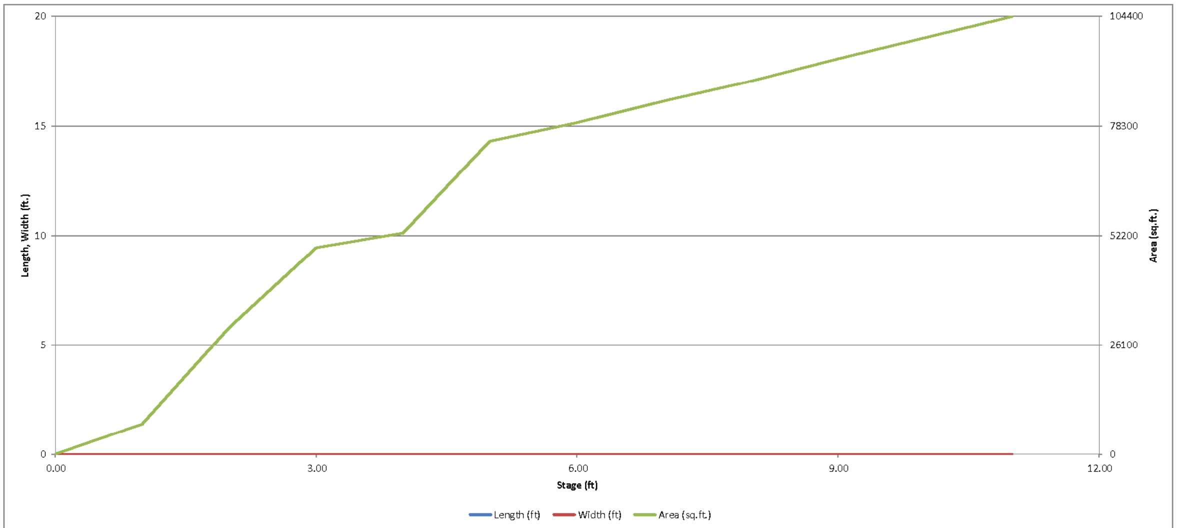
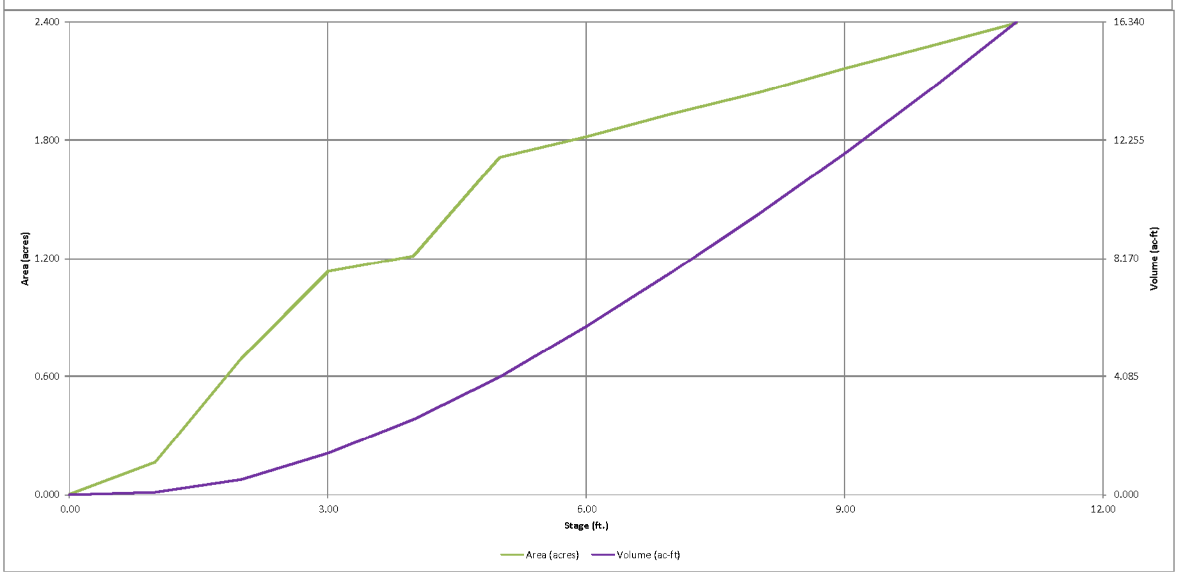
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



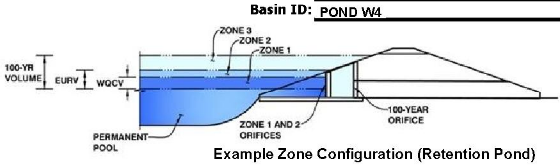


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W4



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.75	2.291	Orifice Plate
Zone 2 (EURV)	4.74	1.329	Orifice Plate
Zone 3 (100-year)	8.92	7.972	Weir&Pipe (Restrict)
Total (all zones)		11.591	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.74	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	19.00	inches
Orifice Plate: Orifice Area per Row =	8.79	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	6.104E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.58	3.16					
Orifice Area (sq. inches)	8.79	8.79	8.79					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.74	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	20.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	10.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.24	N/A	feet
Overflow Weir Slope Length =	10.31	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.25	N/A	
Overflow Grate Open Area w/o Debris =	144.31	N/A	ft^2
Overflow Grate Open Area w/ Debris =	72.15	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	60.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	50.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	17.49	N/A	ft^2
Outlet Orifice Centroid =	2.25	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.30	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	74.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.50	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.14	feet
Stage at Top of Freeboard =	12.44	feet
Basin Area at Top of Freeboard =	2.39	acres
Basin Volume at Top of Freeboard =	16.34	acre-ft

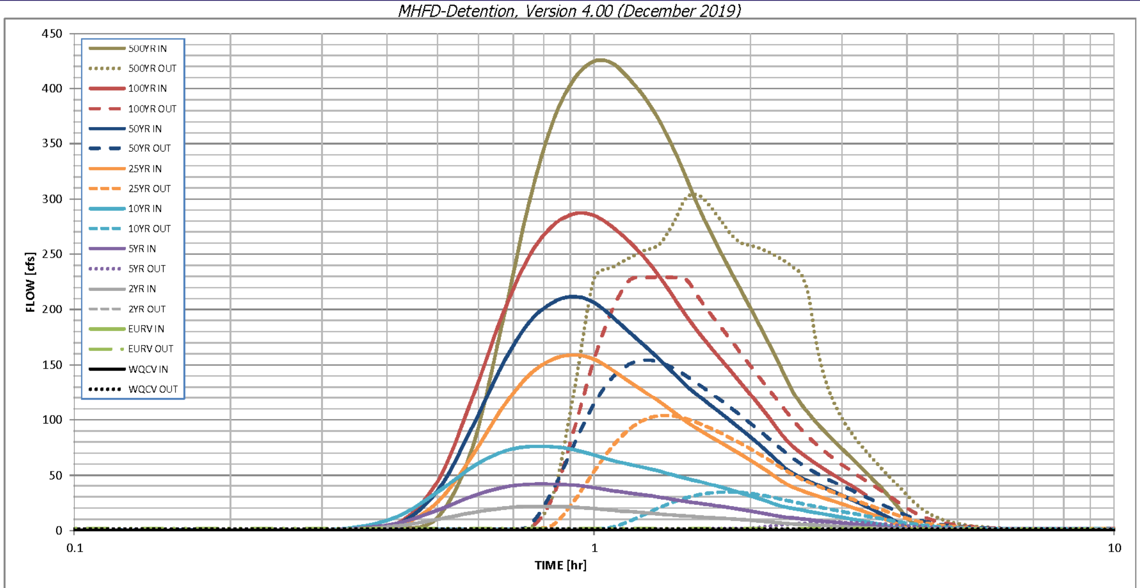
Routed Hydrograph Results

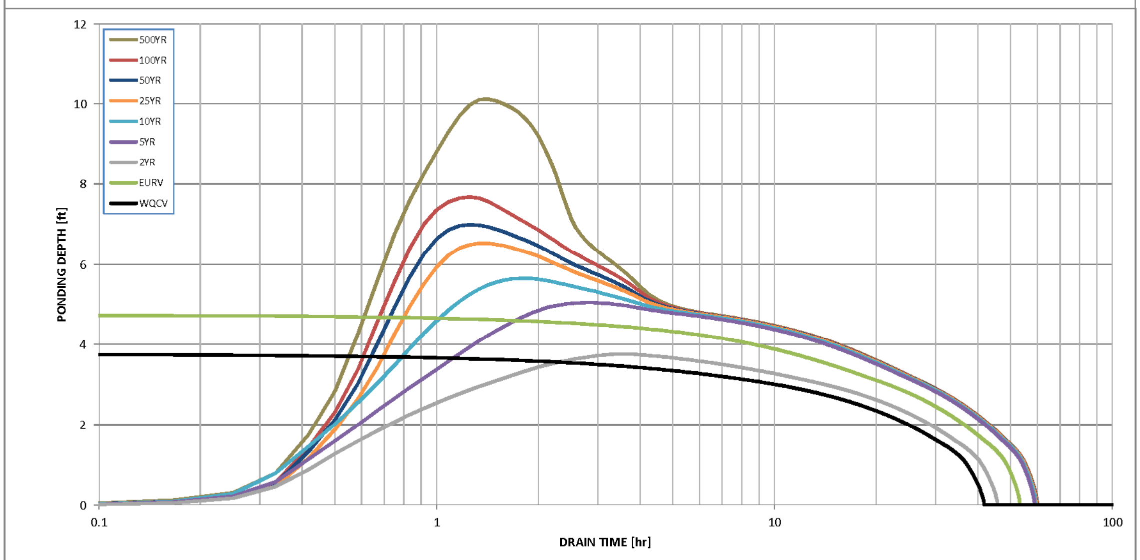
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

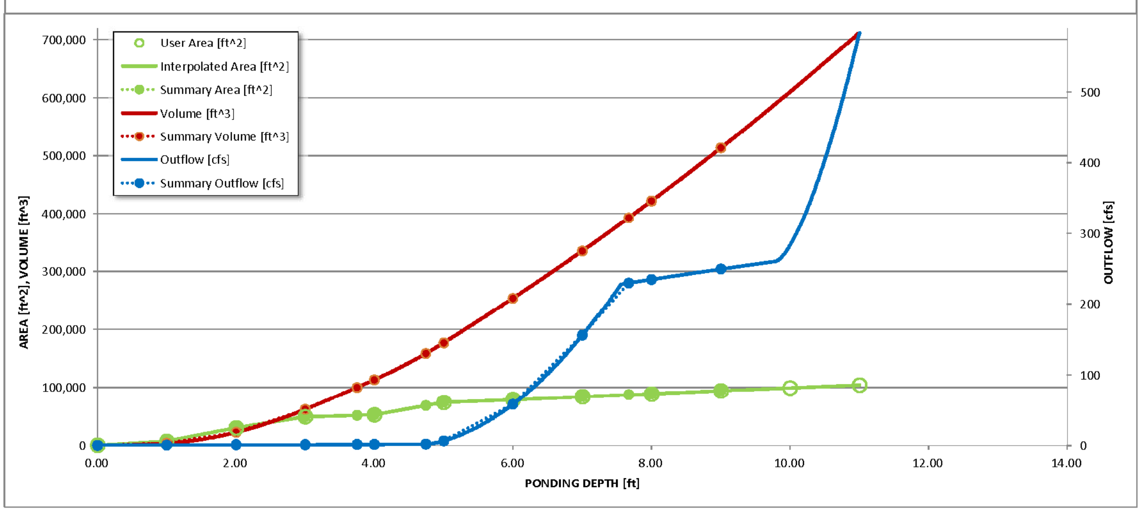
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	2.291	3.619	2.590	5.037	9.064	17.896	23.888	33.958	51.136
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.590	5.037	9.064	17.896	23.888	33.958	51.136
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	3.3	16.2	47.9	127.8	179.4	256.3	393.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.05	0.14	0.36	0.51	0.73	1.12
Peak Inflow Q (cfs) =	N/A	N/A	21.6	41.9	75.8	158.9	211.8	286.6	424.6
Peak Outflow Q (cfs) =	1.2	1.5	1.2	7.3	34.4	103.6	154.1	229.3	303.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	0.8	0.9	0.9	0.8
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.7	1.1	1.6	1.8
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	48	41	52	48	42	39	34	27
Time to Drain 99% of Inflow Volume (hours) =	**40**	51	44	56	55	52	50	47	43
Maximum Ponding Depth (ft) =	3.75	4.74	3.75	5.04	5.64	6.52	6.99	7.67	10.11
Area at Maximum Ponding Depth (acres) =	1.19	1.58	1.19	1.71	1.78	1.88	1.93	2.01	2.29
Maximum Volume Stored (acre-ft) =	2.294	3.628	2.294	4.107	5.173	6.779	7.654	9.012	14.254

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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.

Time Interval 5.00 min

SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
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]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.05
0:15:00	0.00	0.00	0.13	0.22	0.27	0.19	0.26	0.23	0.42
0:20:00	0.00	0.00	0.70	1.01	1.66	0.80	0.98	0.99	1.74
0:25:00	0.00	0.00	3.81	6.22	11.90	3.67	4.87	5.51	11.55
0:30:00	0.00	0.00	9.87	18.06	34.49	25.41	35.76	44.31	74.68
0:35:00	0.00	0.00	15.89	30.57	57.41	67.74	93.64	120.05	188.47
0:40:00	0.00	0.00	19.86	38.49	71.03	110.97	150.23	195.40	296.59
0:45:00	0.00	0.00	21.49	41.60	75.79	140.69	188.27	247.95	370.05
0:50:00	0.00	0.00	21.60	41.87	75.55	154.95	206.59	275.74	408.77
0:55:00	0.00	0.00	20.83	40.69	72.83	158.88	211.84	286.63	424.55
1:00:00	0.00	0.00	19.43	38.24	68.04	154.88	206.37	285.02	422.88
1:05:00	0.00	0.00	17.99	35.58	63.23	145.28	193.27	274.37	408.91
1:10:00	0.00	0.00	16.81	33.56	59.75	134.91	179.63	261.43	392.01
1:15:00	0.00	0.00	15.73	31.74	56.77	125.49	167.21	246.82	371.40
1:20:00	0.00	0.00	14.67	29.76	53.63	116.53	155.25	230.14	346.80
1:25:00	0.00	0.00	13.64	27.65	50.17	107.44	143.17	212.30	320.08
1:30:00	0.00	0.00	12.82	25.85	47.05	98.65	131.60	194.76	293.93
1:35:00	0.00	0.00	12.16	24.42	44.36	91.46	122.19	179.95	271.77
1:40:00	0.00	0.00	11.53	23.00	41.61	85.21	113.82	166.92	252.02
1:45:00	0.00	0.00	10.93	21.57	38.87	79.48	106.07	155.11	234.11
1:50:00	0.00	0.00	10.33	20.14	36.15	73.93	98.59	143.98	217.21
1:55:00	0.00	0.00	9.70	18.74	33.49	68.60	91.39	133.23	200.92
2:00:00	0.00	0.00	9.03	17.33	30.85	63.31	84.25	122.72	185.02
2:05:00	0.00	0.00	8.31	15.88	28.16	58.00	77.11	112.38	169.41
2:10:00	0.00	0.00	7.55	14.39	25.43	52.65	69.93	102.18	154.02
2:15:00	0.00	0.00	6.79	12.92	22.79	47.29	62.77	92.00	138.72
2:20:00	0.00	0.00	6.21	11.79	20.86	42.25	56.09	82.48	124.72
2:25:00	0.00	0.00	5.78	11.01	19.53	38.62	51.39	75.46	114.35
2:30:00	0.00	0.00	5.39	10.29	18.27	35.83	47.69	69.86	105.84
2:35:00	0.00	0.00	5.04	9.60	17.06	33.48	44.55	64.95	98.30
2:40:00	0.00	0.00	4.70	8.95	15.90	31.31	41.65	60.51	91.46
2:45:00	0.00	0.00	4.38	8.33	14.78	29.31	38.98	56.39	85.12
2:50:00	0.00	0.00	4.06	7.72	13.69	27.34	36.36	52.48	79.14
2:55:00	0.00	0.00	3.76	7.14	12.63	25.43	33.80	48.78	73.52
3:00:00	0.00	0.00	3.46	6.57	11.61	23.55	31.29	45.28	68.22
3:05:00	0.00	0.00	3.17	6.02	10.62	21.70	28.81	41.81	62.96
3:10:00	0.00	0.00	2.88	5.48	9.66	19.86	26.36	38.35	57.74
3:15:00	0.00	0.00	2.60	4.95	8.72	18.04	23.92	34.91	52.52
3:20:00	0.00	0.00	2.32	4.42	7.78	16.21	21.49	31.46	47.31
3:25:00	0.00	0.00	2.05	3.90	6.85	14.40	19.07	28.02	42.11
3:30:00	0.00	0.00	1.77	3.38	5.92	12.59	16.65	24.59	36.92
3:35:00	0.00	0.00	1.51	2.86	4.99	10.78	14.23	21.16	31.73
3:40:00	0.00	0.00	1.24	2.35	4.08	8.97	11.83	17.74	26.56
3:45:00	0.00	0.00	0.98	1.84	3.16	7.18	9.42	14.32	21.40
3:50:00	0.00	0.00	0.73	1.35	2.27	5.39	7.04	10.92	16.27
3:55:00	0.00	0.00	0.49	0.89	1.47	3.64	4.70	7.58	11.28
4:00:00	0.00	0.00	0.35	0.61	1.02	2.11	2.72	4.73	7.23
4:05:00	0.00	0.00	0.29	0.50	0.84	1.26	1.66	3.05	4.84
4:10:00	0.00	0.00	0.24	0.41	0.69	0.81	1.07	2.03	3.29
4:15:00	0.00	0.00	0.21	0.34	0.57	0.57	0.73	1.34	2.19
4:20:00	0.00	0.00	0.18	0.27	0.46	0.40	0.51	0.86	1.42
4:25:00	0.00	0.00	0.15	0.22	0.36	0.30	0.38	0.53	0.87
4:30:00	0.00	0.00	0.13	0.18	0.28	0.23	0.28	0.30	0.49
4:35:00	0.00	0.00	0.11	0.14	0.21	0.17	0.21	0.18	0.30
4:40:00	0.00	0.00	0.09	0.11	0.15	0.13	0.16	0.13	0.23
4:45:00	0.00	0.00	0.07	0.09	0.11	0.10	0.12	0.10	0.18
4:50:00	0.00	0.00	0.05	0.07	0.08	0.08	0.09	0.08	0.14
4:55:00	0.00	0.00	0.04	0.05	0.06	0.06	0.07	0.06	0.11
5:00:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.05	0.08
5:05:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.06
5:10:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.04
5:15:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
5:20:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	20	0.000	0	0.000	0.00
	1.00	7,181	0.165	3,600	0.083	0.29
	2.00	30,115	0.691	22,248	0.511	0.61
	3.00	49,313	1.132	61,962	1.422	0.86
WQCV	3.75	51,917	1.192	99,923	2.294	1.23
	4.00	52,785	1.212	113,011	2.594	1.31
EURV	4.74	68,898	1.582	158,034	3.628	1.53
	5.00	74,559	1.712	176,683	4.056	6.18
	6.00	79,051	1.815	253,488	5.819	58.22
	7.00	84,185	1.933	335,106	7.693	155.52
100-YR	7.67	87,355	2.005	392,572	9.012	229.28
	8.00	88,917	2.041	421,657	9.680	234.33
	9.00	94,245	2.164	513,238	11.782	248.99

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).

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected   Worksheet Protected

Stormwater Facility Name: Pond W-5

Facility Location & Jurisdiction: Sterling Ranch Sudivision, Marksheffel Road, El Paso County / El Paso County

User Input: Watershed Characteristics

Watershed Slope =	0.025	ft/ft
Watershed Length =	2500	ft
Watershed Area =	175.68	acres
Watershed Imperviousness =	53.0%	percent
Percentage Hydrologic Soil Group A =	54.8%	percent
Percentage Hydrologic Soil Group B =	45.2%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown): User Input

WQCV Treatment Method = Extended Detention

Verify - soil conditions need to match soils map

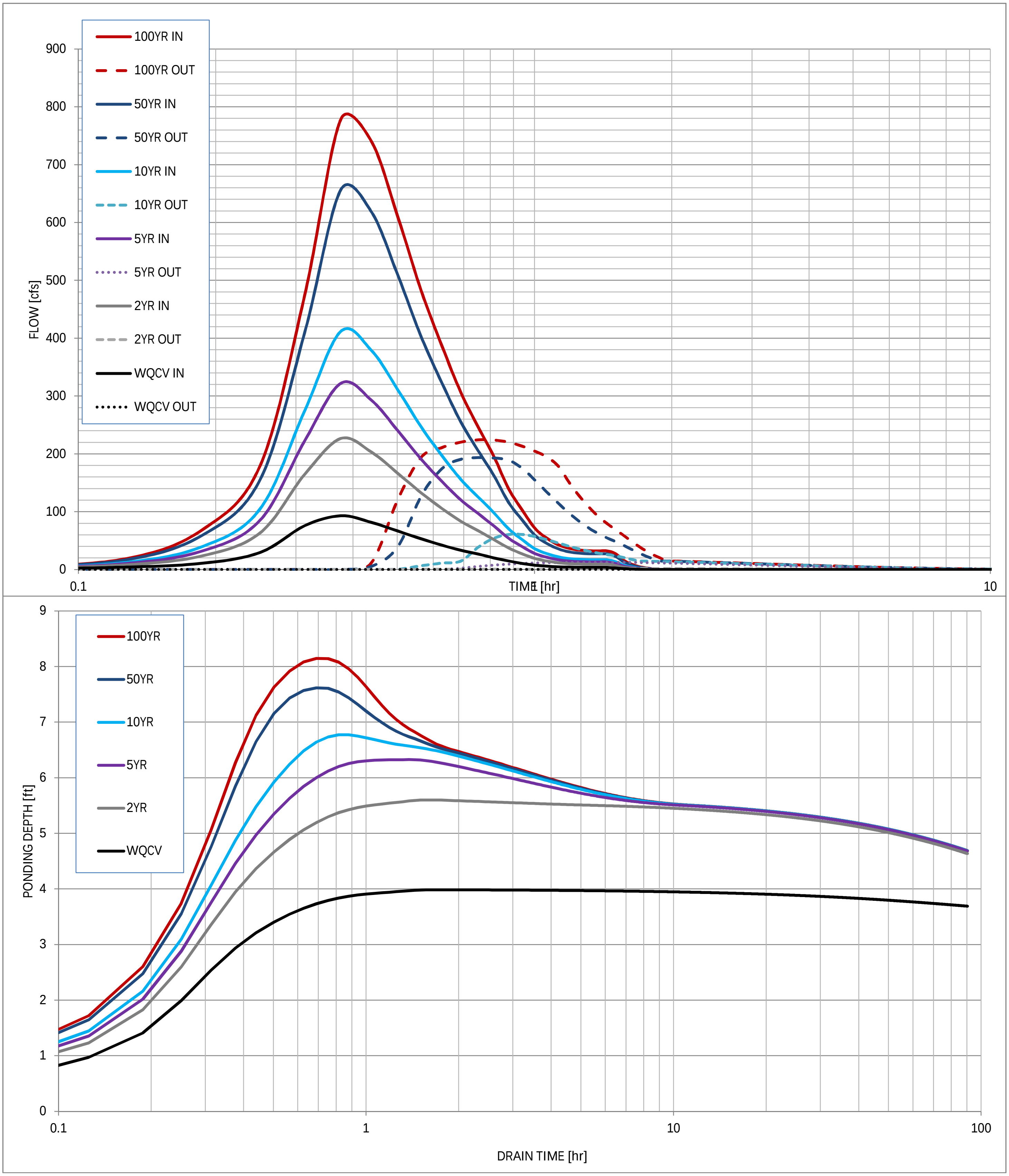
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	632	0.00	0.00
0.58	1,269	0.58	0.01
1.50	15,375	1.50	0.01
2.50	40,729	2.50	0.01
3.50	76,997	3.50	0.01
4.50	112,420	4.50	0.25
5.50	136,692	5.50	0.45
6.50	158,382	6.50	15.00
7.50	176,379	7.50	187.00
8.50	188,901	8.50	245.00
9.50	202,723	9.50	327.00
10.50	210,154	10.50	410.00
11.50	217,594	11.50	480.00

After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	3.142	7.627	10.843	13.906	22.334	26.591	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	3.141	7.619	10.842	13.899	22.331	26.586	acre-ft
Time to Drain 97% of Inflow Volume =	>90	>90	>90	>90	>90	>90	hours
Time to Drain 99% of Inflow Volume =	>90	>90	>90	>90	>90	>90	hours
Maximum Ponding Depth =	3.98	5.60	6.33	6.77	7.62	8.15	ft
Maximum Ponded Area =	2.16	3.18	3.54	3.75	4.08	4.23	acres
Maximum Volume Stored =	3.128	7.501	9.943	11.590	14.896	17.099	acre-ft

Stormwater Detention and Infiltration Design Data Sheet



Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: Pond W-4

Facility Location & Jurisdiction: Sterling Ranch Sudivision, Vollmer Road, El Paso County / El Paso County

User Input: Watershed Characteristics

Watershed Slope =	0.022	ft/ft
Watershed Length =	16051	ft
Watershed Area =	352.23	acres
Watershed Imperviousness =	10.0%	percent
Percentage Hydrologic Soil Group A =	54.0%	percent
Percentage Hydrologic Soil Group B =	46.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown): User Input

WQCV Treatment Method = Extended Detention

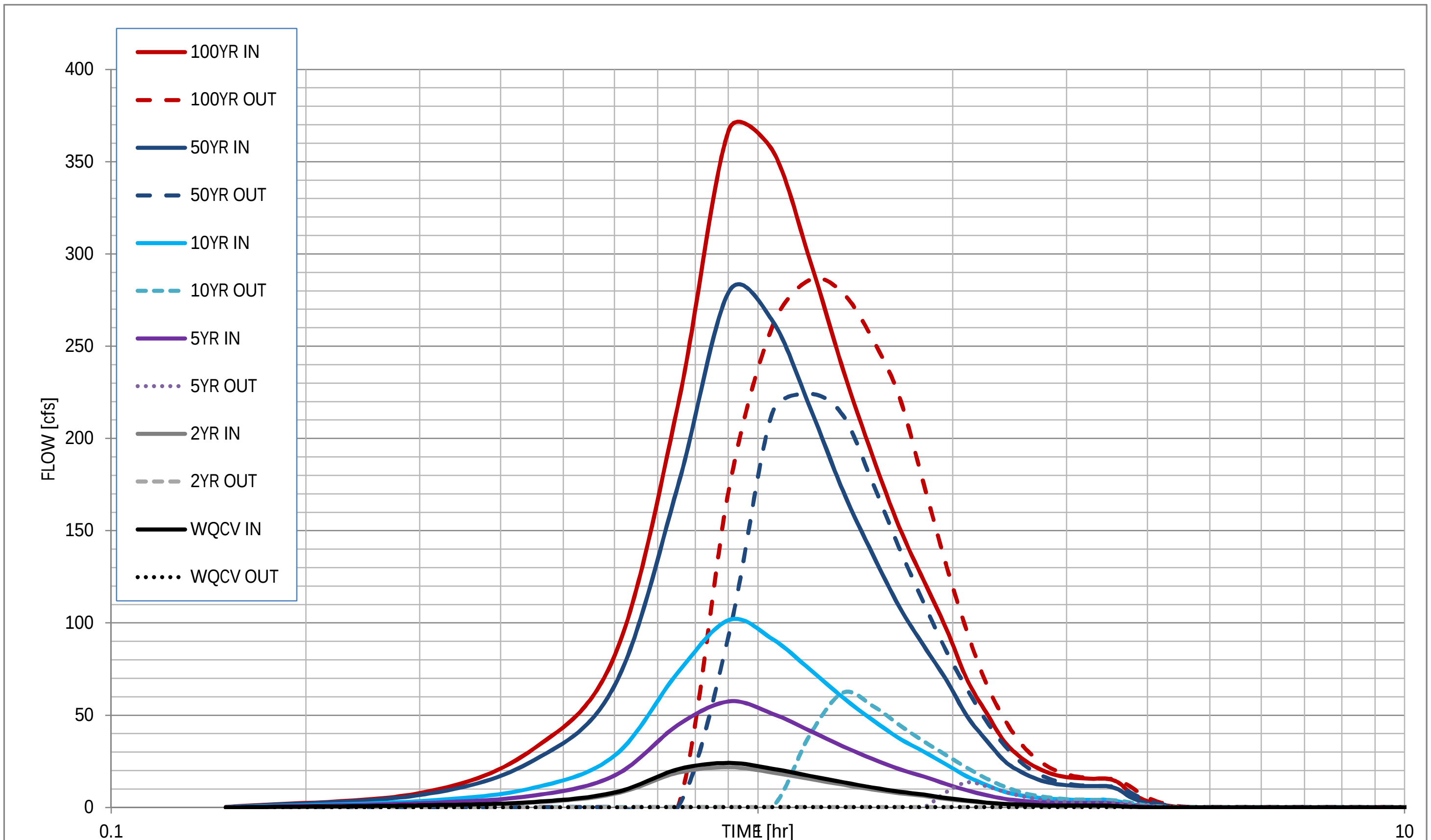
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	632	0.00	0.00
0.37	5,106	0.37	0.10
1.00	30,156	1.00	0.15
2.00	33,323	2.00	0.20
3.00	37,601	3.00	0.22
4.00	40,867	4.00	0.24
5.00	44,238	5.00	0.26
6.00	48,178	6.00	117.00
7.00	51,797	7.00	210.00
8.00	55,999	8.00	257.00
9.00	59,878	9.00	307.00
10.00	63,364	10.00	389.00
11.00	67,955	11.00	543.00
12.00	72,155	12.00	668.00

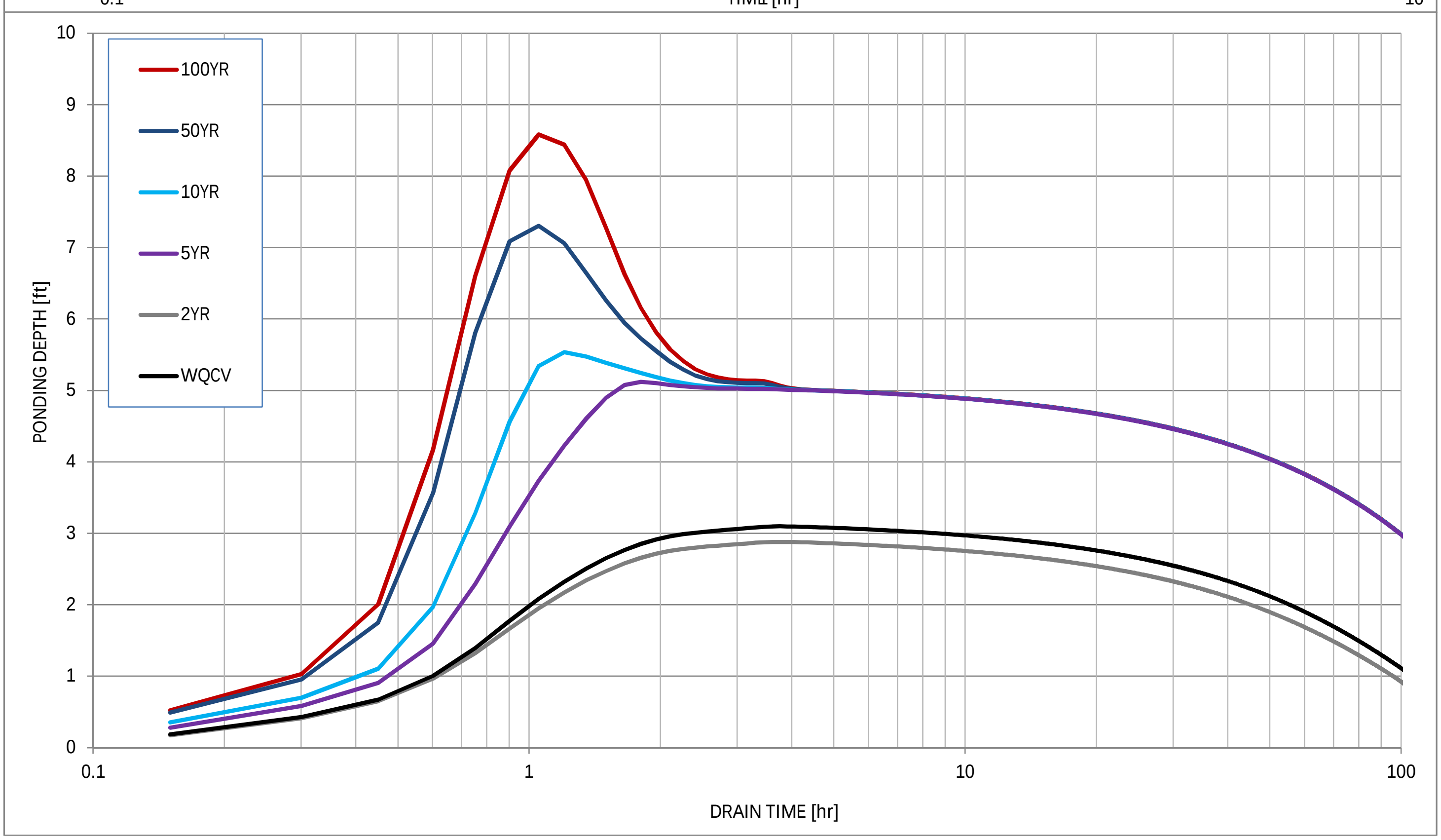
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	1.967	1.778	4.643	8.198	22.829	30.818	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	1.966	1.777	4.643	8.196	22.820	30.809	acre-ft
Time to Drain 97% of Inflow Volume =	125.9	116.1	208.4	199.2	166.8	151.3	hours
Time to Drain 99% of Inflow Volume =	130.4	120.3	0.0	214.1	200.9	194.4	hours
Maximum Ponding Depth =	3.10	2.88	5.12	5.53	7.31	8.58	ft
Maximum Ponded Area =	0.87	0.85	1.03	1.06	1.22	1.34	acres
Maximum Volume Stored =	1.897	1.712	3.816	4.244	6.264	7.900	acre-ft

Stormwater Detention and Infiltration Design Data Sheet

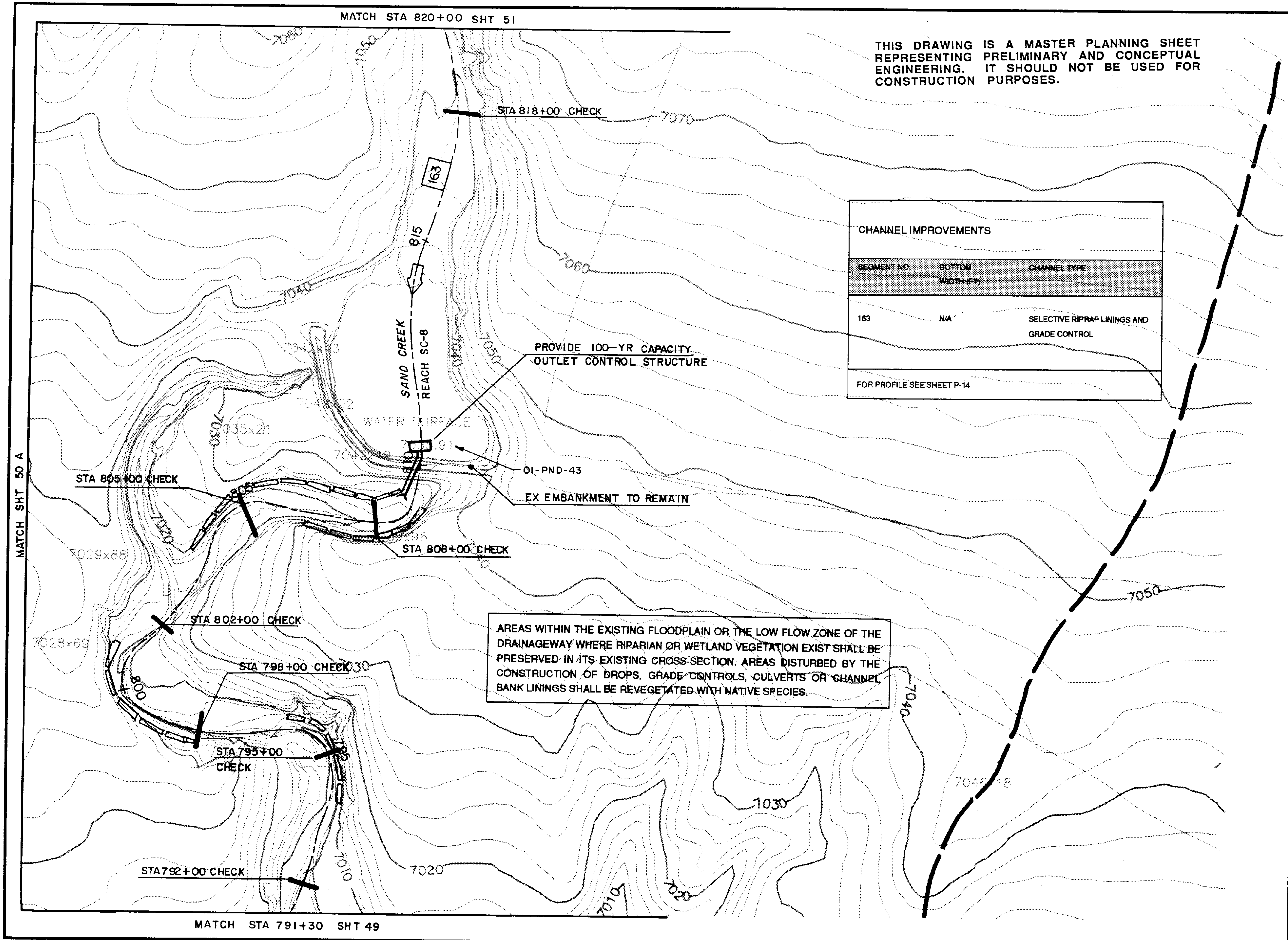




APPENDIX D

REFERENCE MATERIALS

Include DBPS plan sheets 48 and 47



CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

FOR PROFILE SEE SHEET P-14

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

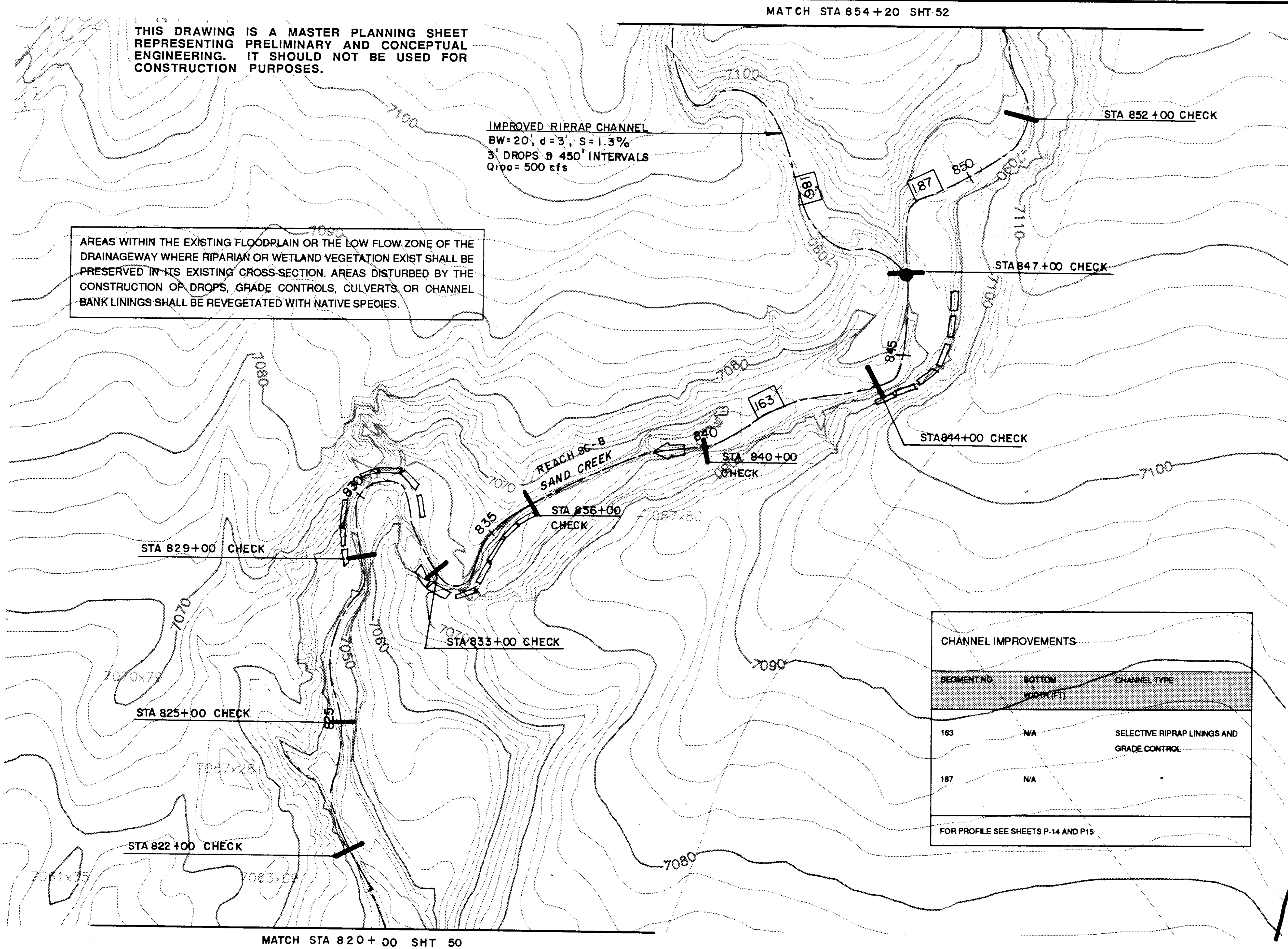
SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No 90-04-09
Date: 11/92
Design: RNW
Drawn: EAK
Check: RNW
Revisions:

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

AREAS WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION. AREAS DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OR CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.



CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
163	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
187	N/A	"

FOR PROFILE SEE SHEETS P-14 AND P15

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No	90·04·09
Date:	11/92
Design:	RNW
Drawn:	EAK
Check.	RNW
Revisions:	

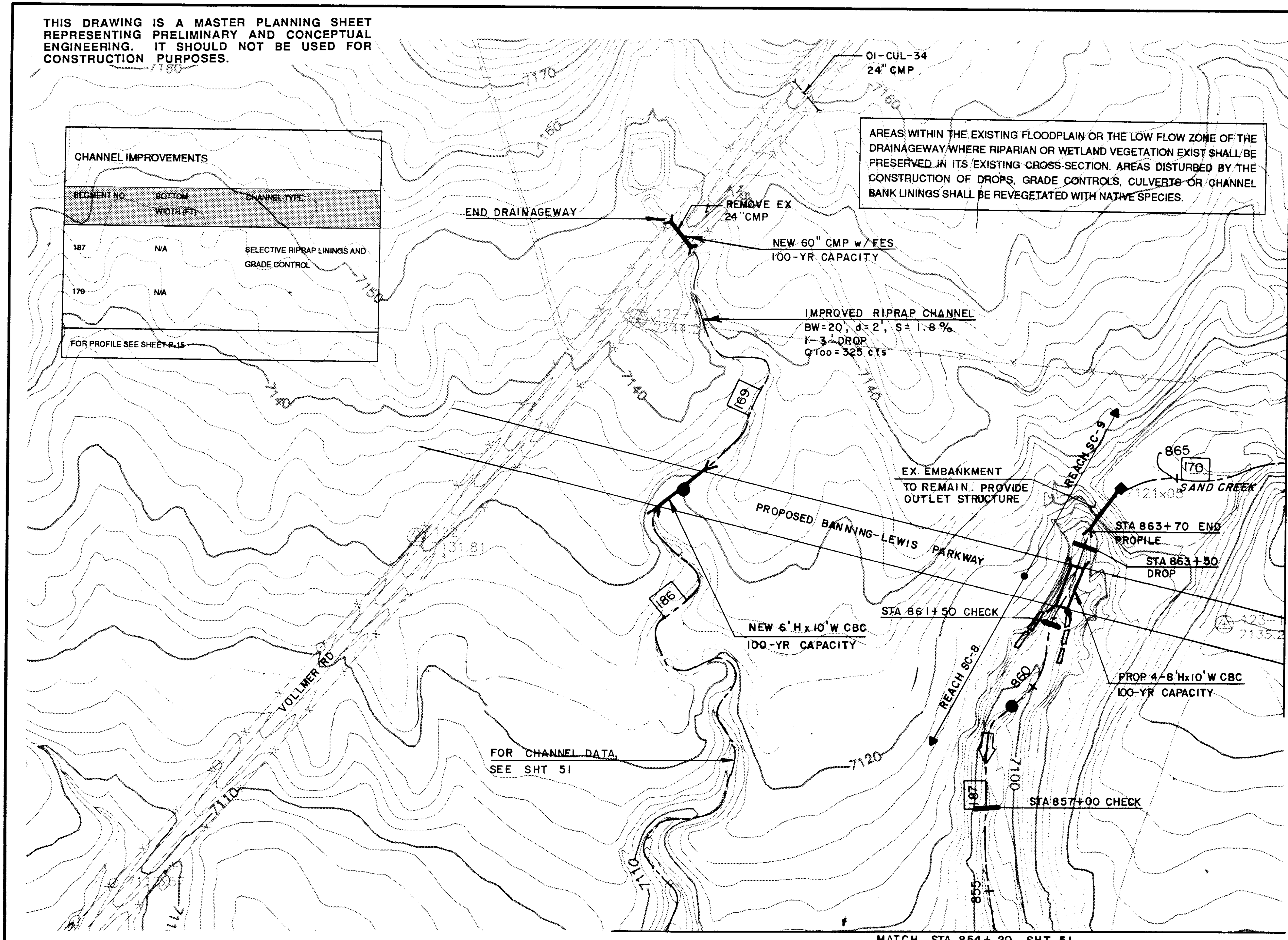
THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
187	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
170	N/A	

FOR PROFILE SEE SHEET P-15

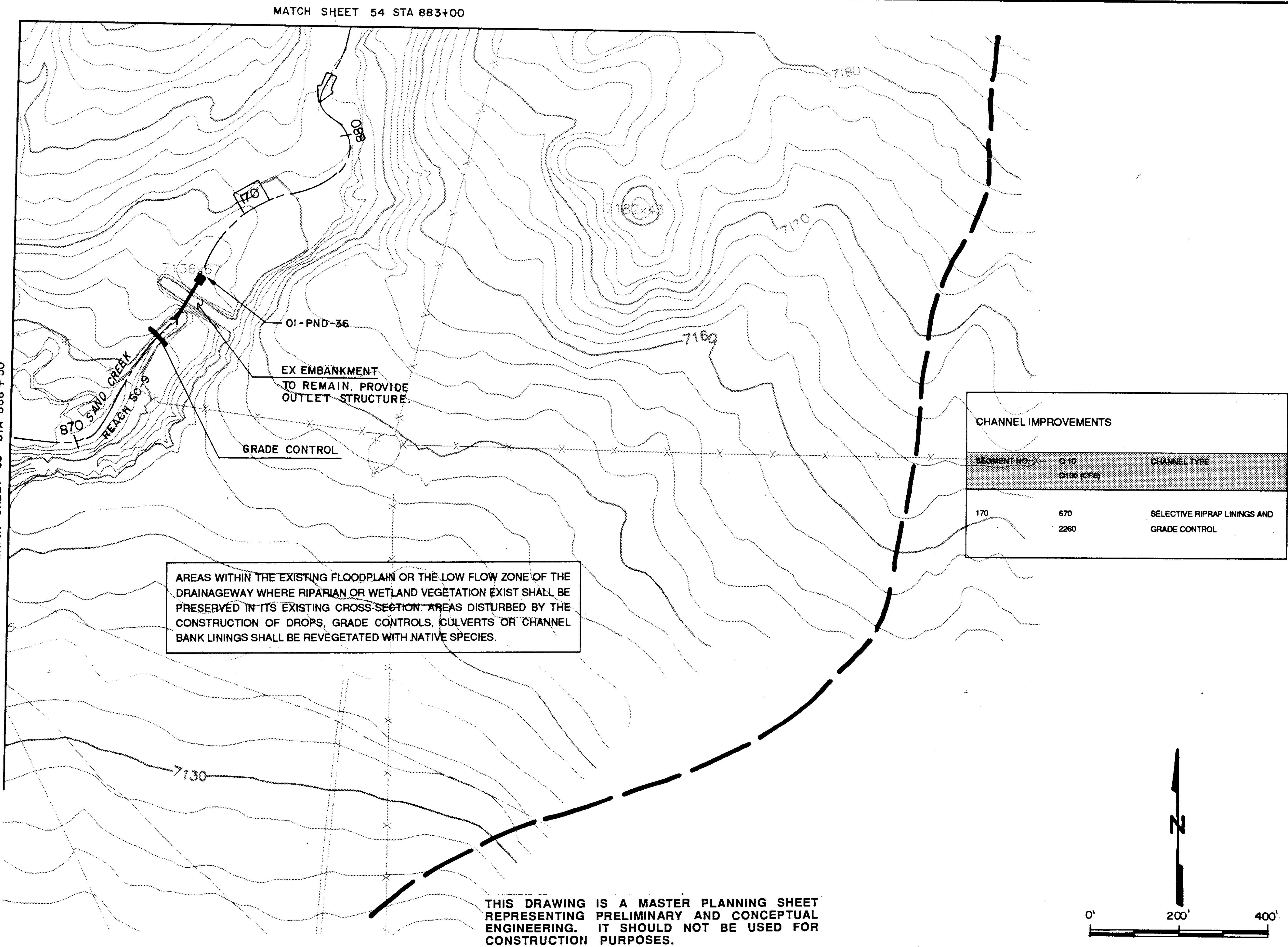
AREAS WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION. AREAS DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OR CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No	90-04-09
Date:	11/92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	



AREAS WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION. AREAS DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OR CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.

CHANNEL IMPROVEMENTS

SEGMENT NO.	Q 10 Q100 (CFS)	CHANNEL TYPE
170	670 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

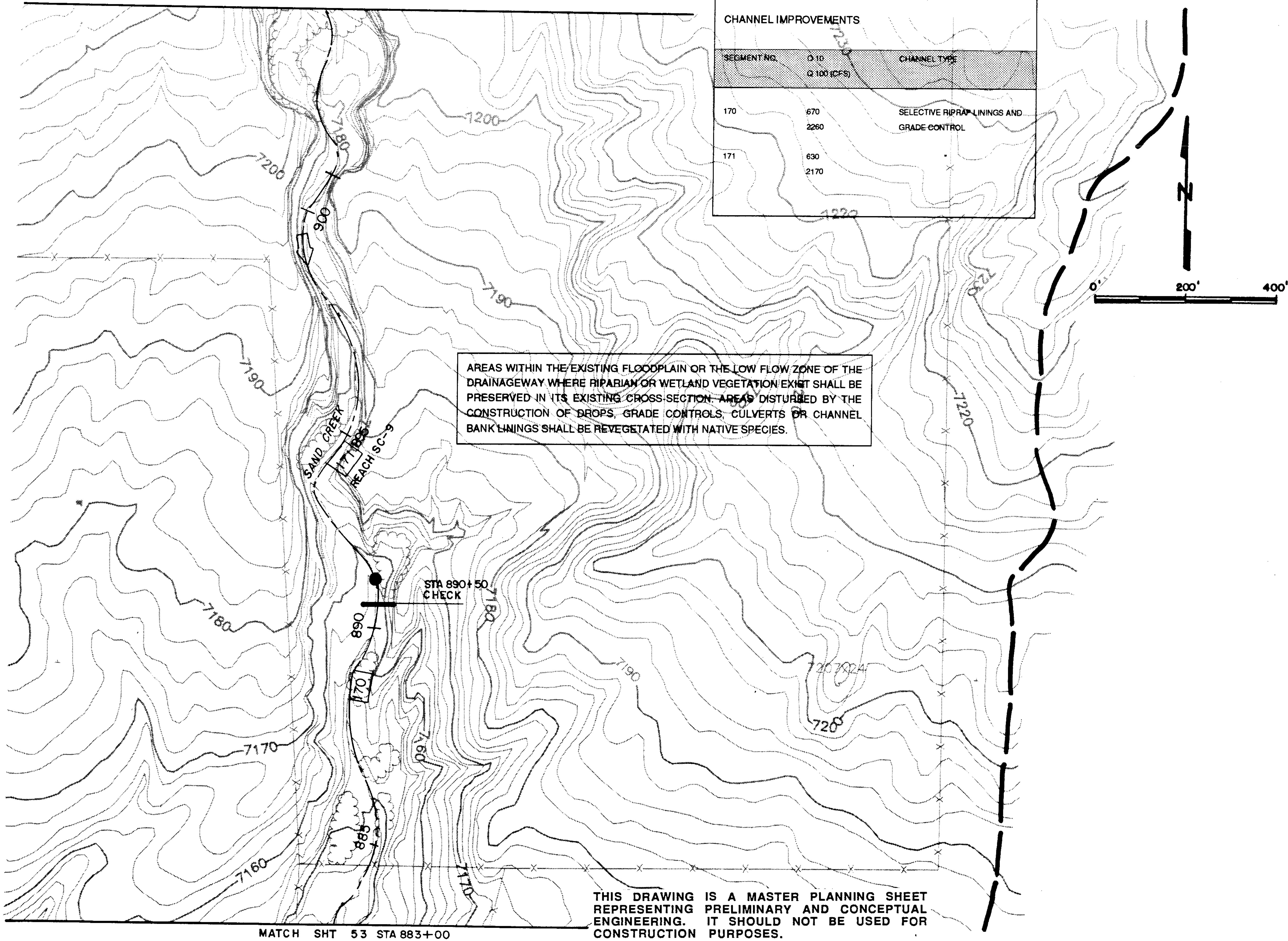
Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

Project No 90-04-09
Date: 9-92
Design: RNW
Drawn: EAK
Check. RNW
Revisions:

MATCH SHT 55 STA 905+00



CHANNEL IMPROVEMENTS

SEGMENT NO.	Q 10 Q 100 (CFS)	CHANNEL TYPE
170	670 2260	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
171	630 2170	•

AREAS WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION. AREAS DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OR CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

MATCH SHT 53 STA 883+00

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN PLANS

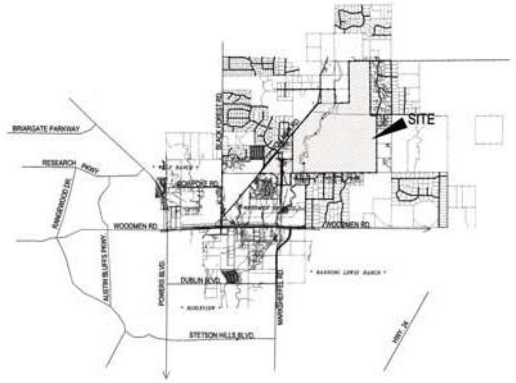
Project No 90-04-09
Date: 9/92
Design: RNW
Drawn: EAK
Check. RNW
Revisions:

STERLING RANCH FILING NO. 2 - TRACTS AND RIGHT-OF-WAY - DRAINAGE & BRIDGE FEES (2020)

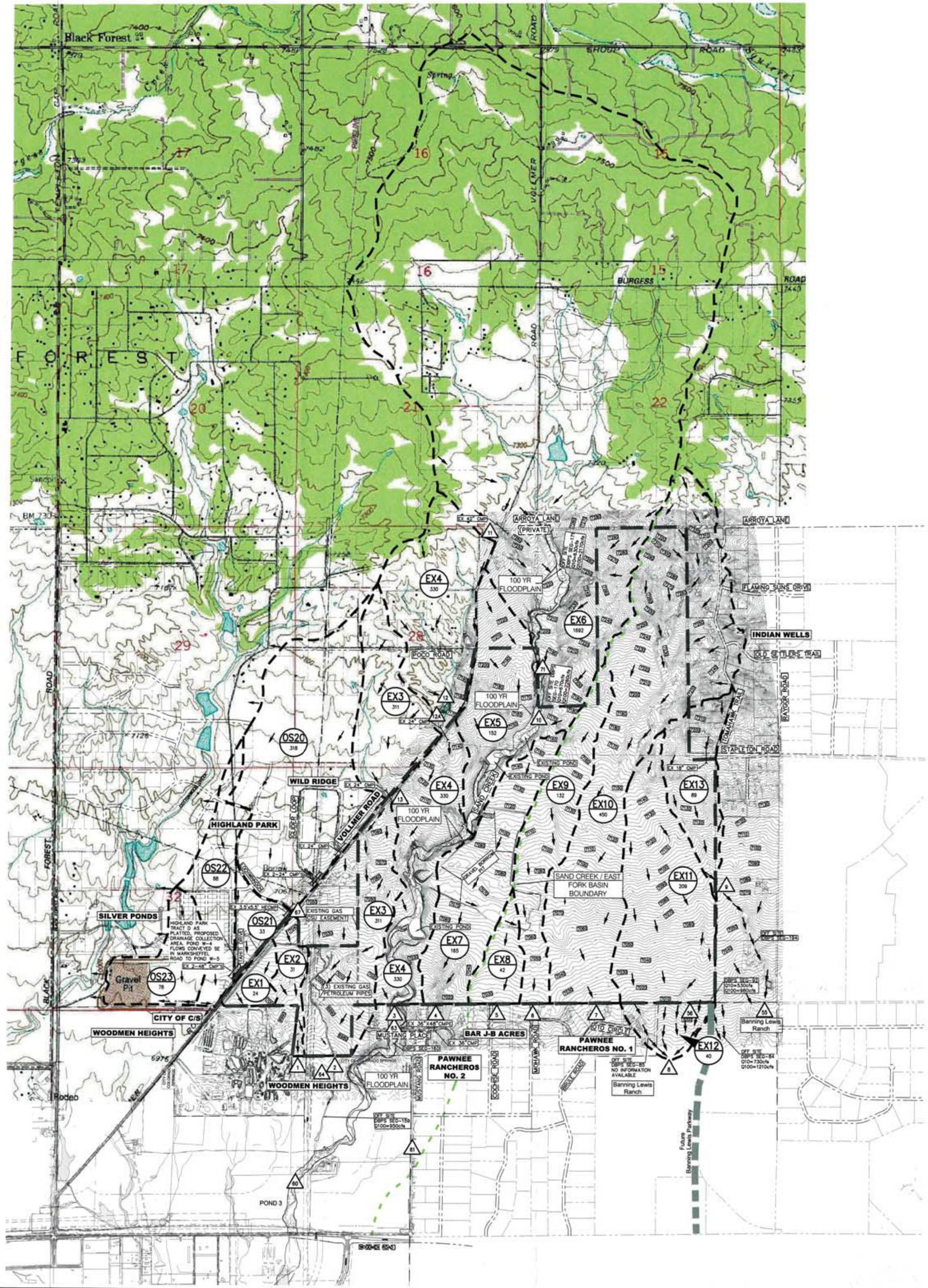
TRACT/ROW	SIZE/ACRE	USE	MAINTENANCE	OWNERSHIP	% Impervious	DRAINAGE FEE	FEE	BRIDGE FEE	FEE
A	0.391	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	29.0%	$ 19,698	$ 2,233.56	$ 8,057	$ 913.58
B	0.658	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	29.0%	$ 19,698	$ 3,758.77	$ 8,057	$ 1,537.44
C	0.845	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	24.0%	$ 19,698	$ 3,994.75	$ 8,057	$ 1,633.96
D	2.159	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	13.0%	$ 19,698	$ 5,528.64	$ 8,057	$ 2,261.36
E	19.674	ZERO LOT LINE FUTURE SINGLE FAMILY RESIDENTIAL LOTS	SR LAND, LLC	SR LAND, LLC	70.0%	$ 19,698	$ 271,276.92	$ 8,057	$ 110,959.39
F	1.231	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	4.0%	$ 19,698	$ 969.93	$ 8,057	$ 396.73
G	0.249	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	2.0%	$ 19,698	$ 98.10	$ 8,057	$ 40.12
H	0.062	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	2.0%	$ 19,698	$ 24.43	$ 8,057	$ 9.99
I	0.5	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY/MAIL KIOSK	SRMD #1	SRMD #1	15.0%	$ 19,698	$ 1,477.35	$ 8,057	$ 604.28
J	0.379	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	30.0%	$ 19,698	$ 2,239.66	$ 8,057	$ 916.08
K	0.387	LANDSCAPE/PUBLIC IMPROVEMENTS/PUBLIC UTILITY	SRMD #1	SRMD #1	30.0%	$ 19,698	$ 2,286.94	$ 8,057	$ 935.42
49 LOTS	11.871	SINGLE FAMILY RESIDENTIAL LOTS	SRMD #1	SRMD #1	70.0%	$ 19,698	$ 163,684.47	$ 8,057	$ 66,951.25
ROW	4.734	ROAD RIGHTS OF WAY (STERLING RANCH ROAD)	EPC	EPC	95.0%	$ 19,698	$ 88,587.82	$ 8,057	$ 36,234.75
ROW	3.525	ROAD RIGHTS OF WAY (MARKSHEFFEL ROAD)	EPC	EPC	95.0%	$ 19,698	$ 65,963.68	$ 8,057	$ 26,980.88
ROW	2.979	ROAD RIGHTS OF WAY (VOLLMER ROAD, ULTIMATE)	EPC	EPC	95.0%	$ 19,698	$ 55,746.32	$ 8,057	$ 22,801.71
							DRAINAGE FEE		BRIDGE FEE
	49.644	TOTAL AREA				TOTAL FEES	$ 667,871.33		$ 273,176.94

*SRMD#1 = STERLING RANCH METROPOLITAN DISTRICT NO. 1

See plat comments for added tracts



STERLING RANCH
N.T.S.



HISTORIC CONDITION

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5 (CFS)	Q_{100} (CFS)
EX-1	24	3	40
EX-2	31	3	45
EX-3	311	49	341
EX-4	330	71	353
EX-5	152	14	209
EX-6	1692	118	2168
EX-7	165	12	197
EX-8	42	4	64
EX-9	132	11	149
EX-10	450	48	474
EX-11	209	17	261
EX-12	40	5	65
EX-13	89	6	114
OS-20	318	61	310
OS-21	33	8	38
OS-22	88	18	91
OS-23	78	34	84

* NOTE: BASINS OS-22 & OS-23 NOT PART OF THIS REPORT. FLOWS FOLLOW HISTORIC PATTERNS ON THE WESTSIDE OF VOLLMER ROAD.

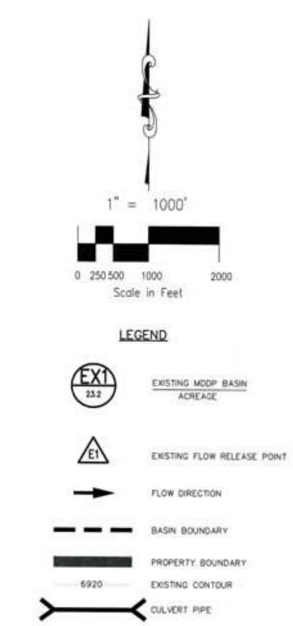
HISTORIC CONDITION

DESIGN POINTS						
DESIGN POINT	SQ. MI.	Q_5 (CFS)	Q_{100} (CFS)	SQ. MI.	DBPS Q_{100}	DBPS DP/ID
1	0.09	5	84			
2	0.49	55	465	0.74	465	64
3	0.52	139	2610	4.33	2552	63
4	0.26	12	197			
5	0.07	4	64			
6	0.21	11	149			
7	0.70	48	474			
8	0.39	18	305			
9	0.14	6	114			
10	2.64	122	2245	3.27	2245	71
11	0.09	5	83			
12A	0.01	3	16			
12	0.27	10	200			
13	0.17	6	126			
				0.48	#	55
				0.53	1210	56
				5.38	2629	60
				0.38	76	61
				0.49	115	67

* NOTE: SQ. MI. ARE NOT CONSISTANT AT EACH DESIGN POINT DP-DBPS

* NOTE: DBPS FLOWS ARE FOR THE EXISTING CONDITION

NO DATA GIVEN IN DBPS



CIVIL CONSULTANTS, INC.
102 E. PIKES PEAK AVE. STE 306
COLORADO SPRINGS, CO 80903
(719) 955-5485, FAX (719) 444-8427

STERLING RANCH MDDP			
HISTORIC – DRAINAGE MAP			
PROJECT NO. 09-001	FILE: *\dwg\Dev Plan\09001-MDDP HISTORIC		
DESIGNED BY: VAS	SCALE	DATE: 03/16/15	
DRAWN BY: VAS	HORIZ: 1"=500'	SHEET 1 OF 1	D1
CHECKED BY: VAS	VERT: N/A		

NEW DOC

FINAL DRAINAGE REPORT
For

BARBARICK SUBDIVISION, PORTIONS OF LOTS 1, 2 and LOTS 3 & 4
El Paso County, Colorado

Sand Creek Drainage Basin

Prepared for:
El Paso County Development Services
Engineering Division

On Behalf of:
Wykota Construction
430 Beacon Light Road, Suite 130
Monument, CO 80132

Prepared by:
Matrix
DESIGN GROUP
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
Fax (719) 572-0208

June 6, 2016

15.789.001

Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin.

SEAL

Gregory G. Shaner
Registered Professional Engineer
State of Colorado No. 36307

Developer's Statement:

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

Wykota Construction
Business Name

By: Justin Ballard

Title: President

Address: 430 Beacon Light Road, Suite 130
Monument, CO 80132

El Paso County:

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

9 JUNE 2016

Print Name — JENNIFER IRVINE Date
County Engineer / ECM Administrator

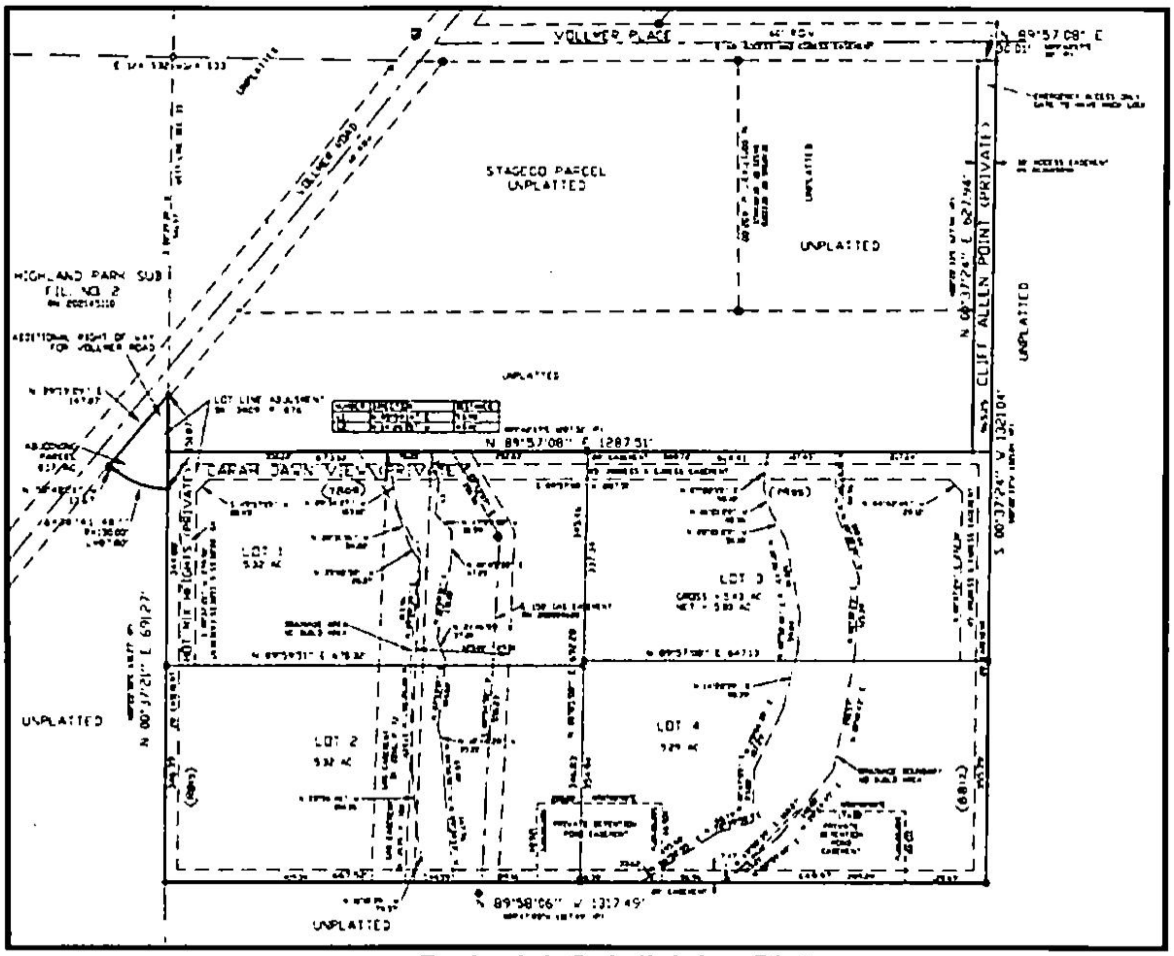
TABLE of CONTENTS

Surrounding Developments. The following are the existing or planned general land uses adjacent to the property.

North: Un-platted parcels that contain commercial/industrial uses. Carah Dawn View is on the north side of the property.

East and South: Although this adjacent area is currently undeveloped, the Sterling Ranch Master Planned area is in the process of developing this area (future single family development).

West: This is an undeveloped, un-platted lot. Across Vollmer Road is a low density single family development (Highland Park, Fil 2).



Barbarick Subdivision Plat

Property Description

1. Major Drainage Way: The entire site is located within the Sand Creek Drainage Basin. The Main Fork of Sand Creek is located about 1500 feet to the east. The site currently drains to the south into natural drainage ways that direct runoff to Sand Creek. The Sand Creek Drainage Basin is located in the northeastern portion of the City of Colorado Springs and El Paso County. The general drainage pattern of this larger basin flows to the southwest and ultimately feeds into Fountain Creek.

2. Project Site Area: This site is approximately 21.37 acres in area.

3. Ground Cover: This site is covered with native grasses.

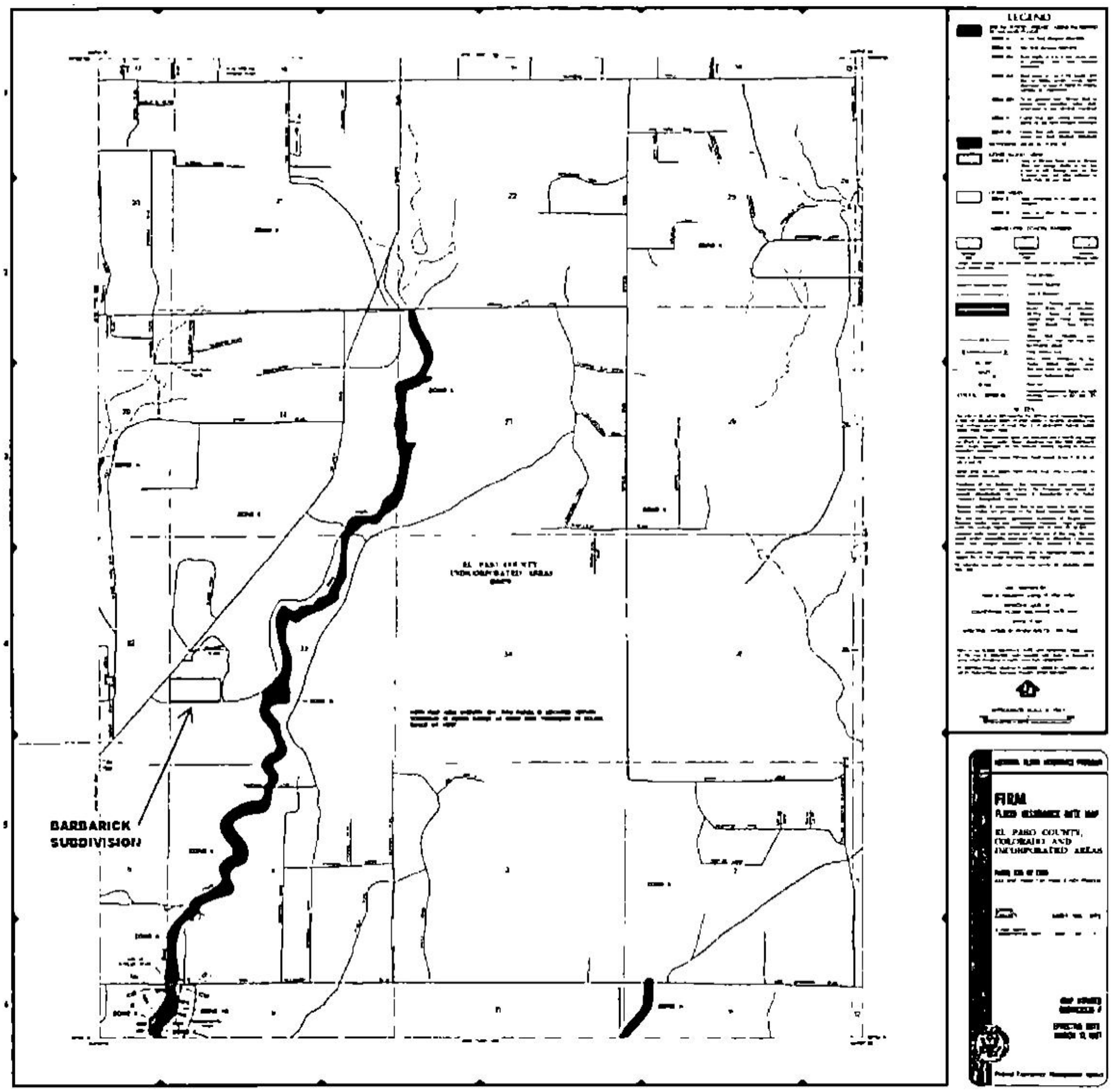
4. General Topography: The site drains from north to the south with average grades ranging from 1% to 5%. There are two natural drainage ways that drain through these lots.

5. Irrigation Facilities: No known functioning irrigation facilities are located on the site. A small detention pond does exist to the northeast of the property; however, the outfall of this pond will be re-routed in order to direct runoff around the perimeter of the proposed development.

6. Utilities: Utilities in the project area include; but are not limited to, telephone, high pressure gas/petroleum and electrical lines. Water & wastewater service is provided through wells & individual septic systems. These utilities will be examined on a case-by-case basis and avoided where feasible, or they will be relocated. Any relocation of these utilities will be coordinated with the respective utility contact. Utility services will be extended into the site as necessary. There are large gas easements that run north-south through these lots. These easements contain one 6 inch and two 20 inch high pressure gas/petroleum pipelines. These Utility Easements will be no-build zones and grading will be fill only.

7. On-Site Drainage Ways: The plat shows two "Drainage Boundary – No Build Area(s)" draining through the subdivision. These are not regulated FEMA floodplains. The site development will include the installation of pass through culverts for offsite flows, and regraded. An amended plat has been completed for the removal of the no build areas, identification of new drainage easements, and relocation of water quality ponds.

8. <u>Floodplain Statement:</u> Review of the Flood Insurance Rate Map (FIRM) 535 (08041CO535 F), effective date March 17, 1997, published by the Federal Emergency Management Agency (FEMA) reveals that no portion of Barbaric Subdivision lie within any designated 100-year floodplain.



FEMA - Flood Insurance Rate Map (FIRM)

HYDROLOGIC AND HYDRAULIC ANALYSIS

Basin Description

The Barbarick Subdivision is located within the Sand Creek Drainage Basin. The tributary area that drains through the Barbarick Subdivision is developed, which includes large lot single-family parcels and some commercial/industrial land uses. Sub-basins were delineated using surveyed information, proposed contours and field observations. See the Drainage Basin Maps in the Appendix.

This study is in conformance with the following two approved Drainage Reports:

1. ***Preliminary Drainage Report for Sterling Ranch-Phase 1, Sand Creek Drainage Basin***, M & S Civil Consultants, Inc., May 2015 **AKA: "SR-PDR"**

2. ***Woodmen Storage Final Drainage Report, El Paso County,*** Calibre Engineering, Inc., July 2004; Revised February, 2010; Revised May, 2010; Revised July, 2010 **AKA: "WS-FDR"**

This study is *not* in conformance with the following approved Drainage Report due to changes from the approved recent reports cited above that supercede the original report:

1. ***Preliminary and Final Drainage Plan and Report, Barbarick Subdivision a Replat of Lot "D", McClintock Subdivision, El Paso County,*** Oliver E. Watts, Consulting Engineer, Inc., August 15, 2007 **AKA: "BS-FDR"**

Design Criteria

This report has been prepared in accordance to the criteria set forth in the ***City of Colorado Springs & El Paso County Drainage Criteria Manual, Volumes I and II***, dated November 1991 including subsequent updates. El Paso County has also adopted Chapter 6 and Section 3.2.1 of Chapter 13 in the ***City of Colorado Springs & El Paso County Drainage Criteria Manual, Volumes I and II***, dated May 2014 (Appendix I of the El Paso County's Engineering Criteria Manual (ECM), 2008). In addition to the ECM, the ***Urban Storm Drainage Criteria Manuals, Volumes 1-3***, published by the Urban Drainage and Flood Control District, (Volumes 1 & 2 dated January 2016, Volume 3 dated November 2010 with some sections update November 2015), has also been used to supplement the ECM.

Hydrologic Criteria

Hydrologic analyses for the site have been completed using the Rational Method for on-site basins. The SCS Method was used in the referenced studies for the larger off-site basins (greater than 100 acres). The design storms for each method are:

Initial Storm = 5-Year Storm
Major Storm = 100-Year Storm

Rational Method: The Rational Method will be utilized to evaluate smaller basins (under 100 acres). This methodology is used for the design of localized facilities such as inlets, storm drain, drainage swales and detention:

Rational Method peak flow rate equation (cfs): Q=C*I*A

Where: Q = Maximum runoff rate in cubic feet per second (cfs)
C = Runoff coefficient
I = Average rainfall intensity in inches per hour
A = Area of drainage sub-basin in acres

Runoff Coefficient

Rational Method coefficients are derived from UDFCD Vol 1 (Chapter 6 – Runoff, 2016-01 Rev) for the various land uses, including parking areas, drives, walks, roofs, lawns and open space areas. The Runoff Coefficients associated with these land uses also have a corresponding impervious value that is used in the detention calculations. The Rational Method Coefficients used in this study include:

Land Use or Surface Type	% Impervious	Runoff Coefficient (B Soils)	
		(5-Year)	(100-Year)
Greenbelts/Agricultural	2%	.03	.46
Gravel (packed)	40%	.37	.65
Drives & Walks	90%	.84	.90

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential:	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Table 6-5. Runoff coefficients, c

Total or Effective % Imperviousness	NRCS Hydrologic Soil Group A					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
2%	0.02	0.02	0.02	0.02	0.02	0.17
5%	0.04	0.05	0.05	0.05	0.05	0.19
10%	0.09	0.09	0.09	0.09	0.1	0.23
15%	0.13	0.14	0.14	0.14	0.14	0.28
20%	0.18	0.19	0.19	0.19	0.19	0.32
25%	0.22	0.23	0.24	0.24	0.24	0.36
30%	0.27	0.28	0.28	0.28	0.29	0.4
35%	0.31	0.33	0.33	0.33	0.33	0.44
40%	0.36	0.37	0.38	0.38	0.38	0.48
45%	0.4	0.42	0.42	0.42	0.43	0.52
50%	0.45	0.47	0.47	0.47	0.48	0.56
55%	0.49	0.51	0.52	0.52	0.52	0.6
60%	0.53	0.56	0.56	0.57	0.57	0.64
65%	0.58	0.6	0.61	0.61	0.62	0.68
70%	0.62	0.65	0.66	0.66	0.67	0.72
75%	0.67	0.7	0.71	0.71	0.71	0.76
80%	0.71	0.74	0.75	0.76	0.76	0.8
85%	0.76	0.79	0.8	0.8	0.81	0.84
90%	0.8	0.84	0.85	0.85	0.86	0.88
95%	0.85	0.88	0.89	0.9	0.9	0.92
100%	0.89	0.93	0.94	0.94	0.95	0.96
Total or Effective % Imperviousness	**NRCS Hydrologic Soil Group B**					
2%	0.02	0.02	0.14	0.24	0.38	0.46
5%	0.04	0.05	0.17	0.27	0.39	0.48
10%	0.09	0.09	0.21	0.3	0.42	0.5
15%	0.13	0.14	0.25	0.34	0.45	0.53
20%	0.18	0.19	0.29	0.37	0.48	0.55
25%	0.22	0.23	0.33	0.41	0.51	0.58
30%	0.27	0.28	0.37	0.44	0.54	0.6
35%	0.31	0.33	0.41	0.48	0.57	0.63
40%	0.36	0.37	0.45	0.51	0.6	0.65
45%	0.4	0.42	0.49	0.55	0.63	0.67
50%	0.45	0.47	0.53	0.58	0.66	0.7
55%	0.49	0.51	0.57	0.62	0.69	0.72
60%	0.53	0.56	0.61	0.65	0.72	0.75
65%	0.58	0.6	0.65	0.69	0.75	0.77
70%	0.62	0.65	0.69	0.72	0.78	0.8
75%	0.67	0.7	0.73	0.76	0.81	0.82
80%	0.71	0.74	0.77	0.79	0.84	0.85
85%	0.76	0.79	0.81	0.83	0.87	0.87
90%	0.8	0.84	0.85	0.86	0.89	0.9
95%	0.85	0.88	0.89	0.9	0.92	0.92
100%	0.89	0.93	0.94	0.94	0.95	0.94

Time of Concentration

The time of concentration (T_c) for the Rational Method was calculated by methods derived from the UDFCD. The time of concentration consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an initial time or overland flow time (t_i)

plus the time of travel (t_t) in concentrated form, such as a swale or drainageway. A minimum T_c of 5 minutes and 10 minutes were used for the final calculations in developed and undeveloped conditions, respectively.

Storm Drain Systems
All proposed storm drain infrastructure will be located within private property and will be owned and maintained by the property owner.

The storm drain hydraulics is analyzed using *Bentley's* FlowMaster, CulvertMaster & StormCAD design software. Colorado Department of Transportation (CDOT) type inlets will be used where necessary.

The designated outfall locations for the proposed on-site storm drains are the natural drainage ways at the south end of the property. The proposed storm drain infrastructure will be discussed in more detail below.

EXISTING DRAINAGE REPORT DISCUSSION

The approved Barbarick Subdivision Final Drainage Report (BS-FDR) and the approved Woodmen Storage Final Drainage Report (WS-FDR) both apply to the existing general drainage conditions for this site. The off-site basins and general flow patterns in the BS-FDR and WS-FDR still apply. Excerpts from these reports are provided below for reference.

On-site and Off-Site Basin Descriptions from the BS-FDR and WS-FDR:

The following summary is taken from the Barbarick Subdivision Final Drainage Report (BS-FDR):

Off-site:

Off-site Basin O3 This basin encompasses approximately 7.03 acres and represents the area north and northwest of Lot 1. This basin drains into Lot 1 through a series of (2) 24" CMP pipes which control the flow of 14/36 cfs in the 5/100 year storm events.

Lots 1 & 2 – these lots are considered fully developed lots and drain north to south collecting at the existing concrete settling pond on Lot 2. This developed flow (20.8 cfs /57.2 cfs) combines with Off-site Basin O3 to total 30.5 cfs / 80.8 cfs in the greenbelt offsite south of Lot 2. At the time of development permit for these developed lots, a detention pond for water quality will be required, probably in the area of the existing concrete settling pond, that will accommodate Lots 1 and 2 west of the gas easement and flood plain area.

On-site:

On-site Basins A1 and B1 (for portions of Lots 1 and 2, and Lots 3 & 4)
These basins encompass approximately 5.3 & 3.8 acres and represent the buildable portions of the property as described in the BS-FDR (see Basin Map from BS-FDR below). These basins were slated (in the BS-FDR) to drain into small detention ponds that would release to historic rates. These discharge rates were calculated to be 2.9/7.3 and 2.2/5.4 cfs (5/100 year). The BS-FDR does not include the drainage ways in any hydrology calculations due to the fact that this no-build drainage area was not planed on being developed. This drainage way allowed off-site flows from O1+O2 to pass-through Lots 3 & 4. The drainage way to the west of A1 passes through flows from offsite O3. Since the approval of this report, offsite tributary basins O1+O2 have been changed, and the development of the property encompasses the whole property, including the previously determined no-build area.

The following summary is taken from the Woodmen Storage Final Drainage Report (WS-FDR):

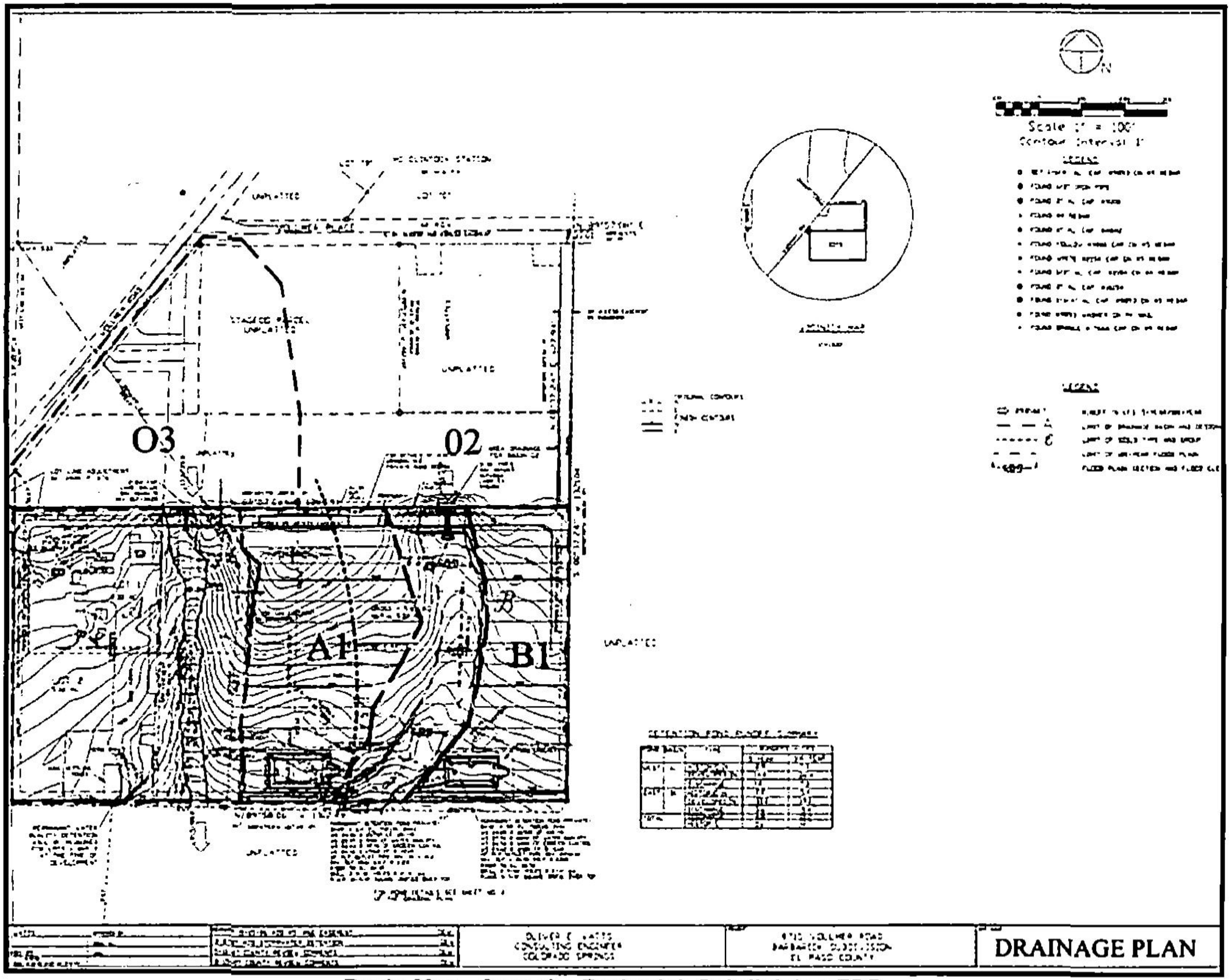
Off-site:

Design Point 5 - This design point encompasses approximately 19.69 acres and represents the tributary area north of the project site. This basin drains into a proposed detention pond near the northeast corner of the property and generates 57.4/92.7 cfs in the 10/100 year storm events, historic flows are 16.7/30.3 cfs. The releases rates from this pond are lower than historic 16.1 cfs/29.4 cfs in the 10/100-year storm events. These flows are conveyed along the east property line of the site and into the eastern natural drainage way that leaves the property to the south.

Review of the Sterling Ranch Preliminary Drainage Report (SR-PDR):

The Barbarick Subdivision is surrounded on three sides by the planned Sterling Ranch Development. The approved Sterling Ranch PDR was prepared by M&S Civil Consultants in May of 2015. This Sterling Ranch PDR re-analyzes runoff from Barbarick Subdivision and plans for storm drain improvements to convey this runoff to a full spectrum detention and water quality pond to be located down stream of Barbarick Subdivision as part of Sterling Ranch Phase One.

In summary; the Sterling Ranch PDR is planning on receiving 73.3/139.2 cfs (5/100 year) from Basin OS3. A 54" RCP is planned to convey this flow through Sterling Ranch. The Sterling Ranch PDR is planning on receiving 45/86 cfs (5/100 year) from OS2, encompasses Lots 1 & 2 and OS3 encompasses Lots 3 & 4 and the Basin north of Lot 3. A 48" RCP is planned to convey this flow through Sterling Ranch. The cumulative runoff from the northerly property and Lots 1 through 4 does not exceed the anticipated rates in the SR-PDR.



Basin Map - from the Barbarick Subdivision FDR

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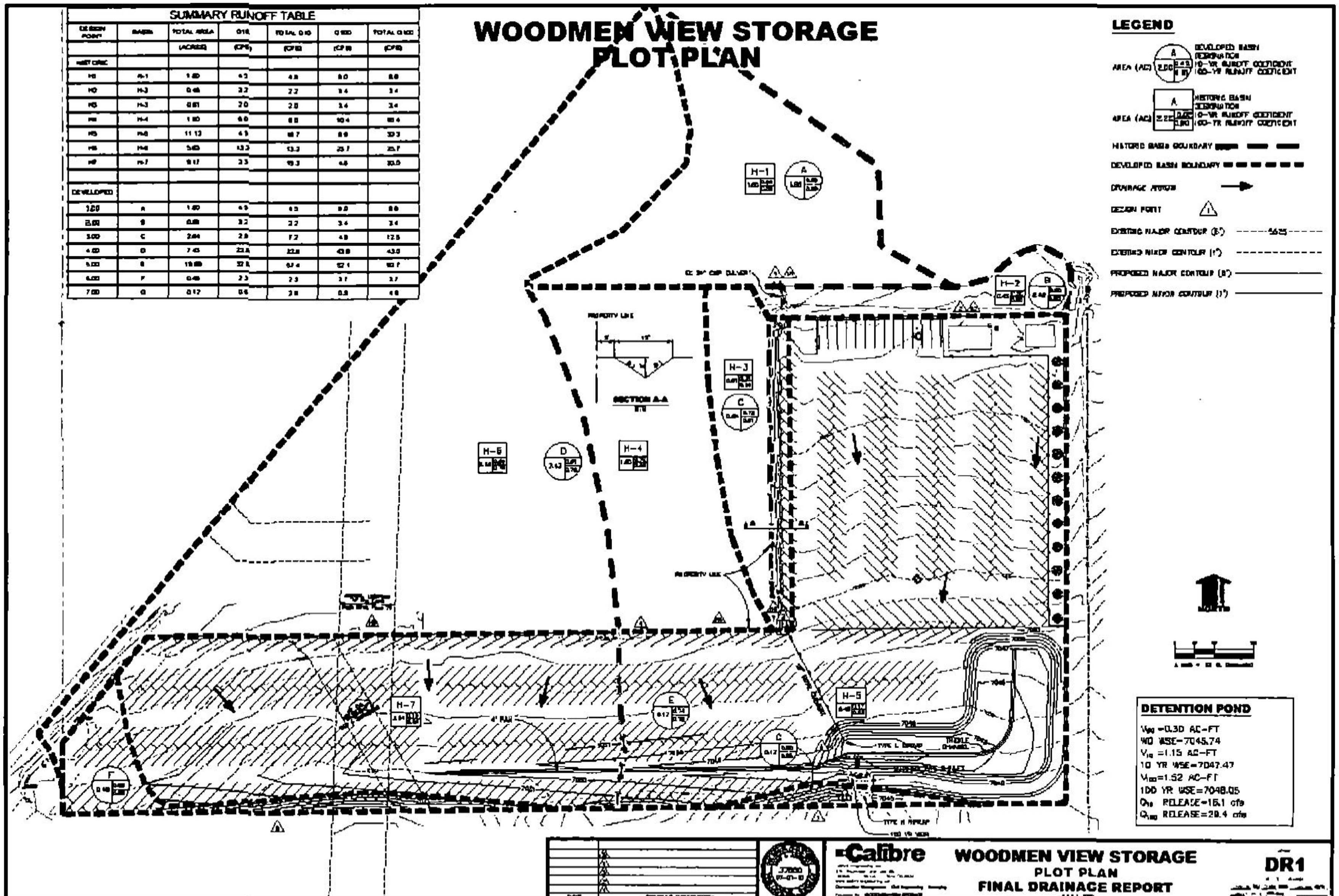

Basin Map - from the FDR

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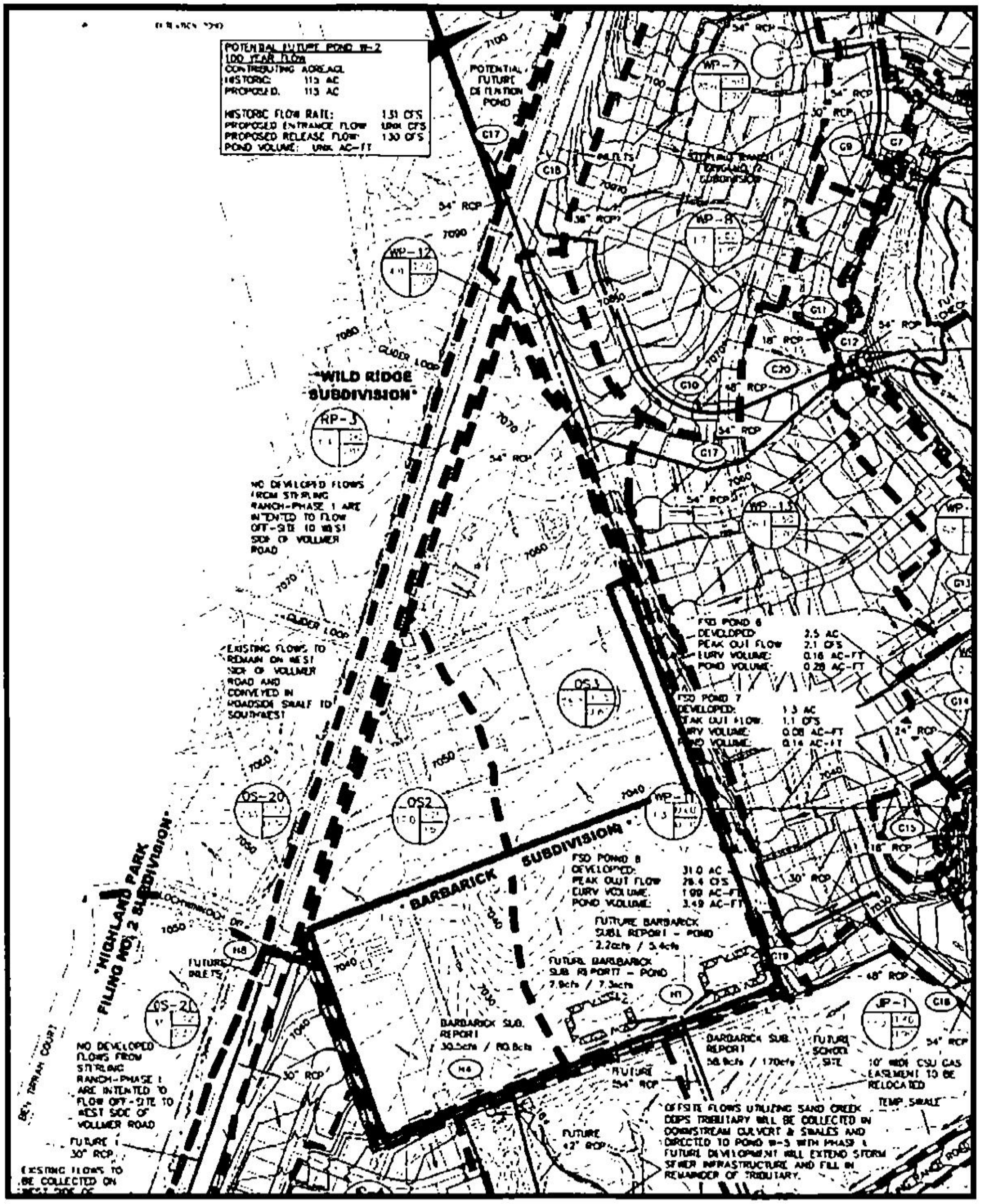
CIVIL CONSULTANTS, INC. 102 E. PIKES PEAK AVE. STE 306 COLORADO SPRINGS, CO 80903 (719) 955-5485, FAX (719) 448-8427	STERLING RANCH PHASE 1 PROPOSED - DRAINAGE MAP (OVERALL)			
	PROJECT NO. 09-001	SCALE	DATE: 5/08/15	
	DESIGNED BY: DLM	HORIZ: 1"=200'		
	DRAWN BY: DLM	VERT: N/A	SHEET 1 OF 1	D2
	CHECKED BY: VAS			

Basin Map from the Sterling Ranch PDR



STORM SEWER ROUTING SUMMARY		
DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
G4A	640	1584
G5	78	146
G6	32	66
G7	82	157
G8	20	42
G9	14	29
G10	47	97
G11	4	9
G12	72	144
G13	12	25
G14	7	14
G15	3	7
G16	60	125
G17	80	130
G18	29	54
G19	11	23
G20	69	138
G21	1044	1767
G22	5	10
G23	64	133
G25	1056	1795
H1	73	139
H2	46	92
H3	103	200
H4	45	86
H5	30	61
H6	68	134
H8	16	29
H11	22	45
H12	31	62
H13	57	118
H14	196	382
H16	31	65
H17	26	54
H18	224	441

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5 (CFS)	Q_{100} (CFS)
OS1	110.1	68	167
OS2	17.0	45	86
OS3	28.7	73	139
OS4	5.0	5	11

Flow Summary from the Sterling Ranch PDR

EXISTING SITE DRAINAGE DISCUSSION:

On-Site (Existing Conditions):

On-site Basin H1 This basin covers approximately 10.7 acres and represents the majority of Lots 3 & 4. This basin is modeled as good condition undeveloped rangeland. This drains to the south and generates 2.6/23.7 cfs in the 5/100 year storm events.

On-site Basin H2 This existing basin covers approximately 3.70 acres and represents the eastern half of Lots 1 & 2.This basin is modeled as good condition rangeland and generates 0.9/8.2 cfs in the 5/100 year storm events.

On-site Basin H3 This existing basin covers 1.1 acres and represents the a small portion of lots 3 & 4 that drains south easterly. This basin is modeled as good condition rangeland and generates 0.3/2.7 cfs in the 5/100 year storm events. This basin sheet flows offsite where it is captured in a small swale between the site and existing roadway and conveyed westerly to the low point south of the outfall of Basin H1.

These existing basins encompass the previously unmodelled drainage area from the BS-FDR. The total historic flow from the site is 3.8/34.6 cfs in the 5/100 year storm events. The following design point table is for combined allowable discharge rates from the property at respective locations including historic flows from the tributary upstream basins:

Design Point	5/100 Release	Comments
DP H1	16.7*/30.3 cfs	DP H5 WS-FDR - * is 10year
DP H2	13.7/35.5 cfs	O3 BS-FDR
DP H3	56.7 cfs	DPH1+H1+H3 (100-year)
DP H4	14.6/43.7 cfs	DPH2 + H2

Design Point H3 will release a flow lower than previously anticipated within the BS-FDR (52.9/170 cfs). It is the introduction of development within the Sterling Ranch site that has eliminated offsite flows from BS-FDR Basin O1 that significantly changed the drainage pattern. The historic release is now contained solely to the historic flows from WS-FDR design point H5 and the proposed onsite historic flows.

Design Point H4 will combine with the western half of Lots 1&2. Per the BS-FDR the combined portions of Lots 1&2 and O3 to release a combined flow of 30.5/80.8 cfs downstream. The flow anticipated in the BS-FDR appears consistent with the smaller basin analysis of this report and should be used for downstream analysis.

PROPOSED DRAINAGE DISCUSSION

Introduction

The proposed site will be developed differently than anticipated in the previous BS-FDR. The previous plan for this site maintained the existing native drainage way down the middle of Lots 1 & 2 and 3 & 4, thereby splitting the buildable area into the outer thirds of these lots. The native drainage way and "Drainage Boundary – No Build Area" (as shown on the Plat & FDR) will be eliminated with the proposed development. The proposed site and proposed drainage improvements will allow this native drainage way to be eliminated while maintaining the pass through of major flows. These modifications to the site and to the drainage patterns will allow a larger buildable area.

The existing retention pond, located just north of Lot 3, will be modified by others to become a water quality/detention pond pursuant to the WS-FDR. A new outlet works and a storm drain pipe will convey runoff from this detention pond (16.1/29.4 cfs in the 10/100 year storm events) discharging at the property line. This development is proposing a CDOT Type D inlet to capture the discharged flow and pipe it downstream along the east side of Lots 3 & 4 to discharge into the proposed Full Spectrum Extended

Detention Basin (EDB) in Lot 4. The EDB is designed to pass through, and not treat or detain, these offsite flows.

A new EDB will be provided in Lot 4. This detention basin will provide water quality treatment for portions of Lots 1 & 2, and Lots 3 & 4. In the approved Barbarick FDR there were to be two separate ponds. The new site development has been planned for a single pond to treat the developed flows. Tributary water sheet flow across the site to shallow swales that will direct runoff to the proposed EDB. The EDB will have a forebay at the confluence of the two pipe outfalls, a concrete trickle channel that terminates at a micropool structure, and is designed to treat the WQCV, EURV and 100-year detention.

A second SFB water quality with detention catchment basin will be provided at the south east/downstream end of Lot 2. This SFB will not have an outlet structure to release flows due to requirements from the gas main utility ownership of no structure to be built within the existing easements. There will be a small spillway to allow the release of large storm events. Runoff will be directed to the proposed SFB where possible.

Flow from the area north of Lot 1 (Basin O3) will pass through the site via two 24" culverts and will be discharged at the southern boundary of Lot 2, as historically done. An earthen channel will run north-south along the east side of the existing Lot 1 and Lot 2 developments. The channel is approximately 1-ft deep with 4:1 side slopes and will capture and convey any westerly flowing nuisance runoff from the proposed improvements to the sand filter detention pond as discussed in the original Barbarick Subdivision FDR, instead of the existing Lot 1 and 2 improved areas.

Runoff from the property is at historic flows and will not exceed the anticipated runoff as determined in the Sterling Ranch PDR. This is described in more detail below. The Sterling Ranch PDR includes an analysis of future drainage conditions and includes recommended infrastructure to convey this runoff. Since the Sterling Ranch surrounds the Barbarick Subdivision, it is appropriate to include the recommendations from the SR-PDR in this Proposed Drainage Discussion.

Proposed On-Site Basin Descriptions: (See Basin Map in the pocket)

On-site Basin D1 (D for Developed condition) - This developed basin encompasses approximately 11.4 acres - the majority of Lots 3 & 4 and small portions of Lots 1 & 2. This basin generates 19.7/56.0 cfs in the 5/100 year storm events and sheet flows into shallow swales that direct the runoff into the proposed EDB to be located in Lot 4. Lot 3 is based on Owner provided information for a gravel parking/vehicle storage area, and Lot 4 has been based on proposed building site improvements as identified in the rezoning application. Any changes to the land use will require an update to the Final Drainage Report; much like the original Barbarick Subdivision Final Drainage Report is being updated with the grading and Lot 4 development application.

On-site Basin D2 This undeveloped basin encompasses 1.2 acres and represents the south portion of Lot 4, below and south of the two detention ponds. This basin is historic in nature and generates 0.8/3.0 cfs and drains directly into a road side ditch within the Sterling Ranch development.

On-site Basin D3 This developed basin encompasses approximately 3.13 acres - the remaining proposed infill portions of Lots 1 and 2 (east of the currently built out Lots 1&2). As discussed in the original Barbarick Subdivision FDR, development of these areas will require a detention water quality pond. This basin generates 4.1/11.6 cfs in the 5/100 year storm events and sheet flows southerly to the proposed SFB located at the southern-most portion of Lot 2.

The following design point table is for combined allowable discharge rates from the property at respective locations including historic flows from the tributary upstream basins:

Design Point	5/100 Year	Comments
DP D1	85.4 cfs (100)	D1+O2 Pass Through
DP D2	48.9 cfs (100)	Pond Release+D2
DP D3	4.1/11.6 cfs	D3
DP D4	13.8/39.1 cfs	Pond Release +03 Pass Through

All release flows downstream are at or below historic levels.

RECOMMENDED DESIGN

Off-site Detention Facility:

This shallow pond will be modified for the proposed development to the north as part of the WS-FDR. This will eliminate the retention properties in this pond, will provide detention for off-site flows, will provide a suitable outlet structure, and will remove accumulated sediment. The modified pond will store up to 1.52 acft (66,211 cuft) to the principal spillway (elevation = 7048.05). A summary of flows into and out of this pond:

Off-site Pond Flow Summary (cfs)	5 year	100 year
Proposed Flow into offsite pond (Basin G/DP 5)	**57.4**	**92.7**
Increase in peak flow due to development	46.2	51.3
Proposed flow out of modified pond	**16.1**	**29.4**
Reduction in peak flow	41.3	63.3

For complete pond design, refer to the WS-FDR.

Proposed 30" HDPE Storm Drain from Modified Off-site Detention Pond:

This storm drain will capture flows from the discharged offsite pond and route them along the perimeter of the property daylighting into the EDB in Lot 4. 4' precast concrete manholes will be used for maintenance access at all bends and grade breaks. A grouted riprap forebay will help dissipate energy at the outlet of the pipe, and allow for settling prior to entering the pond. See the Appendix for the hydraulic analysis of this storm drain (StormCAD).

In the event of an emergency and the offsite pond fails, developed flow (Q100=93.0 cfs) will overtop the pond and be collected between the proposed roadway and pond berm.. Flow not captured by the proposed inlet will bypass easterly to the proposed offsite swale between this property and the Sterling Ranch property and conveyed southerly.

Proposed 18" HDPE Storm Drain Culvert:

A 18" HDPE culvert will convey collected runoff from Lot 3 (Developed Q100 = 15.90cfs) through Lot 4 to the FSD Pond and join sheet flow from Lot 4 and the 30" piped bypass flow from basin O2. This culvert will be privately owned and maintained by the property owners. See the Appendix for open channel calculations.

On-site FSD - EDB Pond in Lot 4 (Basin D1):

This On-site Full Spectrum Extended Detention Basin Pond provides water quality, EURV and 100-year detention. Onsite flows will combine with the 30-inch bypass flows from the north and pass through the EDB. The pond has been sized for the release of historic flows from Basin D1, as well as provides capacity for pass through conveyance of historic flows from the north.

The following table outlines the onsite existing and developed flow, required detention, and modifications to required detention utilizing the upstream over detention.

On-site Basin Flow Summary (cfs)	5 year	100 year
Existing On-site Flow at Pond	2.2	16.5
Developed On-site Flow (Basin D1)	19.7	56.0
Increase in peak flow due to development	17.5	39.5
Proposed Pass Through Flow from Off-Site Pond	16.1*	29.4
Proposed total flow out of EDB pond	0.3	45.9**

*Includes 10 year from WS-FDR
**Includes Pass Through flow of 29.4 cfs

Water Quality Benefits:
Stormwater from Lots 3 & 4, and portions of 1 &2 will drain directly to the proposed Full Spectrum Extended Detention Pond. This pond will be privately maintained and provide water quality treatment to approximately 11.4 acres of developed land.

The proposed Water Quality facility is sized using the methods derived from the UDFCD Stormwater FSD Design Workbook (UD-FSD 1.11) (see Appendix). The Water Quality Capture Volume (WQCV) will be provided in this EDB, where the "initial flush" of storm water will be drained over a 40-hour time period.

The impervious area ratio is used in the UDFCD workbook to calculate the WQCV. An adjusted impervious ratio of 57% to correlate with the land use charts and Runoff Coefficients (provided above) is being utilized for the sizing of the facility.

The EDB Pond will have a a forebay, concrete trickle channel and micro-pool within the outlet structure (per UDFCD). This outlet structure will have a bar screen and an orifice plate containing 3 rows outlets (1.55 sq in orifices for the first two, and 3.8 sq in for the last row). The EURV has been designed to an elevation of 7021.50. The top of the inlet will have a grate to allow flows that exceed the WQCV and EURV to drain through the outlet works without overtopping the spillway, with an internal orifice plate of 2.37-ft diameter constricting flows to historic release rates ($Q100_{Onsite}$ = 16.5 cfs + $Q100_{bypass}$ = 29.4 Total Release = 45.9 cfs) .

The EDB pond can store up to 64,904 cuft (1.49 acft) to the principal spillway (7023.20). The pond bottom elevation will be at 7018.50 and the top of the embankment will be at elevation 7025.10. Should the outlet works become fully blocked; the 36' spillway will have the capacity to pass the combined 100 year peak developed runoff and northerly bypass with a flow depth = 0.90' (55.0 + 29.4 = 84.4 cfs) maintaining 1-ft of freeboard. .

Summary results include:

- WQCV Volume = 0.203 ac-ft depth 1.53-ft (40 hour release)
- EURV Volume Stored = 0.677 ac-ft at depth 2.98 ft (72 hour release)
- 5 Year Volume Stored = 0.673 ac-ft at depth 2.98 ft (72 hour release)
- 100 Year Volume Stored = 1.261 ac-ft depth 4.26-ft (77 hour release)
- Emergency Spilllway Volume at Crest = 1.49 ac-ft at depth 4.7ft.

A 30" HDPE pipe will drain this outlet structure. A Low-Tailwater basin will be provided at the outlet for energy dissipation. This storm drain will daylight into the open channel just south of Lot 4 near the entrance of an existing 12" CMP. This existing 12" CMP drains under a dirt road. This dirt road will be eliminated upon development of the Sterling Ranch. Due to the limited capacity of this existing 12" CMP, runoff in excess of 5.7 cfs will overtop this dirt road, creating tail water to 7018.0. See the Appendix for the calculation results (CulvertMaster).

On-site Sand Filter Basin w/ Detention in Lot 2 (Basin D3):

A sand filter basin detention pond is being proposed to treat runoff from the proposed gravel parking portions of Lots 1 and 2 prior to discharging from the site. Due to the high pressure gas mains within this basin, grading is limited to fill only and no structures are allowed within the gas easement, so this pond will have underdrain design with partial infiltration and a controlled overflow design for the 100-year event.

The following table outlines the onsite existing and developed flow, required detention, and modifications to required detention utilizing the upstream over detention.

On-site Basin Flow Summary (cfs)	5 year	100 year
Existing On-site Flow at Pond	0.5	4.2
Developed On-site Flow (Basin D3)	4.1	11.6
Increase in peak flow due to development	3.6	7.4
Proposed total flow out of Sand Filter pond	0.1	3.6

Water Quality Benefits:
Stormwater from portions of 1 &2 will drain directly to the proposed Sand Filter Pond. This pond will be privately maintained and provide water quality treatment to approximately 3.13 acres of developed land.

The proposed Water Quality facility is sized using the methods derived from the UDFCD Stormwater Detention Design Workbook (UD-Detention 3.04) (see Appendix). The Water Quality Capture Volume (WQCV) will be provided in this SFB, where the "initial flush" of storm water will be drained over a 12-hour time period.

The impervious area ratio is used in the UDFCD workbook to calculate the WQCV. An adjusted impervious ratio of 57% to correlate with the land use charts and Runoff Coefficients (provided above) is being utilized for the sizing of the facility.

The sand filter will contain a 4" underdrain beneath 18" of CDOT Class C material. The underdrain will contain a 1.27" diameter orifice to control the outflow time in accordance with UDFCD.

The SFB pond can store up to 16,247 cu ft (0.373 acft) to the principal spillway (7025.50). The pond bottom elevation will be at 7023.00 and the top of the embankment will be at elevation 7027.37. Because the spillway acts as the 100-year control structure and notched weir design is proposed. The spillway is 5-ft wide for a depth of 10-inches for the release of the 100-year flow (3.6 cfs which is less than the 4.2 historic) then the spillway widens to 10ft for a depth of 18-inches which will have the capacity to pass the combined 100 year peak developed runoff (11.6cfs) with a flow depth = 0.5' maintaining 1-ft of freeboard.

Summary results include:

- WQCV Volume =0.039 ac-ft depth 0.37-ft (12 hour release)
- EURV Volume Stored = 0.181 ac-ft at depth 1.52 ft (42 hour release)
- 5 Year Volume Stored = 0.181 ac-ft at depth 1.52 ft (42 hour release)
- 100 Year Volume Stored = 0.394 ac-ft depth 2.83-ft (68 hour release)

Proposed (2) 24" HDPE Storm Drain Culvert:

Two 24" pipes will convey offsite flows through Lots 1 and 2 discharging to the south. The culverts will connect to a pair of existing 24" culverts entering the property and will discharge to a riprap settling basing prior to the released downstream. These culverts will be privately owned and maintained by the property owners. See the Appendix for the hydraulic analysis of this storm drain (CulvertMaster). Flow from these pipes will join the flow from the Sand Filter and discharge at Design Point 4 (combined 39.4 cfs in the 100-year event). Per the BS-FDR this flow combines with the westerly portions of Lots 1 & 2 offsite for a total release of 30.5/80.8 cfs in the 5/100 year events.

As stated above in the summary from the Sterling Ranch PDR, the anticipated runoff from this proposed discharge point (aka: SR-PDR Basin H4) is 30.5/80.8 cfs (5/100 year) due to the large pass through flow. A 42" RCP is planned to convey this flow through Sterling Ranch.

DRAINAGE, BRIDGE, AND POND FEES

This subdivision has already been platted. No additional Drainage, Bridge or Pond fees are required.

MAINTENANCE

All proposed storm drain infrastructure will be located within private property and will be owned and maintained by the property owner. The detention pond will be owned and maintained by the property owner and will require maintenance consisting of routine inspections, removal of debris from the detention area, and bi-annual inspections for hydraulic performance of the basin. Refer to the DCM for exact maintenance criteria and for other Best Management Practices (BMP).

EROSION CONTROL

Best Management Practices (BMPs) will be utilized to minimize erosion during construction and will be shown on the construction drawings. These will be in accordance with will be utilized as deemed necessary by the contractor and/or engineer. The contractor shall minimize the amount of area disturbed during all construction activities.

In general, the following shall be applied in developing the sequence of major activities;

1. Install down slope and side slope perimeter BMPs _before_ the land disturbing activity occurs.
2. Do not disturb area until it is necessary for the construction activity to proceed.
3. Cover or stabilize exposed areas as soon as possible.
4. Time the construction activities to reduce the impacts from seasonal climatic changes or weather events.
5. The construction of permanent filtration BMPs should wait until the end of the construction project when drainage areas have been stabilized.
6. Do not remove the temporary erosion controls until after all areas are stabilized.

Slopes

Erosion control soil retention blankets shall be installed where noted on slopes 3:1 or steeper. At a minimum, coconut/straw blend fiber material blankets should be used. The silt fence or erosion logs shall be installed at the toe of fill slopes where noted on a level contour. Erosion logs shall also be installed on slopes greater than ten feet in height where noted to reduce runoff length. The erosion logs shall be installed on a level contour. Disturbed surfaces shall be left in a roughened condition at all times when horizontal depressions approximately 2" to 4" deep, spaced 4" to 6" apart. Silt fence and erosion logs shall remain in place until all construction is complete and/or "finally stabilized", after which the silt fence and erosion logs shall be removed from the slopes. All material shall be installed per manufacturer's installation instructions.

Stockpiles/Mobilization/Winter Shutdown

Soils stockpiled for more than 30 days shall be mulched with mulch tackifier and native seeding within 14 days of stockpile construction. After mobilization and prior to winter shutdown, all disturbed slopes not completed shall be mulched with mulch tackifier and native seeding.

Inlet and Outlet Protection

Storm Drain Inlet Protection shall be provided at all storm inlets. Outlet protection shall be provided at all pipe outlet and runoff / rundown treatment locations. All materials shall be installed per manufacturer's installation instructions.

Concrete Washout

Concrete washout structures shall be installed for cleaning concrete trucks. The concrete washout structure shall be constructed such that water can only evaporate or infiltrate from the structure . Residue and concrete from the washout structure shall be periodically cleaned out and properly disposed.

Erosion Control Supervisor and Maintenance

The erosion control supervisor shall be a person other than the superintendent. The erosion control supervisor shall inspect at least every 14 days and after any precipitation or snowmelt event that causes surface erosion. At sites where construction has been completed but a vegetative cover has not been established, these inspections must occur at least once per month.

All erosion control measures shall remain in place until all construction is complete and final stabilization has been achieved. "Final stabilization" is where all disturbed areas have been built on, paved, or germinated with a uniform vegetative cover with a density of at least 70% of pre-disturbance levels. Equivalent permanent, physical erosion reduction methods may also be employed. Any areas not meeting this standard shall be repaired according to the BMP guidelines. Accumulated sediment and debris shall be removed when the sediment level reaches one half the height of the BMP or when the sediment/debris adversely impacts the functionality of the BMP. The Contractor shall remove all sediment, mud, and construction debris that may accumulate in public right of ways not designated before-hand as a result of this construction project. All repairs, removals, and replacements stated above shall be conducted in a timely manner.

Cost Estimate

The proposed drainage system to be constructed will be privately owned and maintained. The developer will be responsible for constructing the proposed improvements.

An engineer's estimate of probable construction costs has been provided for the proposed improvements. The storm sewer systems will be located in the Sand Creek Drainage Basin. The construction cost for the improvements are not eligible for reimbursement.

Engineer's Estimate of Probable Construction Costs
Tri-Lakes Construction - Sand Creek Drainage Basin
Non-Reimbursable Private Improvements

Item	Unit	Quantity	Unit Cost	Total Cost
Precast Manhole	EA	4	$2,500	$10,000
18" HDPE Pipe	LF	231	$45	$10,395
24" HDPE Pipe	LF	1212	$60	$72,720
30" HDPE Pipe	LF	1128	$72	$81,216
18" Flared End	EA	2	$225	$450
24" Flared End	EA	2	$250	$500
24" CMP-HDPE	EA	2	$200	$400
30" Flared End	EA	1	$350	$350
CDOT Type D Inlet	EA	1	$4,000	$4,000
EDB Pond Outlet	EA	1	$35,000	$35,000
			SubTotal	$215,031.00
			15% Contingency	$32,254.65
			Total Estimate	**$247,285.65**

REFERENCES

1. ***City of Colorado Springs & El Paso County Drainage Criteria Manual, Volumes I and II***, dated May 2014 including subsequent updates

2. ***City of Colorado Springs & El Paso County Drainage Criteria Manual, Volumes I and II***, dated November 1991 including subsequent updates

3. **Appendix I of the El Paso County's Engineering Criteria Manual** (ECM), 2008).

4. ***Urban Storm Drainage Criteria Manuals, Volumes 1-3***, published by the Urban Drainage and Flood Control District, (Volumes 1 & 2 dated 2016, Volume 3 dated 2015)

5. ***Preliminary Drainage Report for Sterling Ranch-Phase 1, Sand Creek Drainage Basin***, M & S Civil Consultants, Inc., May 2015

6. ***Woodmen Storage Final Drainage Report, El Paso County,*** Calibre Engineering, Inc., July 2004; Revised February, 2010; Revised May, 2010; Revised July, 2010

7. ***Preliminary and Final Drainage Plan and Report for Barbarick Subdivision, El Paso County***, Oliver E. Watts Consulting Engineer Inc., January 2005; Revised October 2005; Revised December 2006; Revised May 2007; Revised August 15, 2007

8. ***NOAA Atlas 14, Volume 8 Version 2*** U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Hydrometeorological Design Studies Center.

9. FEMA Map Service Center: http://msc.fema.gov

10. NRCS Web Soil Survey. http://websoilsurvey.nrcs.usda.gov

APPENDIX A

HYDROLOGIC AND HYDRAULIC CALCULATIONS

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: **Barbarick Subdivision**
Catchment ID: **H-1 5 Year**

I. Catchment Hydrologic Data

Catchment ID = H1
Area = 10.70 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

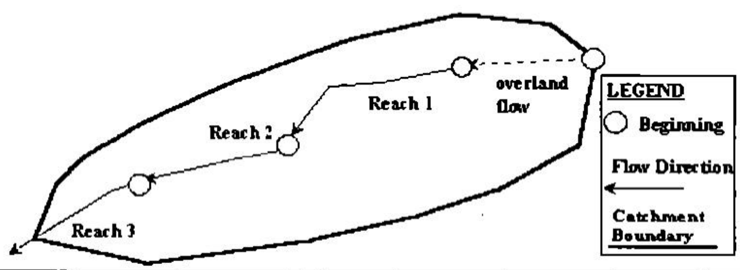
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.23 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.08
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0300	300	0.08	N/A	0.23	22.16
1	0.0300	338		10.00	1.73	3.25
2						
3						
4						
5						
	Sum	638				

Computed Tc = 25.42
Regional Tc = 13.54
User-Entered Tc = 13.54

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 2.12 inch/hr — Peak Flowrate, Qp = 1.85 cfs
Rainfall Intensity at Regional Tc, I = 2.93 inch/hr — Peak Flowrate, Qp = 2.56 cfs
Rainfall Intensity at User-Defined Tc, I = 2.93 inch/hr — Peak Flowrate, Qp = 2.56 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: Barbarick Subdivision
Catchment ID: H-1 100 Year

I. Catchment Hydrologic Data

Catchment ID = H1
Area = 10.70 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

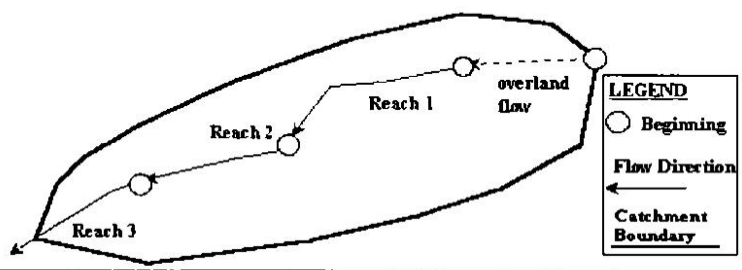
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 100 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 2.57 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.36
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0300	300	0.08	N/A	0.23	22.16
1	0.0300	338		10.00	1.73	3.25
2						
3						
4						
5						
Sum		638				

Computed Tc = 25.42
Regional Tc = 13.54
User-Entered Tc = 13.54

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 4.44 inch/hr — Peak Flowrate, Qp = 17.20 cfs
Rainfall Intensity at Regional Tc, I = 6.12 inch/hr — Peak Flowrate, Qp = 23.71 cfs
Rainfall Intensity at User-Defined Tc, I = 6.12 inch/hr — Peak Flowrate, Qp = 23.71 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: **Barbarick Subdivision**
Catchment ID: **H-2 5 Year**

I. Catchment Hydrologic Data

Catchment ID = H2
Area = 3.70 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

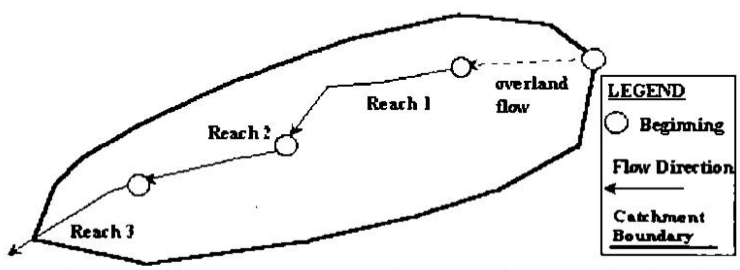
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.23 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.08
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0380	155	0.08	N/A	0.18	14.74
1	0.0350	515		10.00	1.87	4.59
2						
3						
4						
5						
	Sum	670				

Computed Tc = 19.32
Regional Tc = 13.72
User-Entered Tc = 13.72

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 2.46 inch/hr — Peak Flowrate, Qp = 0.74 cfs
Rainfall Intensity at Regional Tc, I = 2.91 inch/hr — Peak Flowrate, Qp = 0.88 cfs
Rainfall Intensity at User-Defined Tc, I = 2.91 inch/hr — Peak Flowrate, Qp = 0.88 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: **Barbarick Subdivision**
Catchment ID: **H-2 100 Year**

I. Catchment Hydrologic Data

Catchment ID = H2
Area = 3.70 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

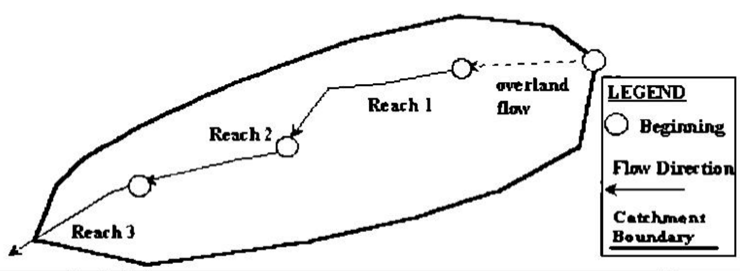
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 100 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 2.57 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.36
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0380	155	0.08	N/A	0.18	14.74
1	0.0350	515		10.00	1.87	4.59
2						
3						
4						
5						
	Sum	670				

Computed Tc = 19.32
Regional Tc = 13.72
User-Entered Tc = 13.72

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 5.15 inch/hr — Peak Flowrate, Qp = 6.90 cfs
Rainfall Intensity at Regional Tc, I = 6.08 inch/hr — Peak Flowrate, Qp = 8.15 cfs
Rainfall Intensity at User-Defined Tc, I = 6.08 inch/hr — Peak Flowrate, Qp = 8.15 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: **Barbarick Subdivision**
Catchment ID: **H-3 5 year**

I. Catchment Hydrologic Data

Catchment ID = H3
Area = 1.11 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

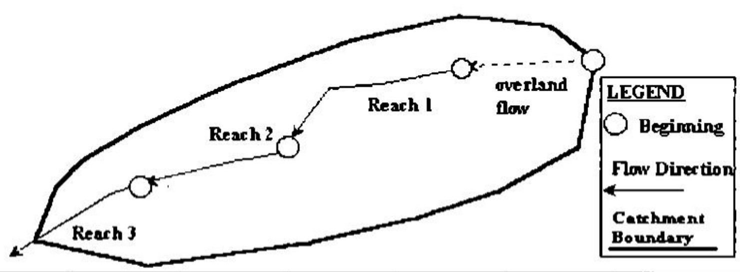
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.23 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.08
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0250	338	0.08	N/A	0.23	24.98
1						
2						
3						
4						
5						
	Sum	338			Computed Tc =	24.98
					Regional Tc =	11.88
					User-Entered Tc =	11.88

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 2.14 inch/hr — Peak Flowrate, Qp = 0.19 cfs
Rainfall Intensity at Regional Tc, I = 3.10 inch/hr — Peak Flowrate, Qp = 0.28 cfs
Rainfall Intensity at User-Defined Tc, I = 3.10 inch/hr — Peak Flowrate, Qp = 0.28 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: **Barbarick Subdivision**
Catchment ID: **H-3 100 year**

I. Catchment Hydrologic Data

Catchment ID = H3
Area = 1.11 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

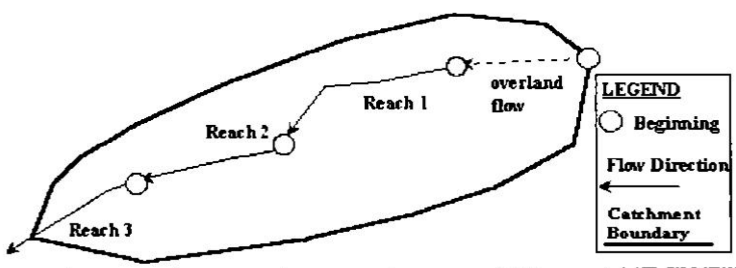
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 100 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 2.67 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.36
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0250	338	0.08	N/A	0.23	24.98
1						
2						
3						
4						
5						
	Sum	338				

Computed Tc = 24.98
Regional Tc = 11.88
User-Entered Tc = 11.88

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 4.65 inch/hr — Peak Flowrate, Qp = 1.87 cfs
Rainfall Intensity at Regional Tc, I = 6.73 inch/hr — Peak Flowrate, Qp = 2.71 cfs
Rainfall Intensity at User-Defined Tc, I = 6.73 inch/hr — Peak Flowrate, Qp = 2.71 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: **Barbarick Subdivision**
Catchment ID: **D-2 5 Year**

I. Catchment Hydrologic Data

Catchment ID = D2
Area = 1.20 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

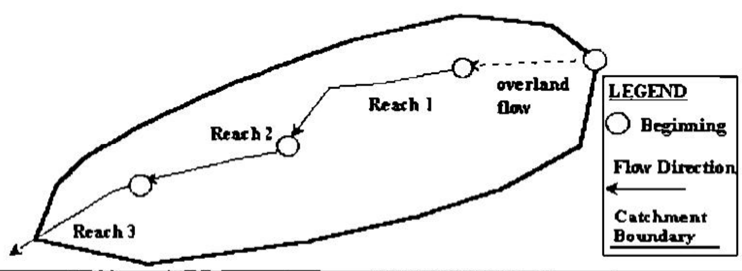
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.23 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.08
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0200	155	0.08	N/A	0.14	18.21
1						
2						
3						
4						
5						
Sum		155				
					Computed Tc =	18.21
					Regional Tc =	10.86
					User-Entered Tc =	10.86

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 2.54 inch/hr — Peak Flowrate, Qp = 0.25 cfs
Rainfall Intensity at Regional Tc, I = 3.22 inch/hr — Peak Flowrate, Qp = 0.32 cfs
Rainfall Intensity at User-Defined Tc, I = 3.22 inch/hr — Peak Flowrate, Qp = 0.32 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: **Barbarick Subdivision**
Catchment ID: **D2 - 100yr**

I. Catchment Hydrologic Data

Catchment ID = D2
Area = 1.20 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

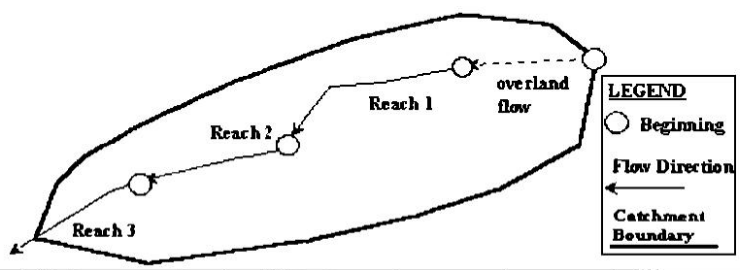
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr =	100 years	(input return period for design storm)
C1 =	28.50	(input the value of C1)
C2=	10.00	(input the value of C2)
C3=	0.786	(input the value of C3)
P1=	2.57 inches	(input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.36
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0200	85	0.08	N/A	0.11	13.49
1						
2						
3						
4						
5						
Sum		85				

Computed Tc = 13.49
Regional Tc = 10.47
User-Entered Tc = 10.47

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I =	6.13 inch/hr	Peak Flowrate, Qp =	2.66 cfs
Rainfall Intensity at Regional Tc, I =	6.83 inch/hr	Peak Flowrate, Qp =	2.97 cfs
Rainfall Intensity at User-Defined Tc, I =	6.83 inch/hr	Peak Flowrate, Qp =	2.97 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: Barbarick Subdivision
Catchment ID: Lot3-Culvert 100yr

I. Catchment Hydrologic Data

Catchment ID = Lot 3
Area = 4.86 Acres
Percent Imperviousness = 57.00 %
NRCS Soil Type = B A, B, C, or D

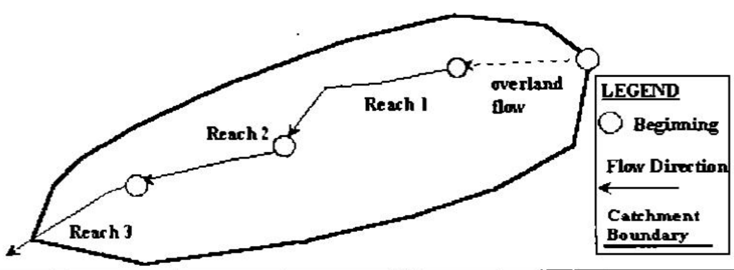
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 100 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 2.57 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.55
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.39
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0300	300	0.39	N/A	0.32	15.41
1	0.0100	500		10.00	1.00	8.33
2						
3						
4						
5						
	Sum	800				

Computed Tc = 23.74
Regional Tc = 14.44
User-Entered Tc = 14.44

IV. Peak Runoff Prediction

Rainfall Intensity at Computed Tc, I = 4.61 inch/hr — Peak Flowrate, Qp = 12.34 cfs
Rainfall Intensity at Regional Tc, I = 5.94 inch/hr — Peak Flowrate, Qp = 15.90 cfs
Rainfall Intensity at User-Defined Tc, I = 5.94 inch/hr — Peak Flowrate, Qp = 15.90 cfs

Matrix
DESIGN GROUP

Final Design for Full Spectrum Detention Basins

Project: Barbarick Subdivision
Basin ID: Lot 3 FSD Pond

See Outlet Structure Figure on Initial Design Worksheet

User Input: Watershed Parameters

Watershed Area =	11.40	acres
Watershed Length =	668	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	57.0%	percent
Percentage Hydrologic Soil Group A =	5%	percent
Percentage Hydrologic Soil Group B =	95%	percent
Percentage Hydrologic Soil Groups C/D =	0%	percent
Location for 1-hr Rainfall Depths =	User Input	

User Input: Detention Basin Parameters

Depth of Initial Surcharge Volume =	0.33	ft
Depth of Trickle Channel =	0.50	ft
Trickle Channel Slope =	0.005	ft/ft
Available EURV Ponding Depth =	3.00	ft (2.99 ft recommended)
Desired WQCV Drain Time =	40	hours

User Input: Outlet Structure Parameters

Overflow Weir Front Edge Height, H_o =	3.3	ft (relative to lowest WQ orifice)
Overflow Weir Front Edge Length =	6.0	ft
Overflow Weir Slope =	0	H:V (enter zero for flat grate)
Horizontal Length of the Overflow Weir Sides =	3.5	ft
Overflow Grate Open Area % =	70%	%, grate open area / total area
Debris Clogging % =	50%	%

Calculated Outlet Discharge Parameters

Height of Grate Upper Edge H_t =	3.3	ft
Over Flow Weir Slope Length =	3.5	ft
Grate Open Area /100-yr Orifice Area =	9.3	should be ≥ 4
Overflow Grate Area w/o Debris =	14.7	ft^2

User Input: Water Quality Orifices (numbered from lowest to highest)

	Row 1	Row 2	Row 3	Row 4	Row 5
Area (sq inch)	1.55	1.55	3.80		
Stage (ft)	0.00	1.00	2.00		

	Row 6	Row 7	Row 8	Row 9	Row 10
Area (sq inch)					
Stage (ft)					

User Input: 100-Year Orifice Parameters

100-yr Restrictor Plate Type =	Circular Orifice	
100-Year Orifice Invert Depth =	1.2	ft (below the lowest WQ orifice)
100-Year Orifice Diameter =	17.0	in

Calculated 100-yr Orifice Parameters

100-Year Orifice Area =	1.6	ft^2
100-Year Orifice Centroid =	0.71	ft
Half-Central Angle of Plate on Pipe =		radians

User Input: Emergency Spillway Parameters

Spillway Invert Stage=	4.7	ft (relative to lowest WQ orifice)
Spillway Crest Length =	23	ft
Spillway End Slopes =	4.0	H:V
Freeboard above Spillway =	1.0	ft

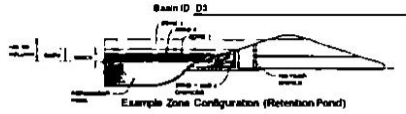
Calculated Spillway Parameters

Spillway Design Flow Depth=	0.8	ft
Stage at Top of Freeboard =	6.5	ft
Basin Area at Top of Freeboard =	0.63	acres

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Volume [ac-ft]
0.00	1,250	0.00
0.50	4,076	0.03
1.50	10,413	0.19
2.50	15,584	0.49
3.00	17,528	0.68
3.50	19,472	0.89
4.50	23,488	1.38
4.70	24,472	1.49
5.50	27,426	1.97
6.50	31,603	2.64

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: Barbarick 1-4
Basin ID: D3



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	SF			
Watershed Area =	3.13	acres		
Watershed Length =	648	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	57.00%	percent		
Percentage Hydrologic Soil Group A =	5.0%	percent		
Percentage Hydrologic Soil Group B =	95.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	12.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.047	acre-feet	Optional User Input 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.194	acre-feet		
2-yr Runoff Volume (P1 = 0.95 in.) =	0.128	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.23 in.) =	0.194	acre-feet	1.23	inches
10-yr Runoff Volume (P1 = 1.48 in.) =	0.253	acre-feet	1.48	inches
25-yr Runoff Volume (P1 = 1.88 in.) =	0.363	acre-feet	1.88	inches
50-yr Runoff Volume (P1 = 2.21 in.) =	0.452	acre-feet	2.21	inches
100-yr Runoff Volume (P1 = 2.57 in.) =	0.554	acre-feet	2.57	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.122	acre-feet		
Approximate 5-yr Detention Volume =	0.179	acre-feet		
Approximate 10-yr Detention Volume =	0.204	acre-feet		
Approximate 25-yr Detention Volume =	0.237	acre-feet		
Approximate 50-yr Detention Volume =	0.273	acre-feet		
Approximate 100-yr Detention Volume =	0.338	acre-feet		

Stage-Storage Calculation

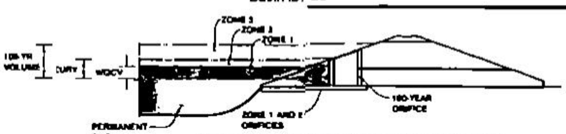
Zone 1 Volume (WQCV) =	0.047	acre-feet
Zone 2 Volume (100-year - Zone 1) =	0.289	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.336	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	2.50	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	1.5	
Initial Surcharge Area (A_{ISV}) =	0	ft^2
Surcharge Volume Length (L_{ISV}) =	0.0	ft
Surcharge Volume Width (W_{ISV}) =	0.0	ft
Depth of Basin Floor (H_{FLOOR}) =	0.00	ft
Length of Basin Floor (L_{FLOOR}) =	81.0	ft
Width of Basin Floor (W_{FLOOR}) =	54.0	ft
Area of Basin Floor (A_{FLOOR}) =	4,370	ft^2
Volume of Basin Floor (V_{FLOOR}) =	0	ft^3
Depth of Main Basin (H_{MAIN}) =	2.50	ft
Length of Main Basin (L_{MAIN}) =	101.0	ft
Width of Main Basin (W_{MAIN}) =	74.0	ft
Area of Main Basin (A_{MAIN}) =	7,469	ft^2
Volume of Main Basin (V_{MAIN}) =	14,626	ft^3
Calculated Total Basin Volume (V_{total}) =	0.336	acre-feet

Depth Increment = 0.1 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)
Media Surface	0.00		81.0	54.0	4,370		0.100		
	0.10		81.8	54.8	4,478		0.103	442	0.010
	0.20		82.5	55.5	4,577		0.105	850	0.020
	0.30		83.3	56.3	4,688		0.108	1,313	0.030
	0.40		84.1	57.1	4,801		0.110	1,788	0.041
Zone 1 (WQCV)	0.45		84.6	57.6	4,869		0.112	2,078	0.048
	0.50		84.9	57.9	4,914		0.113	2,273	0.052
	0.60		85.7	58.7	5,029		0.115	2,770	0.064
	0.70		86.5	59.5	5,145		0.118	3,279	0.075
	0.80		87.3	60.3	5,263		0.121	3,800	0.087
	0.90		88.1	61.1	5,381		0.124	4,332	0.099
	1.00		88.9	61.9	5,501		0.126	4,876	0.112
	1.10		89.7	62.7	5,622		0.129	5,437	0.125
	1.20		90.5	63.5	5,745		0.132	6,000	0.138
	1.30		91.3	64.3	5,869		0.135	6,581	0.151
	1.40		92.1	65.1	5,994		0.138	7,174	0.165
	1.50		92.9	65.9	6,120		0.141	7,780	0.179
	1.60		93.7	66.7	6,248		0.143	8,398	0.193
	1.70		94.5	67.5	6,377		0.146	9,030	0.207
	1.80		95.3	68.3	6,507		0.149	9,674	0.222
	1.90		96.1	69.1	6,639		0.152	10,331	0.237
	2.00		96.9	69.9	6,771		0.155	11,001	0.253
	2.10		97.8	70.8	6,919		0.159	11,754	0.270
	2.20		98.6	71.6	7,054		0.162	12,453	0.286
	2.30		99.4	72.4	7,191		0.165	13,165	0.302
	2.40		100.2	73.2	7,329		0.168	13,891	0.319
Zone 2 (100-year)	2.50		101.0	74.0	7,469		0.171	14,631	0.336
	2.60		101.8	74.8	7,609		0.175	15,385	0.353
	2.70		102.6	75.6	7,751		0.178	16,153	0.371
	2.80		103.4	76.4	7,894		0.181	16,935	0.389
	2.90		104.2	77.2	8,039		0.185	17,732	0.407
	3.00		105.0	78.0	8,184		0.188	18,543	0.426
	3.10		105.8	78.8	8,331		0.191	19,369	0.445
	3.20		106.6	79.6	8,480		0.195	20,209	0.464
	3.30		107.4	80.4	8,629		0.198	21,065	0.484
	3.40		108.2	81.2	8,780		0.202	21,935	0.504
	3.50		109.0	82.0	8,932		0.205	22,821	0.524
	3.60		109.8	82.6	9,085		0.209	23,722	0.545
	3.70		110.6	83.6	9,240		0.212	24,638	0.566
	3.80		111.4	84.4	9,396		0.216	25,570	0.587
	3.90		112.2	85.2	9,553		0.219	26,517	0.609
	4.00		113.0	86.0	9,712		0.223	27,480	0.631
	4.10		113.8	86.8	9,872		0.227	28,460	0.653
	4.20		114.6	87.6	10,033		0.230	29,455	0.676
	4.30		115.4	88.4	10,195		0.234	30,466	0.699
	4.40		116.2	89.2	10,359		0.238	31,494	0.723
	4.50		117.0	90.0	10,523		0.242	32,538	0.747
	4.60		117.8	90.8	10,690		0.245	33,599	0.771
	4.70		118.6	91.6	10,857		0.249	34,676	0.796
	4.80		119.4	92.4	11,026		0.253	35,770	0.821
	4.90		120.2	93.2	11,196		0.257	36,881	0.847
	5.00		121.0	94.0	11,367		0.261	38,009	0.873
	5.10		121.8	94.8	11,540		0.265	39,155	0.899
	5.20		122.6	95.6	11,714		0.269	40,317	0.926
	5.30		123.4	96.4	11,889		0.273	41,497	0.953
	5.40		124.2	97.2	12,066		0.277	42,695	0.980
	5.50		125.0	98.0	12,243		0.281	43,911	1.008
	5.60		125.8	98.8	12,422		0.285	45,144	1.036
	5.70		126.6	99.6	12,602		0.289	46,395	1.065
	5.80		127.4	100.4	12,784		0.293	47,664	1.094
	5.90		128.2	101.2	12,967		0.298	48,952	1.124
	6.00		129.0	102.0	13,151		0.302	50,258	1.154
	6.10		129.8	102.8	13,336		0.306	51,582	1.184
	6.20		130.6	103.6	13,523		0.310	52,925	1.215
	6.30		131.4	104.4	13,711		0.315	54,287	1.246
	6.40		132.2	105.2	13,900		0.319	55,667	1.278
	6.50		133.0	106.0	14,090		0.323	57,067	1.310
	6.60		133.8	106.8	14,282		0.328	58,485	1.343
	6.70		134.6	107.6	14,475		0.332	59,923	1.376
	6.80		135.4	108.4	14,670		0.337	61,380	1.409
	6.90		136.2	109.2	14,866		0.341	62,857	1.443
	7.00		137.0	110.0	15,062		0.346	64,353	1.477
	7.10		137.8	110.8	15,260		0.350	65,870	1.512
	7.20		138.6	111.6	15,460		0.355	67,406	1.547
	7.30		139.4	112.4	15,661		0.360	68,962	1.583
	7.40		140.2	113.2	15,863		0.364	70,538	1.619
	7.50		141.0	114.0	16,066		0.369	72,134	1.656
	7.60		141.8	114.8	16,271		0.374	73,751	1.693
	7.70		142.6	115.6	16,476		0.378	75,388	1.731
	7.80		143.4	116.4	16,684		0.383	77,046	1.769
	7.90		144.2	117.2	16,892		0.388	78,725	1.807
	8.00		145.0	118.0	17,102		0.393	80,425	1.846
	8.10		145.8	118.8	17,313		0.397	82,145	1.886
	8.20		146.6	119.6	17,525		0.402	83,887	1.926
	8.30		147.4	120.4	17,738		0.407	85,650	1.966
	8.40		148.2	121.2	17,953		0.412	87,435	2.007
	8.50		149.0	122.0	18,169		0.417	89,241	2.049
	8.60		149.8	122.8	18,387		0.422	91,069	2.091
	8.70		150.6	123.6	18,605		0.427	92,919	2.133
	8.80		151.4	124.4	18,825		0.432	94,790	2.176
	8.90		152.2	125.2	19,047		0.437	96,684	2.220
	9.00		153.0	126.0	19,269		0.442	98,599	2.264
	9.10		153.8	126.8	19,493		0.447	100,538	2.308
	9.20		154.6	127.6	19,718		0.453	102,498	2.353
	9.30		155.4	128.4	19,944		0.458	104,481	2.399
	9.40		156.2	129.2	20,172		0.463	106,487	2.445
	9.50		157.0	130.0	20,401		0.468	108,516	2.491
	9.60		157.8	130.8	20,631		0.474	110,567	2.538
	9.70		158.6	131.6	20,863		0.479	112,642	2.586

Detention Basin Outlet Structure Design

Project: Barbarick Subdivision
Basin ID: D3



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.45	0.047	Filtration Media
Zone 2 (100-year)	2.50	0.289	Not Utilized
Zone 3			
		0.336	Total

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

Underdrain Orifice Invert Depth =	1.00	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	1.27	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft²
Underdrain Orifice Centroid =	0.05	feet

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

Invert of Lowest Orifice =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft²

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft²
Vertical Orifice Centroid =			feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =			feet
Overflow Grate Open Area % =			%, grate open area/total area
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Over Flow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			should be ≥ 4
Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Open Area w/ Debris =			ft²

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =			ft²
Outlet Orifice Centroid =			feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.66	feet
Stage at Top of Freeboard =	4.16	feet
Basin Area at Top of Freeboard =	0.23	acres

Routed Hydrograph Results

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) =	0.53	1.07	0.95	1.23	1.48	1.88	2.21	2.57	0.00
Calculated Runoff Volume (acre-ft) =	0.047	0.194	0.128	0.194	0.253	0.363	0.452	0.554	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.047	0.194	0.127	0.194	0.253	0.363	0.451	0.553	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.17	0.34	0.80	1.04	1.33	1.89
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.5	1.1	2.5	3.2	4.2	5.9
Peak Inflow Q (cfs) =	1.0	4.1	2.7	4.1	5.3	7.6	9.4	11.6	#N/A
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	0.2	1.7	3.6	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.1	0.5	0.9	#N/A
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Spillway	Spillway	Spillway	#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) =	12	41	29	41	51	66	65	65	#N/A
Time to Drain 99% of Inflow Volume (hours) =	13	42	30	42	52	68	68	68	#N/A
Maximum Ponding Depth (ft) =	0.37	1.52	1.04	1.52	1.91	2.55	2.71	2.83	#N/A
Area at Maximum Ponding Depth (acres) =	0.11	0.14	0.13	0.14	0.15	0.17	0.18	0.18	#N/A
Maximum Volume Stored (acre-ft) =	0.039	0.181	0.117	0.181	0.240	0.343	0.371	0.394	#N/A

APPENDIX B

STORMCAD INFORMATION

Culvert Calculator Report
Twin 24" Culvert

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	2.00 ft	Headwater Depth/Height	1.32
Computed Headwater Eleva	7,038.15 ft	Discharge	35.50 cfs
Inlet Control HW Elev.	7,038.10 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,038.15 ft	Control Type	Entrance Control

Grades

Upstream Invert	7,035.51 ft	Downstream Invert	7,020.00 ft
Length	606.00 ft	Constructed Slope	0.025594 ft/ft

Hydraulic Profile

Profile	S2	Depth, Downstream	0.94 ft
Slope Type	Steep	Normal Depth	0.94 ft
Flow Regime	Supercritical	Critical Depth	1.52 ft
Velocity Downstream	12.17 ft/s	Critical Slope	0.006140 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.012
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	2		

Outlet Control Properties

Outlet Control HW Elev.	7,038.15 ft	Upstream Velocity Head	0.75 ft
Ke	0.50	Entrance Loss	0.37 ft

Inlet Control Properties

Inlet Control HW Elev.	7,038.10 ft	Flow Control	Transition
Inlet Type	Square edge w/headwall	Area Full	6.3 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Calculator Report
Outlet Pipe

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	7,023.10	ft	Headwater Depth/Height	2.07	
Computed Headwater Elevɛ	7,023.10	ft	Discharge	55.60	cfs
Inlet Control HW Elev.	7,023.10	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	7,022.97	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	7,017.92	ft	Downstream Invert	7,017.52	ft
Length	40.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	2.36	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.36	ft
Velocity Downstream	11.58	ft/s	Critical Slope	0.013538	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Concrete		Span	2.50	ft
Section Size	30 inch		Rise	2.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	7,022.97	ft	Upstream Velocity Head	1.99	ft
Ke	0.20		Entrance Loss	0.40	ft

Inlet Control Properties					
Inlet Control HW Elev.	7,023.10	ft	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	4.9	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

O2-Overflow Channel

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02000	ft/ft
Normal Depth	2.00	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	4.00	ft

Results

Discharge	94.99	ft³/s
Flow Area	20.00	ft²
Wetted Perimeter	16.65	ft
Hydraulic Radius	1.20	ft
Top Width	16.00	ft
Critical Depth	1.73	ft
Critical Slope	0.03707	ft/ft
Velocity	4.75	ft/s
Velocity Head	0.35	ft
Specific Energy	2.35	ft
Froude Number	0.75	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.73	ft
Channel Slope	0.02000	ft/ft

02-Overflow Channel

GVF Output Data

Critical Slope	0.03707	ft/ft

Worksheet for Open Channel Culvert Lot 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.03000	ft/ft
Diameter	1.50	ft
Discharge	15.90	ft^3/s

Results

Normal Depth	1.02	ft
Flow Area	1.28	ft^2
Wetted Perimeter	2.91	ft
Hydraulic Radius	0.44	ft
Top Width	1.40	ft
Critical Depth	1.42	ft
Percent Full	68.1	%
Critical Slope	0.01690	ft/ft
Velocity	12.41	ft/s
Velocity Head	2.39	ft
Specific Energy	3.41	ft
Froude Number	2.29	
Maximum Discharge	21.20	ft^3/s
Discharge Full	19.71	ft^3/s
Slope Full	0.01952	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	68.08	%
Downstream Velocity	Infinity	ft/s

Worksheet for Open Channel Culvert Lot 3

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.02	ft
Critical Depth	1.42	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.01690	ft/ft

Worksheet for Outlet with Passthrough-Weir

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	1.40	ft
Crest Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	3.00	US
Crest Length	32.00	ft
Number Of Contractions	0	

Results

Discharge	159.02	ft³/s
Headwater Height Above Crest	1.40	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	44.80	ft²
Velocity	3.55	ft/s
Wetted Perimeter	34.80	ft
Top Width	32.00	ft

Weir is more restrictive than Orifice
159.02 cfs
70% Gate Opening
50% Clogging

= 55.66 cfs > 45.9 tributary
→ Install orifice Restrictor on outlet pipe.

Worksheet for Outlet wPass - Orifice

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	1.40	ft
Centroid Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Discharge Coefficient	0.60	
Opening Width	4.00	ft
Opening Height	12.00	ft

Results

Discharge	273.35	ft^3/s
Headwater Height Above Centroid	1.40	ft
Tailwater Height Above Centroid	0.00	ft
Flow Area	48.00	ft^2
Velocity	5.69	ft/s

Top Box Weir is more Restrictive
USE Weir Calculations.

Worksheet for FSD Outlet Orifice Plate

Project Description

Solve For	Diameter

Input Data

Discharge	45.90	ft^3/s (16.5 Hrs + 29.4 Rcc)
Headwater Elevation	4.70	ft
Centroid Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Discharge Coefficient	0.60	

Results

Diameter	2.37	ft
Headwater Height Above Centroid	4.70	ft
Tailwater Height Above Centroid	0.00	ft
Flow Area	4.40	ft^2
Velocity	10.43	ft/s

Worksheet for FSD Overflow - Pass

Project Description

Solve For	Discharge		

Input Data

Headwater Elevation		0.90	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Gravel		
Crest Breadth		12.00	ft
Crest Length		36.00	ft

Results

Discharge	86.22	ft³/s	(55 bl + 29.4 pass = 84.4 cfs)
Headwater Height Above Crest	0.90	ft	
Tailwater Height Above Crest	0.00	ft	
Weir Coefficient	2.80	US	
Submergence Factor	1.00		
Adjusted Weir Coefficient	2.80	US	
Flow Area	32.40	ft²	
Velocity	2.66	ft/s	
Wetted Perimeter	37.80	ft	
Top Width	36.00	ft	

Worksheet for SFB Overflow Developed

Project Description

Solve For	Discharge

Input Data

Headwater Elevation		0.45	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Gravel		
Crest Breadth		6.00	ft
Crest Length		10.00	ft

Results

Discharge	8.08	ft³/s
Headwater Height Above Crest	0.45	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	2.68	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	2.68	US
Flow Area	4.50	ft²
Velocity	1.80	ft/s
Wetted Perimeter	10.90	ft
Top Width	10.00	ft

Worksheet for Type D Inlet - Weir

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	1.50	ft
Crest Elevation	0.00	ft
Weir Coefficient	3.00	US
Crest Length	17.17	ft

Results

Discharge	94.61	ft^3/s
Headwater Height Above Crest	1.50	ft
Flow Area	25.75	ft^2
Velocity	3.67	ft/s
Wetted Perimeter	20.17	ft
Top Width	17.17	ft

Type D Weir is most restictive
94.61 cfs
70% Grate Opening
50% Clogging

= 33.11 cfs > 29.4 cfs tributary

Worksheet for Type D Inlet - Orifice

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	1.50	ft
Centroid Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Discharge Coefficient	0.60	
Opening Width	2.92	ft
Opening Height	5.67	ft

Results

Discharge	97.50	ft³/s
Headwater Height Above Centroid	1.50	ft
Tailwater Height Above Centroid	0.00	ft
Flow Area	16.54	ft²
Velocity	5.89	ft/s

Type D Weir is more restrictive
→ Use Weir Calculations

Worksheet for Western Channel Capacity

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	17.30	ft³/s
Flow Area	4.00	ft²
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	1.03	ft
Critical Slope	0.01703	ft/ft
Velocity	4.32	ft/s
Velocity Head	0.29	ft
Specific Energy	1.29	ft
Froude Number	1.08	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.03	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01703	ft/ft

Label	Start Node	Stop Node	Branch ID	Branch Element ID	Length (Unified) (ft)	Upstream Inlet C	Upstream Intensity (in/h)	Upstream Inlet Area (acres)	System Intensity (in/h)
CO-1	CB-1	MH-1	1	1	255.4	(N/A)	8	(N/A)	8
CO-2	MH-1	MH-2	1	2	295.1	(N/A)	8	(N/A)	8
CO-3	MH-2	MH-3	1	3	295.1	(N/A)	8	(N/A)	8
CO-4	MH-3	MH-4	1	4	44.9	(N/A)	8	(N/A)	8
CO-5	MH-4	OF-1	1	5	198.3	(N/A)	8	(N/A)	8

	System Rational Flow (ft^3/s)	Total Flow (ft^3/s)	Rise (Unified) (in)	Capacity (Full Flow) (ft^3/s)	Velocity (Average) (ft/s)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)
CO-1	0	29.4	30	44.49	9.68	7032.21	7029.65	0.01
CO-2	0	29.4	30	44.43	9.67	7029.35	7026.4	0.01
CO-3	0	29.4	30	38.97	8.72	7026.2	7023.93	0.008
CO-4	0	29.4	30	57.43	11.77	7023.63	7022.88	0.017
CO-5	0	29.4	30	44.4	9.67	7022.88	7020.9	0.01

APPENDIX C

STANDARD DESIGN CHARTS AND TABLES

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, US*
Latitude: 38.9514°, Longitude: -104.6905°
Elevation: 6984 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

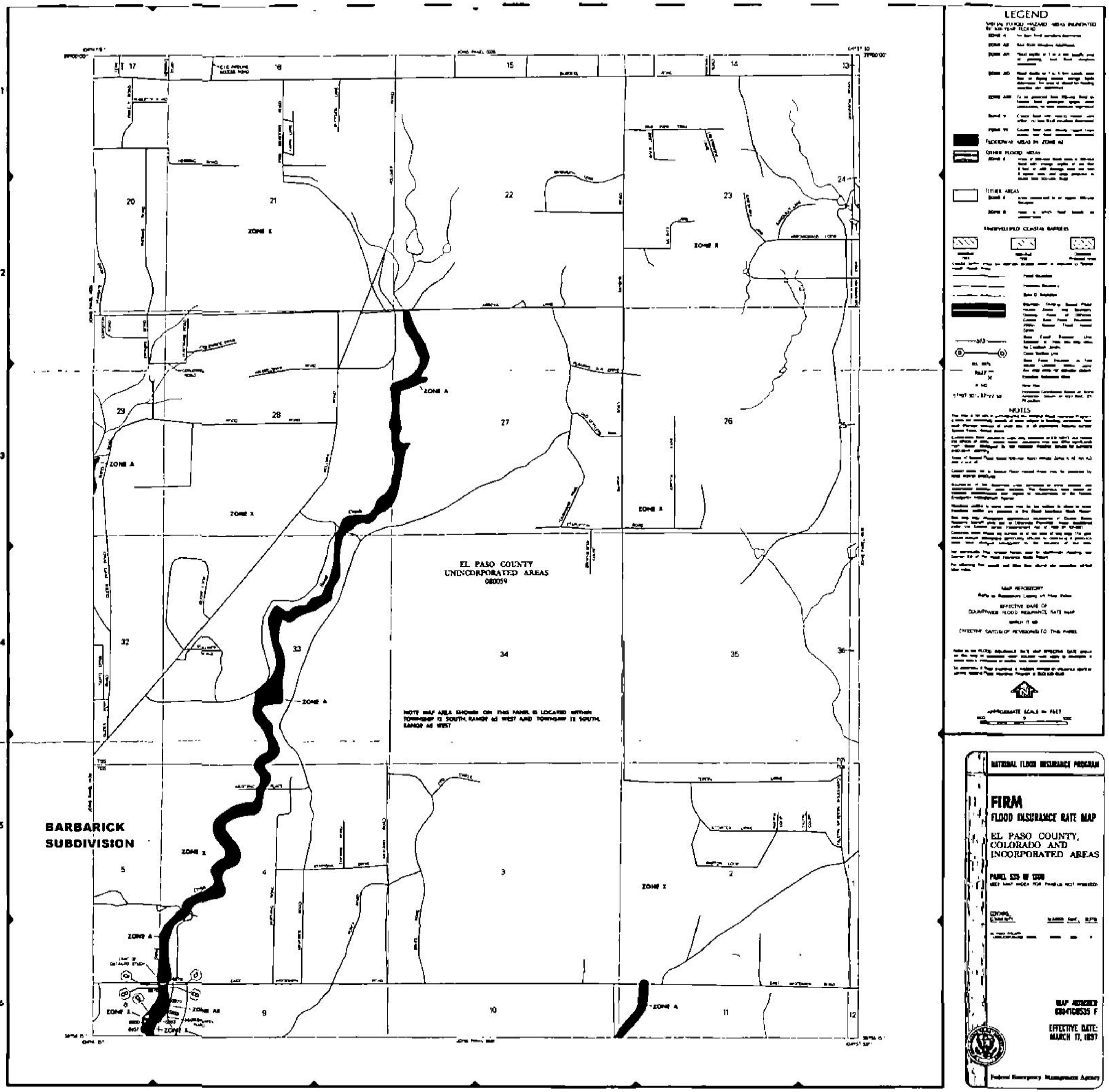
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.237 (0.195-0.290)	0.289 (0.238-0.355)	0.380 (0.311-0.467)	0.460 (0.374-0.568)	0.577 (0.456-0.746)	0.674 (0.517-0.880)	0.775 (0.573-1.04)	0.883 (0.625-1.21)	1.03 (0.701-1.46)	1.15 (0.759-1.65)
10-min	0.347 (0.285-0.425)	0.424 (0.348-0.520)	0.556 (0.455-0.684)	0.673 (0.548-0.832)	0.846 (0.667-1.09)	0.987 (0.757-1.29)	1.14 (0.839-1.52)	1.29 (0.914-1.78)	1.51 (1.03-2.14)	1.69 (1.11-2.41)
15-min	0.423 (0.348-0.519)	0.516 (0.424-0.634)	0.678 (0.555-0.834)	0.821 (0.668-1.01)	1.03 (0.814-1.33)	1.20 (0.924-1.57)	1.38 (1.02-1.85)	1.58 (1.11-2.17)	1.84 (1.25-2.61)	2.06 (1.35-2.94)
30-min	0.613 (0.504-0.751)	0.747 (0.614-0.917)	0.980 (0.802-1.21)	1.19 (0.965-1.47)	1.49 (1.17-1.92)	1.74 (1.33-2.27)	2.00 (1.48-2.67)	2.27 (1.61-3.13)	2.66 (1.80-3.76)	2.97 (1.95-4.24)
60-min	0.795 (0.654-0.974)	0.948 (0.779-1.16)	1.23 (1.00-1.51)	1.48 (1.21-1.83)	1.88 (1.49-2.44)	2.21 (1.70-2.90)	2.57 (1.91-3.46)	2.96 (2.10-4.09)	3.52 (2.39-4.99)	3.97 (2.61-5.67)
2-hr	0.977 (0.809-1.19)	1.15 (0.951-1.40)	1.47 (1.22-1.80)	1.78 (1.46-2.19)	2.27 (1.82-2.94)	2.68 (2.09-3.51)	3.14 (2.35-4.21)	3.65 (2.61-5.02)	4.38 (3.00-6.18)	4.98 (3.30-7.06)
3-hr	1.08 (0.897-1.31)	1.25 (1.04-1.51)	1.58 (1.31-1.93)	1.92 (1.57-2.34)	2.45 (1.98-3.19)	2.92 (2.29-3.83)	3.45 (2.60-4.62)	4.04 (2.91-5.55)	4.90 (3.39-6.92)	5.62 (3.75-7.95)
6-hr	1.26 (1.05-1.51)	1.44 (1.20-1.73)	1.81 (1.51-2.18)	2.19 (1.81-2.65)	2.81 (2.30-3.64)	3.37 (2.66-4.39)	4.00 (3.04-5.34)	4.71 (3.43-6.45)	5.77 (4.02-8.09)	6.65 (4.46-9.33)
12-hr	1.45 (1.23-1.74)	1.68 (1.41-2.00)	2.12 (1.78-2.54)	2.55 (2.13-3.07)	3.26 (2.68-4.19)	3.89 (3.10-5.03)	4.59 (3.52-6.08)	5.38 (3.94-7.31)	6.54 (4.59-9.11)	7.51 (5.08-10.5)
24-hr	1.68 (1.43-1.99)	1.97 (1.67-2.33)	2.50 (2.12-2.98)	3.01 (2.53-3.60)	3.80 (3.13-4.80)	4.48 (3.58-5.72)	5.23 (4.02-6.83)	6.04 (4.45-8.11)	7.23 (5.09-9.96)	8.20 (5.58-11.4)
2-day	1.95 (1.67-2.29)	2.31 (1.97-2.72)	2.95 (2.51-3.48)	3.53 (2.99-4.18)	4.39 (3.62-5.46)	5.11 (4.10-6.44)	5.88 (4.55-7.59)	6.71 (4.96-8.91)	7.89 (5.59-10.8)	8.83 (6.07-12.2)
3-day	2.15 (1.85-2.51)	2.54 (2.18-2.97)	3.22 (2.75-3.78)	3.83 (3.26-4.52)	4.74 (3.92-5.87)	5.50 (4.42-6.88)	6.30 (4.89-8.09)	7.16 (5.31-9.45)	8.37 (5.96-11.4)	9.34 (6.45-12.8)
4-day	2.31 (2.00-2.70)	2.72 (2.34-3.17)	3.42 (2.94-4.01)	4.06 (3.46-4.78)	5.00 (4.15-6.16)	5.78 (4.67-7.21)	6.61 (5.14-8.46)	7.50 (5.58-9.87)	8.75 (6.25-11.8)	9.76 (6.75-13.3)
7-day	2.74 (2.38-3.18)	3.17 (2.75-3.68)	3.92 (3.39-4.57)	4.60 (3.95-5.38)	5.60 (4.67-6.86)	6.43 (5.23-7.97)	7.32 (5.73-9.30)	8.27 (6.19-10.8)	9.60 (6.90-12.9)	10.7 (7.44-14.5)
10-day	3.11 (2.71-3.60)	3.58 (3.11-4.14)	4.39 (3.80-5.09)	5.11 (4.40-5.95)	6.17 (5.17-7.51)	7.05 (5.75-8.69)	7.98 (6.27-10.1)	8.97 (6.75-11.7)	10.4 (7.47-13.9)	11.5 (8.03-15.5)
20-day	4.18 (3.67-4.79)	4.79 (4.20-5.50)	5.83 (5.09-6.71)	6.72 (5.84-7.77)	7.99 (6.71-9.59)	9.01 (7.38-11.0)	10.0 (7.94-12.6)	11.1 (8.42-14.3)	12.6 (9.17-16.7)	13.8 (9.73-18.6)
30-day	5.05 (4.46-5.77)	5.80 (5.11-6.63)	7.04 (6.18-8.07)	8.08 (7.05-9.30)	9.51 (8.01-11.3)	10.6 (8.73-12.8)	11.8 (9.32-14.6)	12.9 (9.79-16.5)	14.4 (10.5-19.0)	15.6 (11.1-20.9)
45-day	6.14 (5.44-6.98)	7.06 (6.25-8.03)	8.54 (7.53-9.74)	9.75 (8.55-11.2)	11.4 (9.60-13.4)	12.6 (10.4-15.1)	13.8 (11.0-17.0)	15.0 (11.4-19.1)	16.6 (12.1-21.7)	17.7 (12.6-23.7)
60-day	7.05 (6.27-7.99)	8.12 (7.20-9.20)	9.80 (8.66-11.1)	11.1 (9.80-12.7)	12.9 (10.9-15.2)	14.2 (11.8-17.0)	15.5 (12.4-19.0)	16.7 (12.8-21.1)	18.3 (13.4-23.8)	19.4 (13.9-25.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 535 OF 1300

MAP NUMBER 08041C0535 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
9	Blakeland-Fluvaquentic Haplaquolls	12.5	76.4%
71	Pring coarse sandy loam, 3 to 8 percent slopes	3.9	23.6%
Totals for Area of Interest		**16.4**	**100.0%**

El Paso County Area, Colorado

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose and/or eolian deposits derived from arkose

Typical profile

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

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D

Minor Components

Other soils

Percent of map unit:

Pleasant

Percent of map unit:
Landform: Depressions

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 13, Sep 22, 2015

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
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
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Park (R048AY222CO)

Minor Components

Other soils

Percent of map unit:

Pleasant

Percent of map unit:

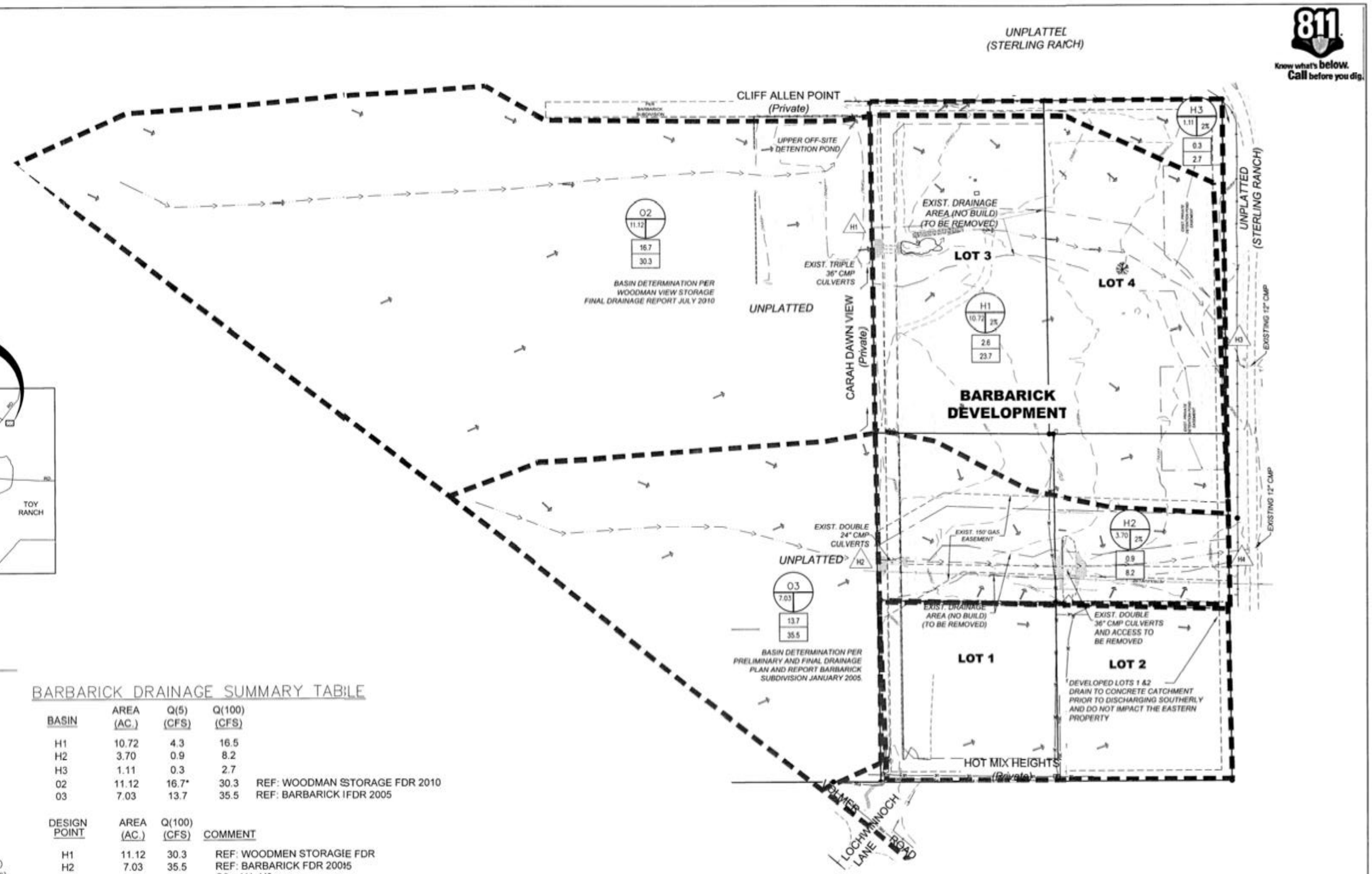
Landform: Depressions

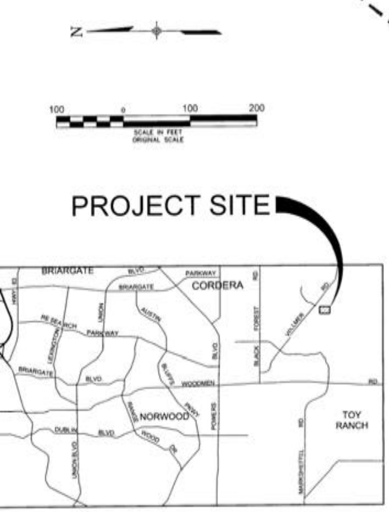
Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 13, Sep 22, 2015

APPENDIX D

MAPS

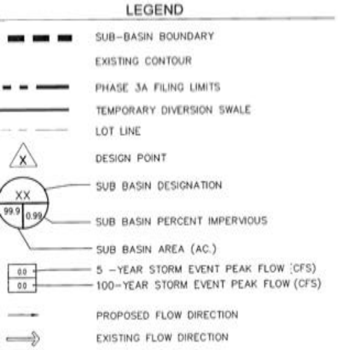




VICINITY MAP

N.T.S.

LEGEND



BARBARICK DRAINAGE SUMMARY TABLE

BASIN	AREA (AC.)	Q(5) (CFS)	Q(100) (CFS)	
H1	10.72	4.3	16.5	
H2	3.70	0.9	8.2	
H3	1.11	0.3	2.7	
02	11.12	16.7*	30.3	REF: WOODMAN STORAGE FDR 2010
03	7.03	13.7	35.5	REF: BARBARICK FDR 2005

DESIGN POINT	AREA (AC.)	Q(100) (CFS)	COMMENT
H1	11.12	30.3	REF: WOODMEN STORAGE FDR
H2	7.03	35.5	REF: BARBARICK FDR 2005
H3	22.95	56.7	O2 + H1+H3
H4	10.73	43.7	O3 + H2

NO.	DATE	DESCRIPTION	BY

REVISIONS

BENCHMARK DATA(ELEV.) ____
(DATUM) ____
(DESCRIPTION/LOCATION) ____

NAME: S:\15.789.001 Tri Lakes\Dwg\CD\Drainage\20160605-DP01.dwg
PCP: Matrix.ctb
PLOT DATE: Tue Jun 07, 2016 12:49pm

VERTICAL BENCHMARK:

THE VERTICAL INFORMATION ON THIS MAP IS BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 AND THE 1960 SUPPLEMENTARY ADJUSTMENT BEING A FOUND 3.25" ALUMINUM CAP IN A ROAD BOX DESIGNATED AS FACILITIES INFORMATION MANAGEMENT SYSTEM (FIMS) MONUMENT "F_I69" AND HAVING PUBLISHED ELEVATION OF 6975.62 FEET WAS USED TO REFERENCE THIS VERTICAL DATUM. THE BENCHMARK IS LOCATED ON THE WEST SIDE OF BLACK FOREST ROAD, ABOUT 1.95 MILES SOUTH OF OLD RANCH ROAD, JUST SOUTH OF THE SCHMIDT CONSTRUCTION COMPANY DRIVEWAY. A CORNER FENCE POST IS 28.1 FEET TO THE SOUTHWEST, AND THE MOST SOUTHERLY GUARD RAIL POST IS 25.7 FEET TO THE NORTH.

BASIS OF BEARING:

THE BASIS OF BEARINGS FOR THIS MAP IS THE NORTH LINE OF BARBARICK SUBDIVISION ACCORDING TO THE OFFICIAL MAP THEREOF RECORDED FEBRUARY 12, 2008 IN THE OFFICE OF THE EL PASO COUNTY CLERK AND RECORDER UNDER RECEPTION NUMBER 208712754,SAID LINE MONUMENTED ON THE WEST END BY A FOUND 5/8" REBAR AND ON THE EAST BY A FOUND 4/8" REBAR WITH 1" ALUMINUM CAP STAMPED "LS 2154" BEING A POINT ON THE NORTH LINE BEARING NORTH 89°12'41 EAST 12287.35 FEET FROM THE WEST END THEREOF

PREPARED UNDER MY DIRECT SUPERVISION, FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

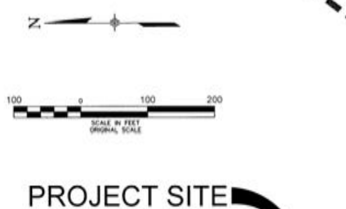
Matrix DESIGN GROUP
2435 Research Parkway, Suite 300 Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

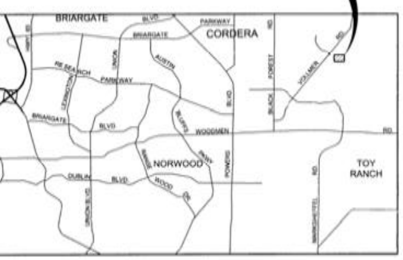
BARBARICK SUBDIVISION LOTS 1-4

EXISTING CONDITIONS DRAINAGE PLAN

DESIGNED BY	BJH	SCALE		DATE ISSUED	April 2016
DRAWN BY	BJH	HORIZ.	1"=50'	SHEET NO. 1 OF 2 SHEETS	
CHECKED BY	ES	VERT.	N/A		

DP01





VICINITY MAP

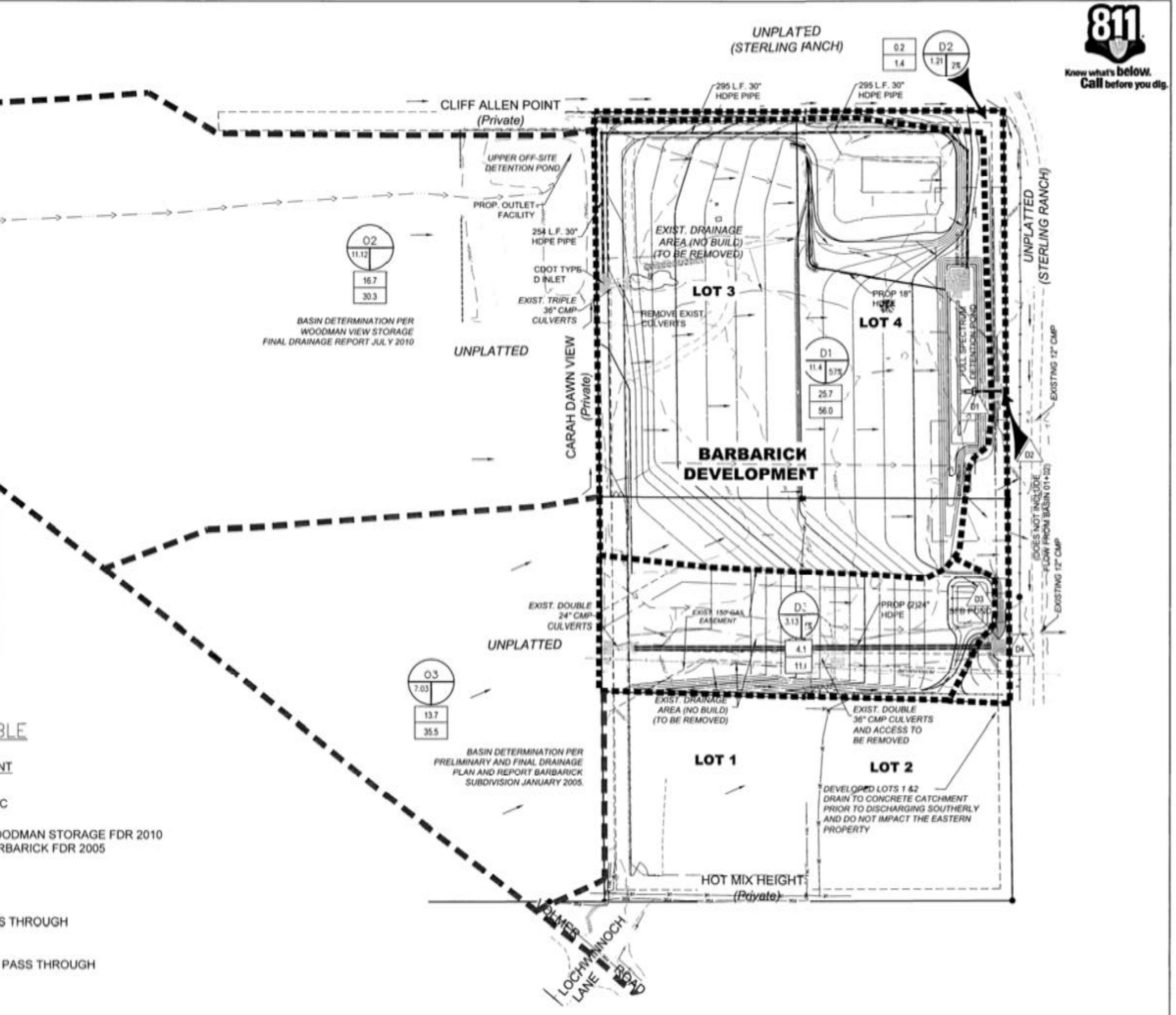
N.T.S.

SAND FILTER POND

V_{WQ} = 0.039 AC-FT
WQ WSE = 23.37
EURV WC = 0.181
EURV ELEV = 24.52
100-YR WSE = 0.394 AC-FT
100-YR ELEV = 25.83
Q_5 RELEASE = 0.1 CFS
Q_{100} RELEASE = 3.6 CFS

FSD POND

V_{WQ} = 0.203 AC-FT
WQ WSE = 20.03
V_5 = 0.673 AC-FT
5-YR WSE = 21.50
V_{100} = 1.261 AC-FT
100-YR WSE = 22.76
Q_{100} RELEASE = 45.9 CFS
EURV = 0.677 AC-FT
EURV ELEV = 21.50



BARBARICK DRAINAGE SUMMARY TABLE

BASIN	AREA (AC.)	Q(5 (CFS)	Q(100) (CFS)	% IMP.	COMMENT
D1	11.40	25.7	56.0	57%	
D2	1.21	0.8	3.0	2%	HISTORIC
D3	3.13	4.1	11.6	57%	
02	11.12	16.7	30.3		REF: WOODMAN STORAGE FDR 2010
03	7.03	13.7	35.5		REF: BARBARICK FDR 2005

DESIGN POINT	AREA (AC.)	Q(100) (CFS)	COMMENT
D1	11.40	85.4	D1 BASIN TO FSD +02 PASS THROUGH
D2	22.52	48.9	POND RELEASE + D2
D3	3.13	11.6	D3 BASIN TO SFB
D4	10.16	39.1	POND RELEASE + O3 PIPE PASS THROUGH

LEGEND

SUB-BASIN BOUNDARY
EXISTING CONTOUR
PHASE 3A FILING LIMITS
TEMPORARY DIVERSION SWALE
LOT LINE
DESIGN POINT
SUB BASIN DESIGNATION
SUB BASIN PERCENT IMPERVIOUS
SUB BASIN AREA (AC.)
5 -YEAR STORM EVENT PEAK FLOW (CFS)
100-YEAR STORM EVENT PEAK FLOW (CFS)
PROPOSED FLOW DIRECTION
EXISTING FLOW DIRECTION

NO.	DATE	DESCRIPTION	BY

REVISIONS

NAME: S:\15.789.001 Tri Lakes\Dwg\CD\Drainage\20160605-DP01.dwg
PCP: Matrix.ctb
PLOT DATE: Tue Jun 07, 2016 12:49pm

BENCHMARK DATA(ELEV.) ______
(DATUM) ______
(DESCRIPTION/LOCATION) ______

VERTICAL BENCHMARK:

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PREPARED UNDER MY DIRECT SUPERVISION, FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite 300 Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

BARBARICK SUBDIVISION LOTS 1-4

PROPOSED DRAINAGE PLAN

DESIGNED BY: BJH | DRAWN BY: BJH | CHECKED BY: ES
SCALE HORIZ: 1"=100' VERT: N/A
DATE ISSUED: April 2016
SHEET NO. 1 OF 2 SHEETS

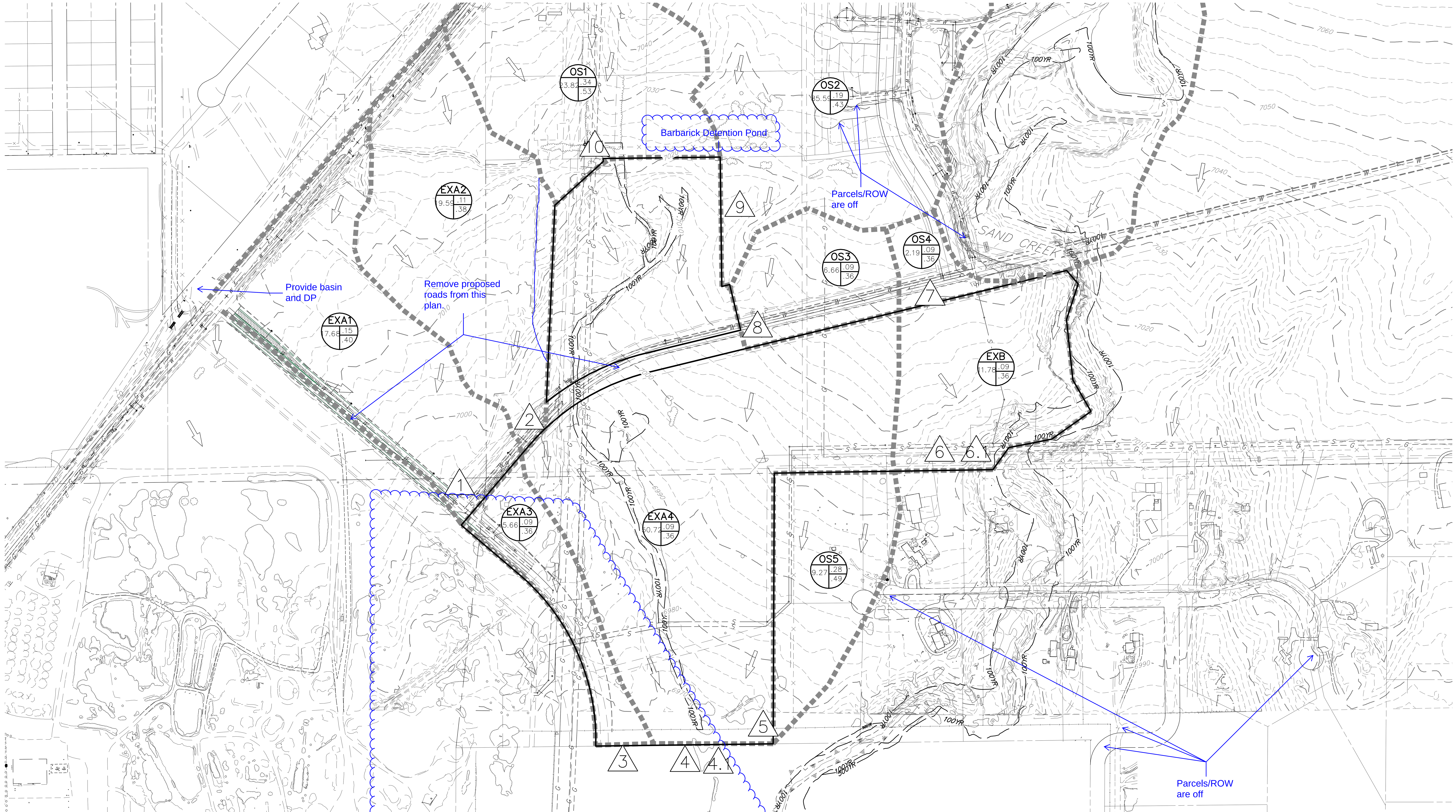
DP02

APPENDIX E

DRAINAGE MAPS & PLANS

STERLING RANCH

EXISTING DRAINAGE MAP



Show basin lines and tributary stream flowlines in this area.

Show where Sand Creek and tributary combine and SCDBPS design points south of those provided.

LEGEND

BASIN ID
A: BASIN LABEL
B: AREA
C: C-100 YR
D: C-5 YR

DESIGN POINT

EXISTING FLOW DIRECTION

BASIN DRAINAGE AREA

EXISTING CONTOURS

SITE BOUNDARY
EXISTING PROPERTY LINE
ROW EXISTING
FL EXISTING
SIDEWALK EXISTING
DRAINAGE ACCESS & MAINTENANCE EASEMENT

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EXA1	17.68	9%	0.15	0.40	25.4	7.2	12.1
EXA2	19.59	5%	0.11	0.38	31.5	5.4	9.0
EXA3	5.66	2%	0.09	0.36	26.4	1.4	2.3
EXA4	50.72	2%	0.09	0.36	33.2	10.6	17.8
EXB	11.78	2%	0.09	0.36	23.8	3.0	5.0
OS1	23.82	45%	0.34	0.53	22.4	23.9	40.1
OS2	85.59	18%	0.19	0.43	34.1	37.3	62.6
OS3	6.66	2%	0.09	0.36	20.3	1.8	3.1
OS4	2.19	2%	0.09	0.36	26.6	0.5	0.9
OS5	9.27	9%	0.28	0.49	22.8	7.5	23.4

DESIGN POINT

DP	Q5 Total	Q100 Total
1	7.2	12.1
2	5.4	9.0
3	1.4	2.3
4	10.6	17.8
5	7.5	23.4
6	3.0	5.0
7	0.5	0.9
8	1.8	3.1
9	37.3	62.6
10	23.9	40.1
4.1	45.6	76.5
6.1	3.0	5.1

200 100 0 200 400
ORIGINAL SCALE: 1" = 200'

STERLING RANCH FILING 2
EXISTING DRAINAGE MAP
JOB NO. 25188.00
5/29/20
SHEET 1 OF 1

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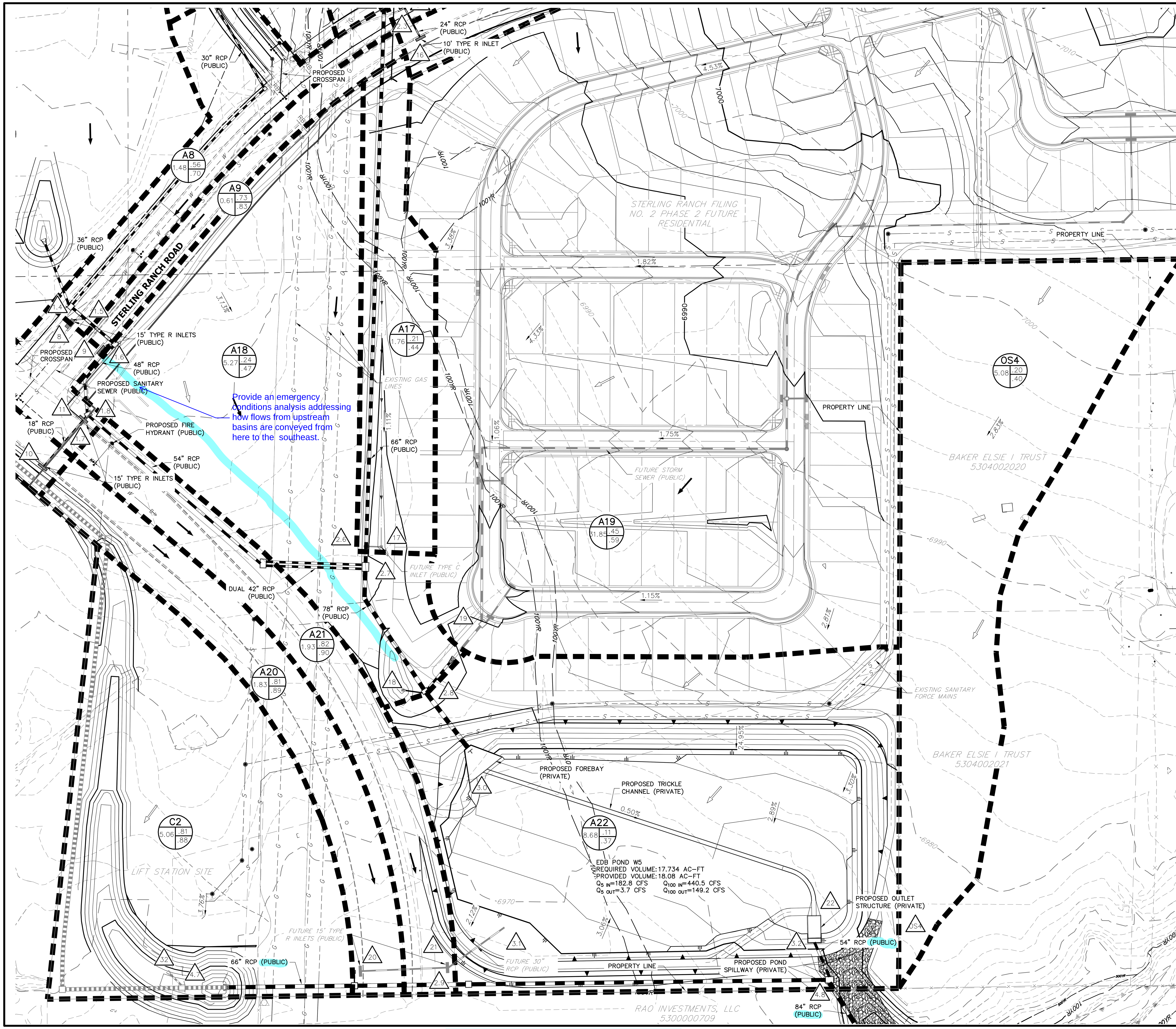
Fort Collins 970-491-9888 • www.jrengineering.com



DESIGN POINT		
DP	Q5 Total	Q100 Total
1	4.4	9.4
2	1.9	3.9
3	11.1	24.7
4	3.7	7.4
5	4.1	19.6
6	3.3	6.7
6A	2.2	4.1
7	27.5	60.6
8	3.0	12.5
9	1.9	4.8
10	9.2	17.3
11	9.5	19.9
12	1.9	9.5
13	15.7	34.6
14	16.0	37.9
15	5.4	11.7
16	4.4	9.6
17	1.4	4.7
18	4.3	14.0
19	38.8	85.4
20	7.1	13.4
21	7.4	15.2
22	2.7	15.4
23	8.8	15.8
24	11.5	20.6
25	33.7	226.1
26	2.8	18.7
27	8.3	14.4
28	8.4	16.7
29	2.1	14.5
30	0.9	6.4
31	2.0	15.0
32	1.4	10.0
1.0	6.0	10.3
1.1	12.6	19.7
1.2	17.6	28.2
1.3	25.9	46.9
1.3A	5.0	8.7
1.4	52.5	105.9
1.5	55.1	103.9
1.6	56.4	107.7
1.7	17.3	25.3
1.8	68.8	125.0
2.0	23.2	74.5
2.1	38.1	106.6
2.2	56.9	138.7
2.3	9.6	17.2
2.4	63.7	151.9
2.5	96.6	250.7
2.6	97.8	250.4
2.7	162.0	336.8
2.8	189.8	424.4
2.9	14.2	22.5
3.0	189.8	424.4
3.1	14.2	22.5
3.2	192.2	438.9
4.0	18.4	26.1
4.1	40.4	235.9
4.2	16.0	31.0
4.3	36.9	262.3
4.4	2.1	2.1
4.5	37.8	37.8
4.6	43.3	242.4
4.7	45.2	245.1
4.8	46.5	315.8
OS2	13.8	39.1
OS3	17.6	48.9
OS4	2.6	8.8

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	2.06	66%	0.51	0.65	9.7	4.4	9.4
A2	0.82	69%	0.53	0.66	9.1	1.9	3.9
A3	6.76	60%	0.47	0.62	15.0	11.1	24.7
A4	1.51	77%	0.60	0.71	10.2	3.7	7.4
A5	1.70	76%	0.59	0.70	9.9	4.1	8.3
A6	1.37	75%	0.58	0.70	10.0	3.3	6.6
A6A	0.53	95%	0.81	0.88	5.0	2.2	4.1
A7	19.00	65%	0.45	0.59	18.3	27.5	60.6
A8	1.48	63%	0.56	0.70	13.9	3.0	6.3
A9	0.61	79%	0.73	0.83	8.7	1.9	3.7
A10	2.61	86%	0.79	0.88	7.9	9.2	17.3
A11	2.89	83%	0.76	0.86	8.7	9.5	18.1
A12	3.87	8%	0.13	0.38	11.9	1.9	9.5
A13	9.65	65%	0.45	0.59	14.0	15.7	34.6
A14	11.76	0%	0.39	0.55	15.3	16.0	37.9
A15	2.91	54%	0.52	0.68	14.9	5.4	11.7
A16	2.34	56%	0.54	0.69	14.7	4.4	9.6
A17	1.76	24%	0.21	0.44	13.7	1.4	4.7
A18	5.27	21%	0.24	0.47	16.4	4.3	14.0
A19	31.85	65%	0.45	0.59	25.8	38.8	85.4
A20	1.83	89%	0.81	0.89	8.0	6.6	12.2
A21	1.93	90%	0.82	0.90	8.7	6.8	12.6
A22	8.68	5%	0.11	0.37	23.3	2.7	15.4
B1	2.98	100%	0.90	0.96	17.6	8.8	15.8
B2	3.89	100%	0.90	0.96	17.6	11.5	20.6
B3	2.05	100%	0.90	0.96	9.4	7.8	14.0
B4	1.94	100%	0.90	0.96	9.4	7.4	13.2
B5	2.91	0%	0.08	0.35	13.1	0.9	6.4
C1	8.01	95%	0.81	0.88	9.9	2.0	15.0
C2	5.06	95%	0.81	0.88	7.9	1.4	10.0
OS20	308.00	0%	0.09	0.36	69.7	33.7	226.1
OS21A	20.26	0%	0.09	0.36	56.6	2.8	18.7
OS21B	8.71	0%	0.09	0.36	25.1	2.1	14.5
OS2	17.00	70%	0.49	0.62	36.0	13.8	39.1
OS3	28.70	70%	0.49	0.62	52.6	17.6	48.9
OS4	5.08	20%	0.20	0.40	28.3	2.6	8.8

Barbarick pond outfalls?

LEGEND:

- PROPOSED STORM SEWER
- 5000 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 5000 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- DRAINAGE BASIN
- A = BASIN DESIGNATION; B = AREA IN ACRES; C = 5-YR RUNOFF COEFFICIENT; D = 100-YR RUNOFF COEFFICIENT
- DESIGN POINT
- HP HIGH POINT
- LP LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW
- PROPOSED DRAINAGE SWALE

DRAINAGE MAP
STERLING RANCH FILING 2
JOB NO. 25188.01
5/15/20
SHEET 1 OF 6

70 35 0 70 140
ORIGINAL SCALE: 1" = 70'

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Clearly show maintenance access roads. If from Marksheffel Road instead of the north, obtain City approval

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LEGEND:

- PROPOSED STORM SEWER
- 5000 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 5000 EXISTING MAJOR CONTOUR
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- DRAINAGE BASIN
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70 35 0 70 140

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DRAINAGE MAP
STERLING RANCH FILING 2
JOB NO. 25188.01
5/15/20
SHEET 2 OF 6

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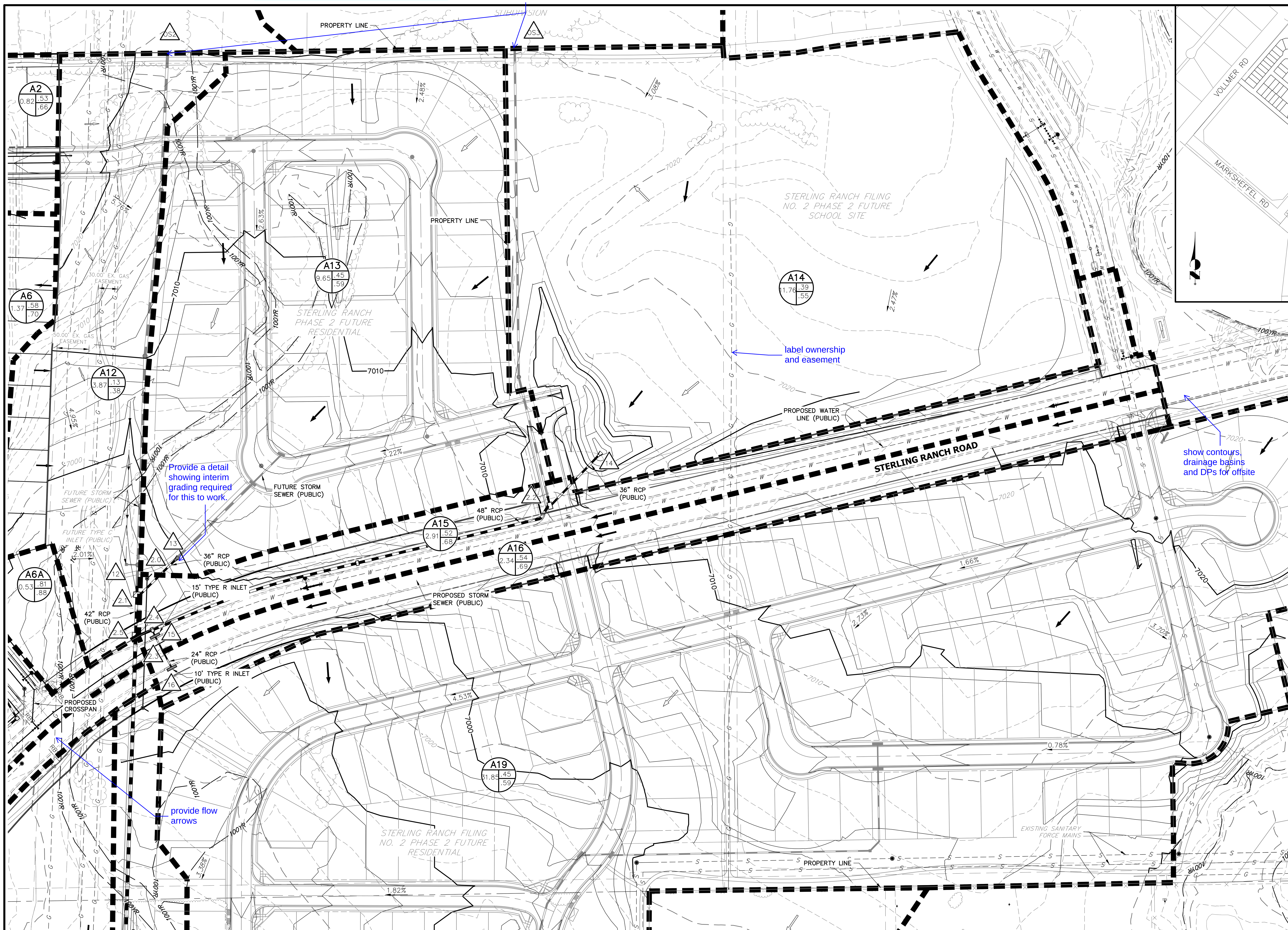
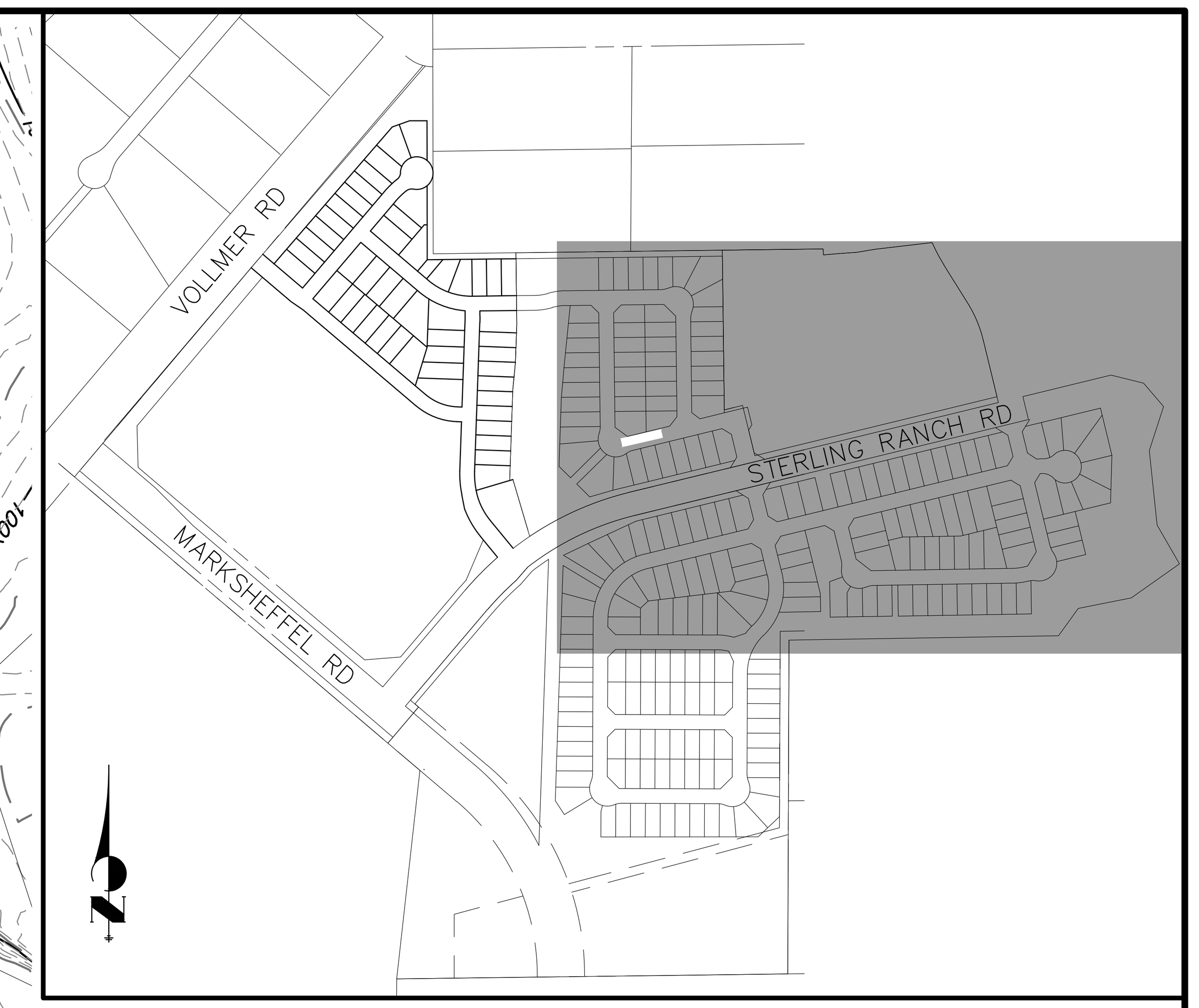
Show or reference Barbarick pond locations

do these connect to something or is grading needed to intercept flows?





70 35 0 70 140

ORIGINAL SCALE: 1" = 70'

LEGEND:

- PROPOSED STORM SEWER
- 5000 PROPOSED MAJOR CONTOUR
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DRAINAGE MAP
STERLING RANCH FILING 2
JOB NO. 25188.01
5/15/20
SHEET 3 OF 6

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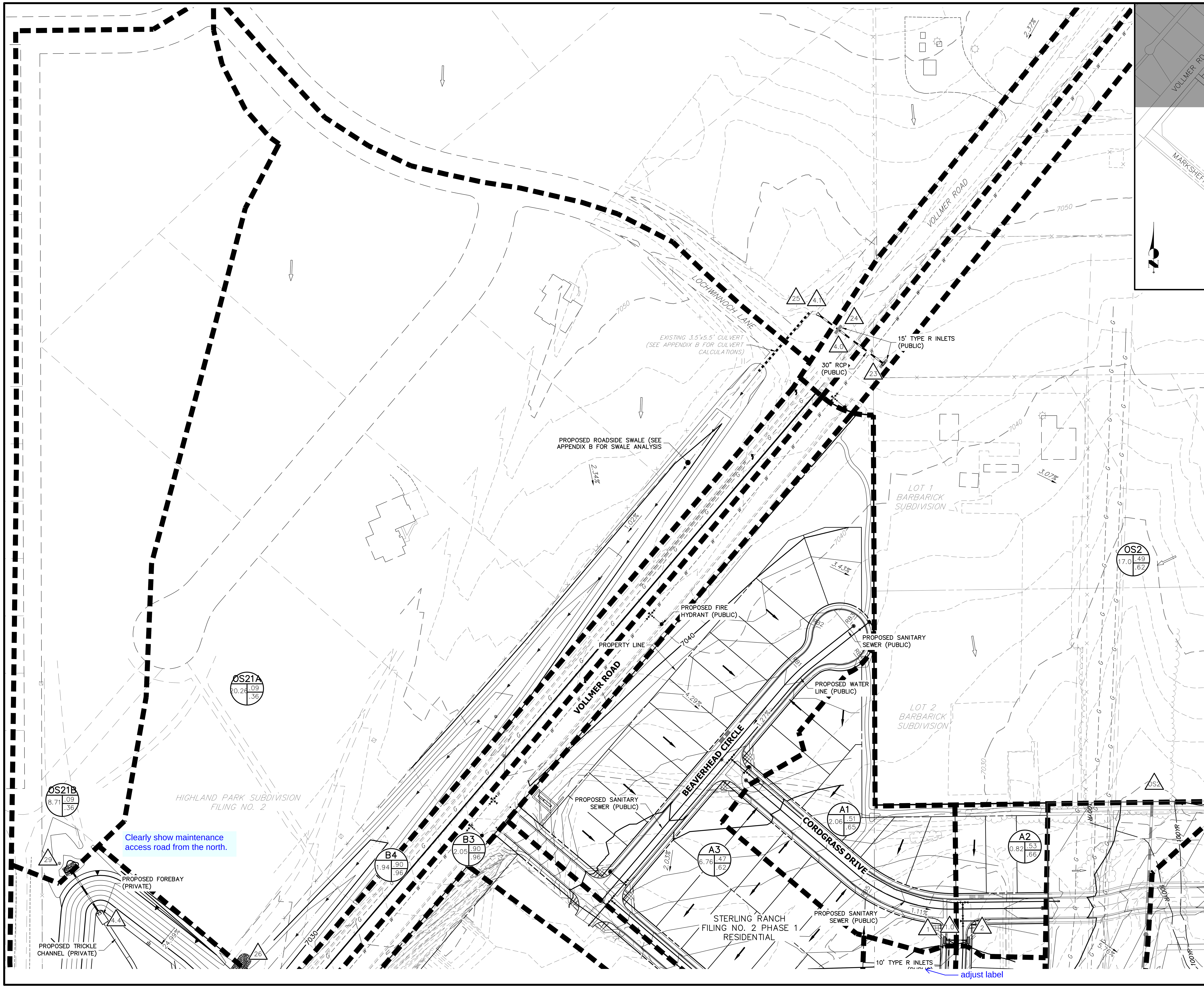

LEGEND:

- PROPOSED STORM SEWER
- 5000 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
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- EXISTING MINOR CONTOUR
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- PROPOSED DRAINAGE SWALE

70 35 0 70 140

ORIGINAL SCALE: 1" = 70'

DRAINAGE MAP
STERLING RANCH FILING 2
JOB NO. 25188.01
5/15/20
SHEET 4 OF 6

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Label basins
VOLLMER ROAD
15' TYPE R INLETS (PUBLIC)
30" RCP (PUBLIC)
LOT 1 BARBARICK SUBDIVISION
LOT 2 BARBARICK SUBDIVISION
LOT 3 BARBARICK SUBDIVISION
LOT 4 BARBARICK SUBDIVISION
PROPOSED SANITARY SEWER (PUBLIC)
PROPOSED WATER LINE (PUBLIC)
Barbarick Detention Pond
Barbarick Detention Pond
PROPERTY LINE
CORDGRASS DRIVE
OS2 17.0 .49 .62
OS3 28.7 .49 .62
A1 2.06 .51 .65
A2 0.82 .53 .66
VOLLMER RD
STERLING RANCH RD
MARKSHEFFEL RD
LEGEND:
PROPOSED STORM SEWER
5000 PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
5000 EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
DRAINAGE BASIN
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DRAINAGE MAP
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SHEET 5 OF 6
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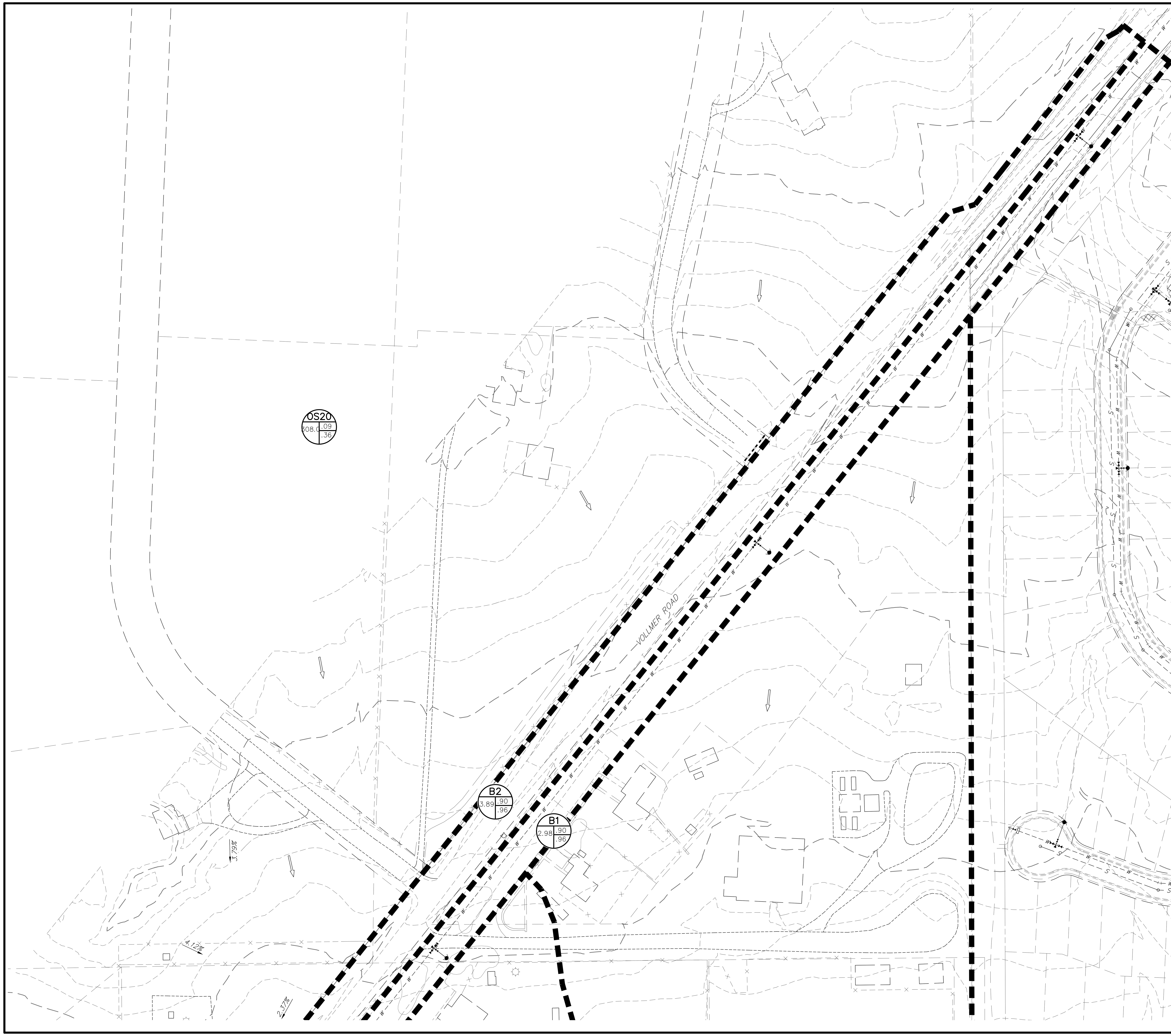

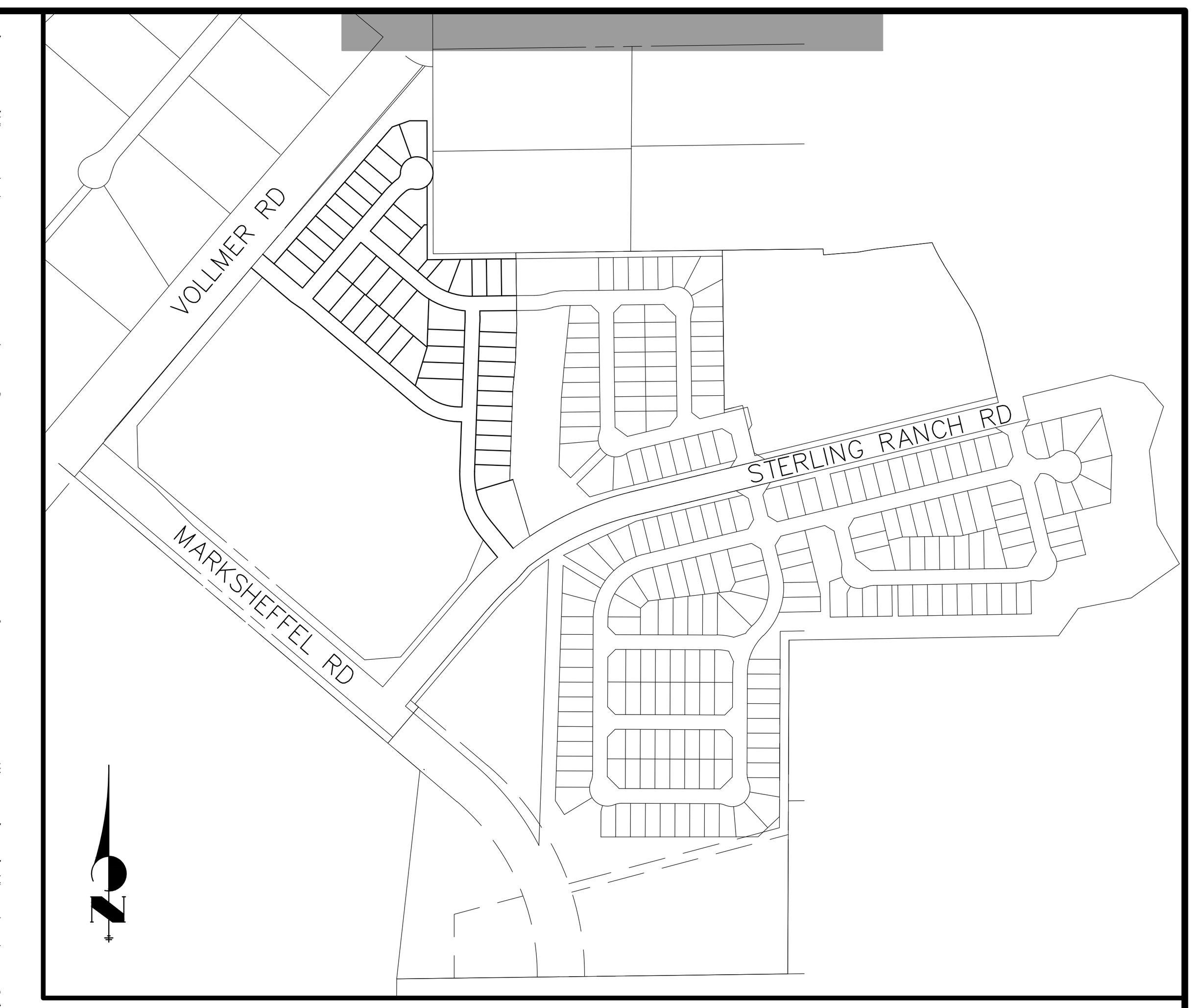

LEGEND:

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70 35 0 70 140

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DRAINAGE MAP
STERLING RANCH FILING 2
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SHEET 6 OF 6

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