

# **FINAL DRAINAGE REPORT FOR BRANDING IRON AT STERLING RANCH FILING NO. 2**

## **EL PASO COUNTY, COLORADO**

January 2020

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

Prepared by:



Project #09-012  
EPC Project # SF-19-018

**FINAL DRAINAGE REPORT FOR  
BRANDING IRON AT STERLING RANCH FILING NO. 2  
DRAINAGE PLAN STATEMENTS**

**ENGINEERS 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 applicable 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.



\_\_\_\_\_  
Virgil A. Sanchez, P.E. #37160  
For and on Behalf of M&S Civil Consultants, Inc

**DEVELOPER'S STATEMENT**

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

BY: James F Morley  
James F Morley  
TITLE: Manager  
DATE: 3-31-2020

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

**EL PASO COUNTY'S STATEMENT**

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

BY: \_\_\_\_\_  
Jennifer Irvine, P.E.  
County Engineer / ECM Administrator

DATE: \_\_\_\_\_

**Approved**

By: Elizabeth Nijkamp  
Date: 06/23/2020

El Paso County Planning & Community Development



**FINAL DRAINAGE REPORT FOR  
BRANDING IRON AT STERLING RANCH FILING NO. 2**

**TABLE OF CONTENTS**

PURPOSE	4
GENERAL LOCATION AND DESCRIPTION	4
SOILS	4
HYDROLOGIC CALCULATIONS	4
HYDRAULIC CALCULATIONS	5
FLOODPLAIN STATEMENT	5
DRAINAGE CRITERIA	5
FOUR STEP PROCESS	5
EXISTING DRAINAGE CONDITIONS	6
PROPOSED DRAINAGE CHARACTERISTICS	6
IMPROVEMENTS TO POND 8	8
EROSION CONTROL	8
CHANNEL IMPROVEMENTS	8
CONSTRUCTION COST OPINION	9
DRAINAGE & BRIDGE FEES	9
STERLING RANCH FILING NO.1-SUBDIVISIONS AGREEMENT	9
SUMMARY	10
REFERENCES	11

**APPENDIX**

Vicinity Map  
Soils Map  
FIRM Panel W/ Revised LOMR  
Hydrologic Calculations  
Hydraulic Calculations  
CD Revisions  
Drainage Map

# **FINAL DRAINAGE REPORT FOR BRANDING IRON AT STERLING RANCH FILING NO. 2**

## **PURPOSE**

This document is the Final Drainage Report for Branding Iron at Sterling Ranch Filing No. 2. This report was previously discussed, as a preliminary drainage report, in the “Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1” prepared by MS Civil Consultants, dated April 2017. 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 Branding Iron at Sterling Ranch Filing No. 2, single family lots, onsite and offsite drainage.

## **GENERAL LOCATION AND DESCRIPTION**

Branding Iron at Sterling Ranch Filing No. 2 is located in the SE  $\frac{1}{4}$  of the NW  $\frac{1}{4}$  of Section 33, and the NE  $\frac{1}{4}$  of the SW  $\frac{1}{4}$  of Section 33, Township 12 South, Range 65 West of the 6<sup>th</sup> Principal Meridian within unincorporated El Paso County, Colorado. The site is bound on the north and south by existing detention ponds and to the east by Sand Creek. Existing Dines Boulevard runs along the western site boundary and residential developments (Branding Iron Filing No. 1, Homestead at Sterling Ranch Filing No. 1) bound the site to the west and northwest. Sterling Ranch lies within the Sand Creek Drainage Basin. Flows from this site are tributary to Sand Creek.

Branding Iron at Sterling Ranch Filing No. 2 consists of 18.881 acres and is presently undeveloped. Vegetation is sparse, consisting of native grasses. Existing site terrain generally slopes from north to southwest at grade rates that vary between 2% and 6%.

Land use for Branding Iron at Sterling Ranch Filing No. 2 is currently listed as AG. Grazing Land. Improvements proposed for the site include paved streets, trails, and utilities as normally constructed for a residential development.

## **SOILS**

Soils for this project are delineated by the map in the appendix as Pring Coarse Sandy Loam (71) and is characterized as Hydrologic Soil Types "B". Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area". Vegetation is sparse, consisting of native grasses and weeds.

## **HYDROLOGIC CALCULATIONS**

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual and where applicable the Urban Storm Drainage Criteria Manual. The Rational Method was used to estimate stormwater runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

## HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. The relevant data sheets can be found in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017 and in the appendix of this report.

## FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain as determined by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0533 G, effective date December 7, 2018 and revised to reflect LOMR, 08-08-O541P, dated July 23, 2009. An annotated FIRM Panel is included in the Appendix.

## DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual, Volumes I & 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 and updates. Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method. July 2019 ECM update for MS4 permit.

## FOUR STEP PROCESS

**Step 1 Employ Runoff Reduction Practices.** Roof drains will be directed to side yard swales and where possible to grass lined swales to aid in minimizing direct connection of impervious surfaces.

**Step 2 Stabilize streams.** – With the full spectrum detention facility in place, the runoff from the proposed residential development will be reduced to predevelopment conditions. The developed discharge from the site is less than existing and therefore is not anticipated to have negative effects on downstream drainageways. An engineered outlet pipe and headwall for Pond 8 was previously constructed to provide for downstream channel protection. Additionally, the Sand Creek Channel will be reinforced with selected areas of riprap bank protection and vegetative slope stabilization.

**Step 3 Implement BMPs that provide a water quality capture volume with slow release.** – An existing Full Spectrum Detention Facility was planned and constructed to handle tributary flows for this site (see Sterling Ranch Filing No 1 - Pond 8) which will incorporate water quality capture volumes that are intended to slowly drain in 40 hours and excess urban runoff volumes that are intended to drain within 72 hours.

**Step 4 Implement site specific and other source control BMPs.** – The proposed project will use silt fence, a vehicle tracking control pad, concrete washout area, inlet protection, temporary sediment basins, sediment control logs, mulching and reseeded to mitigate the potential for erosion across the site.

## EXISTING DRAINAGE CONDITIONS

The Branding Iron at Sterling Ranch Filing No. 2 site consists of 18.881 acres and is situated west of the Sand Creek Watershed. 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 "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017 (henceforth referred to as "Sterling Ranch Filing Nos. 1&2 MDDP"). Branding Iron at Sterling Ranch Filing No. 2 and the surrounding areas, with the exception of the existing Barbarick Subdivision, have already been graded during the overlot of the subdivision. Please refer to the Sterling Ranch Filing Nos. 1&2 MDDP by MS Civil Consultants for information on historic conditions and overlot drainage patterns.

## PROPOSED DRAINAGE CHARACTERISTICS

### General Concept Drainage Discussion

The following is a description of the onsite basins, offsite bypass flows and the overall drainage characteristics for the development of Branding Iron at Sterling Ranch Filing No. 2. The development of Branding Iron at Sterling Ranch Filing No. 2 consists of residential streets and cul-de-sacs, proposed storm drainage improvements, and lots located within the filing boundary. The proposed development results in drainage patterns and flow values that are the same or less than those in the Sterling Ranch Filing Nos. 1&2 MDDP. Surface flow is designated as Design Points (DP). The following DPs and Basins were determined using the Rational Method since this method offers a more conservative approach to drainage. It should be noted that all calculations and drainage basins have been revised to reflect the new criteria updates by the El Paso County/City of Colorado Springs Drainage Criteria Manual. For comparison, the **asterisk (\*)** symbol in the detailed drainage discussions below represents each Basin or Design Point as labeled in the Sterling Ranch Filing Nos. 1&2 MDDP.

### Detailed Drainage Discussion (Design Points)

**DP2\***, 5.39 acres, consists of Basin B\* planned residential lots and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=8.0 cfs and Q100=19.3 cfs has been calculated for DP2\*. The surface runoff is routed via overlot grading and planned swales to two existing 15' CDOT Type R at-grade inlets. The flows are routed east via a 36" RCP to DP5.

**DP5\***, 0.80 acres, consists of Basin G\* residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, Basin H\* existing Dines Boulevard, with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from Sterling Ranch Filing Nos. 1&2 MDDP DP4\*. Developed runoff of Q5=4.2 and Q100=19.7 cfs has been calculated for DP5\*. The surface runoff is routed via overlot grading and curb and gutter to DP5\* which is collected by an existing 15' CDOT type R at-grade inlet. DP5\* has an intercepted flow of (Q5=4.2 cfs and Q100=14.7 cfs) and of flowby of (Q5=0.0 cfs and Q100=5.0 cfs).

**DP6\***, 4.68 acres, consists of Sterling Ranch Filing Nos. 1&2 MDDP Basins J\* and K\* planned residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, Sterling Ranch Filing Nos. 1&2 MDDP Basin I\* (Wheatland Drive) and Basin L\* ( Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year. Developed runoff of Q5=14.1 cfs and Q100=26.7cfs has been calculated for DP6\*. The surface runoff is routed via overlot grading and curb and gutter to DP6\* which is collected by an existing 15' CDOT type R at-grade inlet. DP6\* has an intercepted flow of (Q5=12.1 cfs and Q100=17.2 cfs) and of flowby of (Q5=2.0 cfs and Q100=9.5 cfs).

**DP18\***, 9.74 acres, consists of four cul-de-sacs, streets and residential lots located within Basin GG\* with coefficients of 0.38 for the 5-year and 0.55 for the 100-year. DP18\* also consists of Basin II\* (west half of existing Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year, and flowby from DP5\*. Developed runoff of Q5=14.1 cfs and Q100=37.7 cfs has been calculated for DP18\*. The surface runoff is routed via overlot grading to the cul-de-sacs and streets. A highpoint at the end of each cul-de-sac routes runoff east, via curb and gutter, towards existing Dines Boulevard. The surface runoff is then routed south to DP18\* via existing Dines Boulevard and is collected by an existing 15' CDOT type R at-grade inlet. DP18\* has an intercepted flow of (Q5=12.1 cfs and Q100=21.1 cfs) and of flowby of (Q5=2.0 cfs and Q100=16.6 cfs).

**DP19**, 11.86 acres, consists of proposed Basins BB, DD, FF and HH proposed residential lots and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year, and Basin JJ\* (east half of existing Dines Boulevard), with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from DP6\*. Developed runoff of Q5=20.5 cfs and Q100=52.0 cfs has been calculated for DP19. The cumulative flow of DP18 and DP19 is Q5=34.6 cfs and Q100=89.7 cfs. Per the Minor and Major Storm Capacity Rating Table for Collector Section found in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1", the calculated allowable flows are Q5=34.6 cfs and Q100=110.33 cfs (see Capacity Tables in appendix). The surface runoff is routed via existing overlot grading and curb and gutter to DP19 which is collected by an existing 15' CDOT type R at-grade inlet. DP19 has an intercepted flow of (Q5=15.0 cfs and Q100=23.2 cfs) and of flowby of (Q5=5.5 cfs and Q100=28.8 cfs).

**DP20\***, 2.19 acres, consists of Basin KK\* residential lots and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year, and Basin MM\* (west half of existing Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from DP18\*. Developed runoff of Q5=5.2 cfs and Q100=27.9 cfs has been calculated for DP20\*. The surface runoff is routed via overlot grading and curb and gutter to DP20\* which is collected by an existing 15' CDOT type R at-grade inlet. DP20\* has an intercepted flow of (Q5=5.2 cfs and Q100=17.6 cfs) and of flowby of (Q5=0.0 cfs and Q100=10.3 cfs).

**DP21**, 0.43 acres, consists of Basin LL residential backyard lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, and Basin NN\* (east half of existing Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from DP19\*. Developed runoff of Q5=6.4 cfs and Q100=30.7 cfs has been calculated for DP21. The surface runoff is routed via overlot grading and curb and gutter to DP21 which is collected by an existing 15' CDOT type R at-grade inlet. DP21 has an intercepted flow of (Q5=6.4 cfs and Q100=18.6 cfs) and of flowby of (Q5=0.0 cfs and Q100=12.1 cfs).

**DP24**, 6.22 acres, consists of Basin RR and Basin SS, proposed residential lots and streets with runoff coefficients of 0.38 (0.08) for the 5-year and 0.55 (0.35) for the 100-year. Developed runoff of Q5=8.0 cfs and Q100=19.8 cfs has been calculated for DP24. The surface runoff is routed via overlot grading and curb and gutter to DP24 which will be collected by a proposed 15' CDOT type R sump inlet. Flows collected by the sump inlet are routed to Design Point 26 by a proposed 24" RCP pipe run (PR1), and continue via Pipe Run 2 (PR2) into the north forebay of existing Pond 8. In the event the inlet should become clogged, the emergency overflow shall be routed through Tract A and into Sand Creek.

**DP26**, 1.32 acres, consists of Basin TT, proposed residential lots and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=2.0 cfs and Q100=4.9 cfs has been calculated for DP26. The surface runoff is routed via overlot grading and curb and gutter to DP26 which will be collected by a proposed 5' CDOT type R sump inlet. Flows collected by the sump inlet are routed into the north forebay of existing Pond 8 via Pipe Run 2 (PR2).

**DP27**, 33.84 acres, consists of Pond 8 an existing full spectrum detention pond. Runoff tributary to Pond 8 consists of Basin UU\* with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year, existing pipe runs PR20\*, PR23\*, PR26\* and proposed pipe run PR2. Developed runoff of Q5=50.0 cfs and Q100=132.0 cfs has been calculated for DP27. A 2.91' X 9' outlet structure is designed to detain and treat all flows reaching DP27. Refer to the Hydraulic Calculations section of the appendix for more information.

### **Detailed Drainage Discussion (Drainage Basins)**

**Basins VV and WW**, 1.00 acres, consists of proposed residential backyard lots located along the east and south boundaries of the site, with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year. Developed combined runoff of Q5=0.9 cfs and Q100=3.0 cfs has been calculated for these basins. Sheet flow produced within the residential backyard lots of Basins VV and WW travels east and south via backyard lot grading towards Sand Creek. Since the total area draining into Sand Creek is less than One acre, no permanent water quality facilities are necessary. No deviation to the EPC code is required or requested.

### **IMPROVEMENTS TO POND 8**

An additional watershed area of 6.22 acres was added to existing Pond 8 from proposed Basin RR and Basin SS. Runoff produced within these basins is collected at Design Point 24 by a proposed 15' CDOT Type R sump inlet and routed to existing Pond 8 via a proposed 24" and existing 30" RCP pipe (Pipe Run 1). The increased volume and hydraulic affects for Pond 8 were analyzed and are summarized in the table below. Adjustments were performed to the design of Pond 8 to accommodate for the increase in tributary impervious area and runoff volume. Refer to the Hydraulic Calculations section of the appendix for more information. A forebay calculation sheet has been included in the appendix. A copy of the draft CD/pond modifications have been included with this report.

<b>Description</b>	<b>MDDP</b>	<b>Branding Iron Fil. No. 2</b>
Watershed Area	28.98 Acres	35.20 Acres
100 yr WSE	7020.59	7021.13
Emergency Spillway Crest EL	7020.60	7021.15
100 yr Volume	2.988 Ac-ft	3.490 Ac-ft
North Forebay Volume Required	643 CF	732 CF
North Forebay Volume Provided	855 CF	855 CF

### **EROSION CONTROL**

It is the policy of the El Paso County that a grading and erosion control plan be submitted with the drainage report. EPC approved "Early Grading Plan for Sterling Ranch Phase I Onsite Grading & Erosion Control", November 18, 2015. And "Early Grading Plan for Sterling Ranch Phase I Offsite Grading & Erosion Control", December 3, 2015. Grading and Erosion control operations are currently underway (August 2016). Grading and Erosion Control will cease with the final development of the site in the next 12-36 months.

### **CHANNEL IMPROVEMENTS**

Slope grading and intermittent channel bank lining has been proposed for portions of the developable areas adjacent to Sand Creek to protect the developed lots and prevent excessive erosion until the DBPS recommended Sand Creek Channel improvements are installed. The proposed slope grading is intended to reduce outer bank grades and bring uniformity to areas where significant riling and destabilization has

occurred. Proposed channel stabilization improvements includes placement of soil riprap and turf reinforcement matting along embankment toes and along embankment slopes, both of which will function to retain soils and vegetation during heavy rains or larger flood flow events. All disturbed areas, not hardscaped will be re-vegetated with native species grasses, per El Paso County erosion control standards. Storm sewer outfalls into Sand Creek shall be protected by low-tailwater riprap basins. The outfall protection is shown on the accompanying drainage map in the appendix. Refer to the Branding Iron Filing No.2 Grading and Erosion Control Plans for riprap and turf reinforcement map placement and construction details.

Permanently installed check structures and rip-rap channel lining will be installed within Sand Creek Channel to handle the runoff from fully developed Sterling Ranch and up-gradient watershed in accordance with the Sand Creek DBPS. A discussion regarding the timing of these channel improvements is provided in a subsequent paragraph titled Sterling Ranch Filing No. 1 Subdivision Improvement agreement which follows the Construction Costs segment of this report. Financial Assurance shall be posted for the proposed Sand Creek Channel Improvements and Bank Stabilization (Slope Protection and grade control structures).

## **CONSTRUCTION COST OPINION – BRANDING IRON AT STERLING RANCH FIL. NO. 2**

### **Drainage Facilities:**

Minor drainage improvements are planned with the development of Branding Iron at Sterling Ranch Filing No. 2. A majority of the construction costs have been accounted for in the “Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1” prepared by MS Civil Consultants, dated April 2017. Any additional improvements and costs are listed below.

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Cost</b>
1.	24" RCP	909 LF	\$78 /LF	\$70,902.00
2.	24" RCP FES	1 EA	\$960 /EA	\$960.00
3.	5' CDOT Type R Sump Inlet	1 EA	\$7,188 /EA	\$7,188.00
4.	15' CDOT Type R Sump Inlet	1 EA	\$8,345 /EA	\$8,345.00
<b>Total \$</b>				<b>\$87,395.00</b>

## **DRAINAGE & BRIDGE FEES – BRANDING IRON AT STERLING RANCH FIL. NO. 2**

This site is within the Sand Creek Drainage Basin. The 2019 Drainage and Bridge Fees per El Paso County for the BRANDING IRON AT STERLING RANCH FILING NO. 2 site are as follows:

Per Branding Iron at Sterling Ranch Filing No. 2 Plat – **Total Area 18.881 Acres**

### **FILING NO. 2 FEES:**

<b>Drainage Fees:</b>	18.881 ac	x	53%	x	\$18,940.00/ac =	\$ 189,531.25
<b>Bridge Fees:</b>	18.881 ac	x	53%	x	\$ 5,559.00/ac =	<u>\$ 55,628.52</u>
<b>Total</b>						<b>\$ 245,159.77</b>

## **STERLING RANCH FILING NO. 1 - SUBDIVISION IMPROVEMENTS AGREEMENT**

Sterling Ranch Filing No. 1 final plat and SIA has been recorded, and addressed the following drainage improvements Not located/and located in the Sand Creek Channel. The following SIA paragraphs outlined drainage for Sterling Ranch in the following manner;

**2. Drainage and Landscaping Tracts:** Improvements on Tracts A, B, F, H, I, J, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA and CC as identified on the final plat of Filing No. 1 will be completed to the satisfaction of the County and District and, upon said completion, the improvements will be dedicated to and accepted by the District. Improvements on Tract D (Sand Creek) will be completed to the satisfaction of the County and upon said completion; the improvements will be dedicated to and accepted by the County. The ownership and maintenance of storm drain facilities and structures not located on the foregoing tracts shall be determined as follows. All storm pipes shall be owned and maintained by the District except where located in County road rights of way (see Paragraph 5 below), in which case the County shall own and maintain the storm drain facilities and structures, including but not limited to, inlets and manholes. A typical cross section describing the ownership and maintenance responsibilities of drainage improvements within County rights of way is attached as Exhibit C hereto.

**7. Timing of Construction and Acceptance:**

- a. **Drainage Improvements Not Located in Sand Creek Channel:** Except as set forth below in subsection 6.b. (drainage improvements located in Sand Creek Channel), all drainage improvements described in Exhibit A and constructed within the Drainage and Landscaping Tracts identified in paragraph 2 above shall be completed by the Subdivider and District, meeting all applicable standards for preliminary acceptance, prior to the recording of the first replat of Tracts C, E, G, K or BB. In the event that a portion of the drainage improvements are not completed prior to the recording of the first replat, then prior to such recording collateral sufficient in the opinion of the County to assure completion of the improvements must be posted by the Subdivider and a deadline by which such drainage improvements shall be completed shall be established by written agreement.
- b. **Drainage Improvements Located in Sand Creek Channel (Tract D):** The District agrees that it will construct or cause the construction of all drainage improvements to be located in Tract D as well as future tracts within Sterling Ranch containing the Sand Creek Channel in accordance with the following:
  - i. Bank stabilization of the Sand Creek channel shall be required prior to any replats or other final plats adjacent to the channel. The design and installation of said improvements shall be accomplished and guaranteed through the normal subdivision review and collateralization process.
  - ii. Other drainage improvements in Tract D and future tracts containing the Sand Creek Channel, such as drop structures, check structures and similar stabilization or protection improvements, will be designed and constructed by the District with the final construction drawings to be approved by the County no later than the final platting of the 700<sup>th</sup> single family lot within the boundaries of the approved Sterling Ranch Sketch Plan and the completion of all said improvements no later than the 800<sup>th</sup> single family lot with the boundaries of the approved Sterling Ranch Sketch Plan.
  - iii. In order to assure completion of the drainage improvements required in Subsection 6.b.ii above as well as a fair apportionment of the costs of said drainage improvements amongst adjacent Sterling Ranch subdividers, the District agrees to establish a Sand Creek Channel Drainage Fee to be paid into a District Escrow Fund by adjacent subdividers at the time of final platting. The amount of the fee shall be a minimum of One Thousand Dollars (\$1,000.00) per single family lot. The details of the proposed Sand Creek Channel Drainage Fee and the District Escrow Fund shall be agreed to by the parties in advance of the submittal of the first replat of or subdivision of the Master Pad Sites or other property located within Sterling Ranch.

A full copy of the recorded SIA is located in the files of El Paso County and EPC Clerk and Records office under Reception No. 218714151

## **SUMMARY**

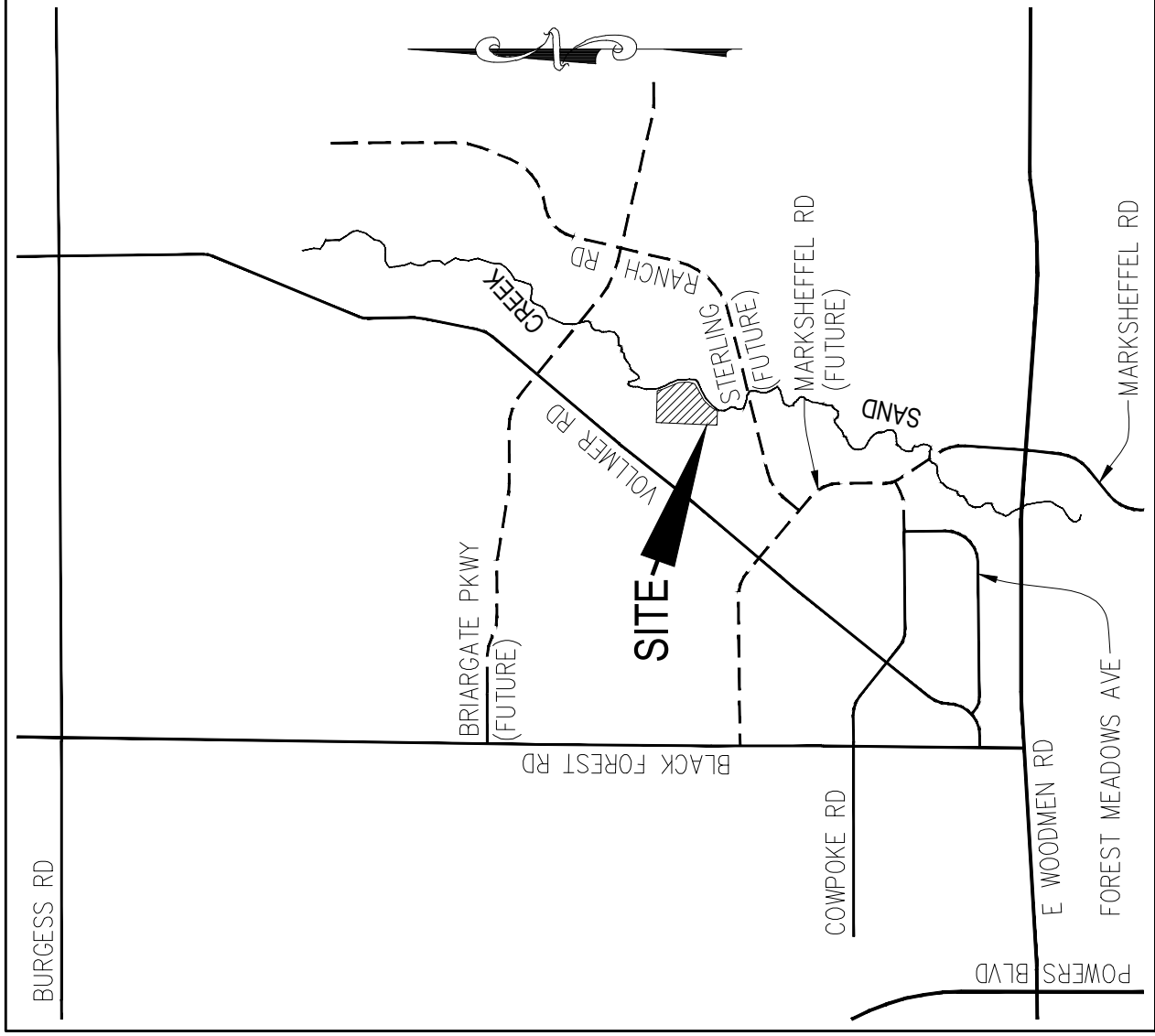
Development of this site will not adversely affect the surrounding development per this final drainage report with no negative impacts to the neighboring developments. The existing drainage facilities will adequately convey, detain and route runoff from tributary and onsite flows to the Sand Creek Drainage channel. Full Spectrum Detention and Water Quality Ponds 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. Slope grading and intermittent channel bank lining has been proposed for portions of the developable areas adjacent to Sand Creek to protect the developed lots and prevent excessive erosion. The development of the BRANDING IRON AT STERLING RANCH FILING NO. 2 project(s) shall not adversely affect adjacent or downstream property.

## REFERENCES

- 1.) "El Paso County and City of Colorado Springs Drainage Criteria Manual, Vol I & II".
- 2.) "Urban Storm Drainage Criteria Manuals, Volumes 1-3"
- 3.) NRSC Web Soil Survey Map for El Paso County. <http://websoilsurvey.nrcs.usda.gov>
- 4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date December 7, 2018.
- 5.) "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Corporation, revised March 1996
- 6.) "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015
- 7.) "Sterling Ranch-Phase 1 Onsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015
- 8.) "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2 and Final Drainage Report for Sterling Ranch Filing No. 1", prepared by M&S Civil Consultants, Inc., dated April 2017
- 9.) "Sterling Ranch Filing Nos. 1&2 MDDP" prepared by MS Civil Consultants, Inc., dated October 2018.

## **APPENDIX**

## **VICINITY MAP**

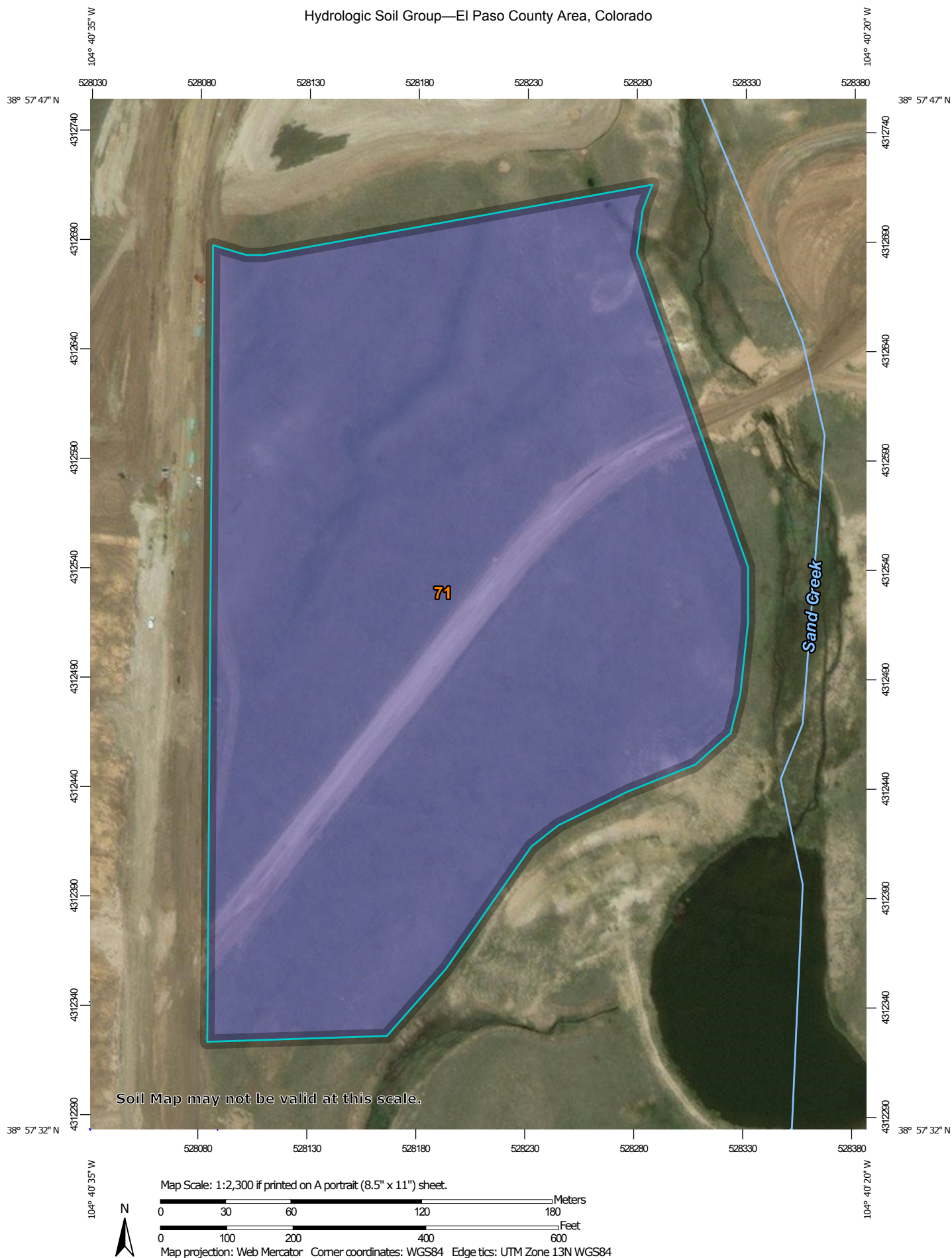


# VICINITY MAP

N.T.S.


## **SOILS MAP**

# Hydrologic Soil Group—El Paso County Area, Colorado



## 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 15, Oct 10, 2017

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

Date(s) aerial images were photographed: May 22, 2016—Mar 9, 2017

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
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	18.1	100.0%
<b>Totals for Area of Interest</b>			<b>18.1</b>	<b>100.0%</b>

## 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*

**FIRM PANEL W/ REVISED LOMR**

## 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 zone numbers 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  
NGA, NGS-12  
National Geodetic Survey  
SSMC-3, #5002  
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) 713-3202 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.

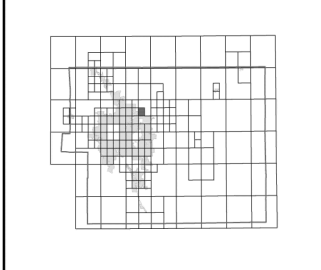
Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FMIX) 1-877-336-2527 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at <http://www.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** (1-877-336-2527) or visit the FEMA website at <http://www.fema.gov/business/firmfp>.

### 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	

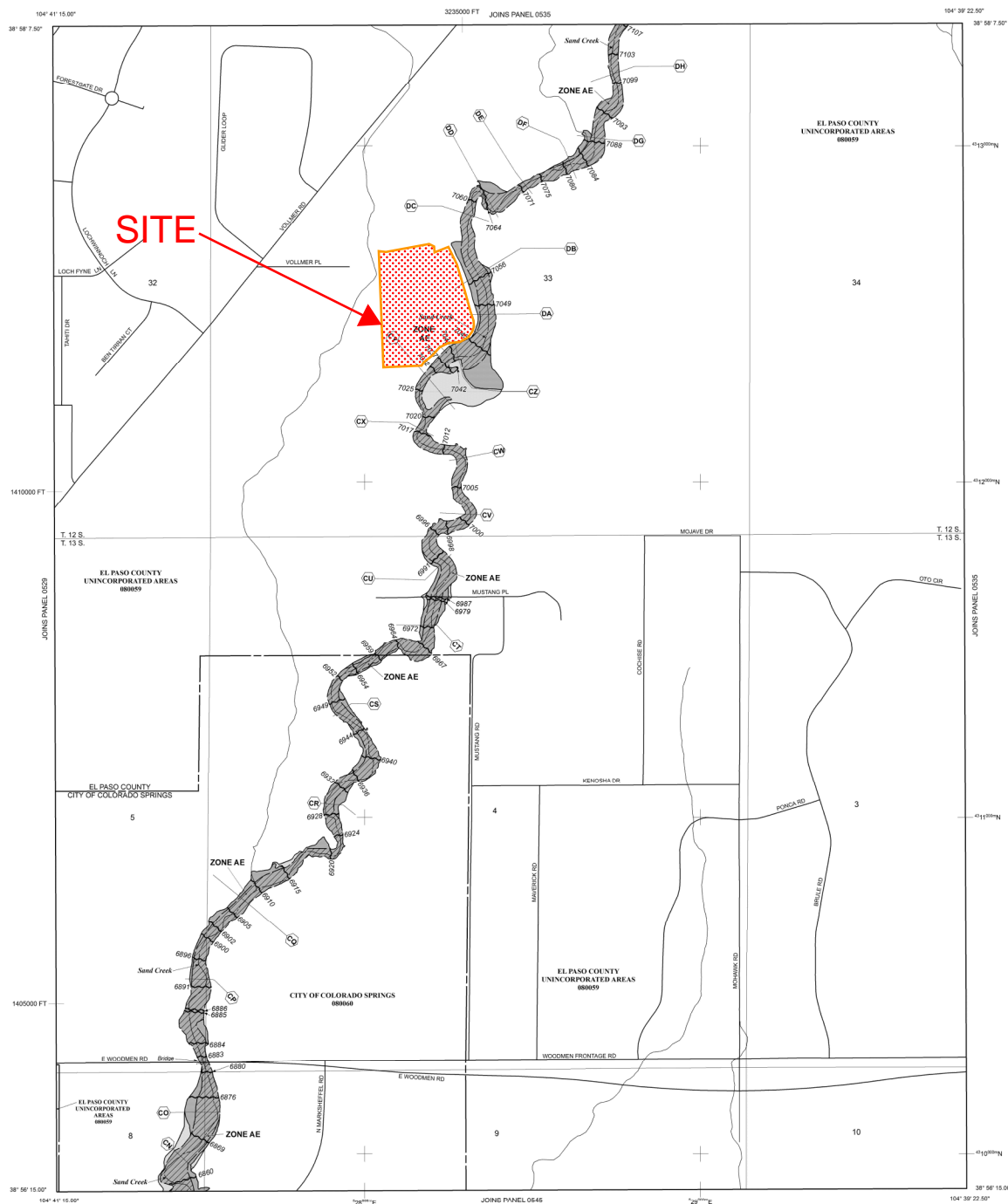
### Panel Location Map



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, AV, 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 Elevation 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, vehicles also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently determined. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE AV** Areas 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 Elevation 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 encroachments 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 any other 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.

**~~~~~** Base Flood Elevation line and value; elevation in feet\*  
**(EL 987)** Base Flood Elevation value where uniform water zone; elevation in feet\*

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

**A** Cross section line

**23** Transsect line

**97° 07' 30.50"** Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), zone 13

**6000000 FT** 1000-meter Universal Transverse Mercator grid ticks, zone 13

**6000000 FT** 5000-foot grid ticks; Colorado State Plane coordinate system, central zone (NAD83 0501), Lambert Conformal Conic Projection

**DX5510** Bench mark (see explanation in Notes to Users section of this FIS report)

**M1.5** River Mile

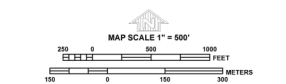
**MAP REPOSITORIES**  
Refer to Map Repositories list on Map Index

**EFFECTIVE DATE OF COUNTRYWIDE FLOOD INSURANCE RATE MAP**  
**MARCH 17, 1997**

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**  
**DECEMBER 17, 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 the National Flood Insurance Program at 1-800-638-6620.



**NFP**  
**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	0000	003	0
	EL PASO COUNTY	0000	003	0

Notes to User: The Map Number shown below should be used when ordering your policy. 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

## **HYDROLOGIC CALCULATIONS**

# BRANDING IRON AT STERLING RANCH FILING NO. 2

## FINAL DRAINAGE REPORT

### (Area Drainage Summary)

From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T <sub>i</sub> )		INTENSITY **		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	Length (ft)	Height (ft)	T <sub>c</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>i</sub> (min)	TOTAL (min)	CHECK (min)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)
Proposed Area Drainage Summary																	
ONSITE BASINS																	
BB	1.8	0.38	0.55	0.38	100	2	10.3	316	2.2%	3.0	1.7	12.1	12.3	3.8	6.5	2.6	6.4
DD	2.58	0.38	0.55	0.38	100	2	10.3	400	1.8%	3.0	2.2	12.5	12.8	3.8	6.4	3.7	9.0
FF	2.72	0.38	0.55	0.38	100	2	10.3	375	2.7%	3.0	2.1	12.4	12.6	3.8	6.4	3.9	9.6
HH	3.77	0.38	0.55	0.38	100	2	10.3	516	1.9%	3.0	2.8	13.2	13.4	3.7	6.2	5.3	12.9
LL	0.23	0.22	0.46	0.22	95	4	9.6	0	2.0%	3.0	0.0	9.6	10.5	4.2	7.0	0.2	0.7
RR	5.93	0.38	0.55	0.38	100	2	10.3	880	2.3%	3.0	4.8	15.2	15.4	3.5	5.9	7.9	19.2
SS	0.29	0.08	0.35	0.08	20	5	2.8	80	0.5%	2.3	0.6	5.0	10.6	5.2	8.7	0.1	0.9
TT	1.32	0.38	0.55	0.38	65	1.3	8.3	387	1.3%	3.0	2.1	10.5	12.5	4.1	6.8	2.0	4.9
VV	0.41	0.22	0.46	0.22	80	1.6	11.3	0	2.0%	2.3	0.0	11.3	10.4	3.9	6.6	0.4	1.2
WW	0.59	0.22	0.46	0.22	80	2	10.5	0	2.0%	2.3	0.0	10.5	10.4	4.1	6.8	0.5	1.8
OFFSITE BASINS*																	
B*	5.39	0.38	0.55	0.38	60	1.2	8.0	1381	2.8%	3.0	7.6	16.3	18.0	3.4	5.7	8.0	19.3
G*	0.61	0.22	0.46	0.22	100	2	12.6	0	2.2%	3.0	0.0	12.6	10.6	4.0	6.8	0.5	1.9
H*	0.19	0.90	0.96	0.19	10	0.2	0.9	280	2.1%	3.0	1.6	5.0	11.6	5.2	8.7	0.9	1.6
K*	0.61	0.22	0.46	0.22	75	1.5	10.9	0	2.0%	3.0	0.0	10.9	10.4	4.0	6.7	0.5	1.9
L*	1.54	0.90	0.96	0.90	10	0.2	0.9	1805	2.1%	3.0	9.9	10.8	20.1	4.0	6.7	5.6	10.0
GG*	8.72	0.38	0.55	0.38	100	2	10.3	282	1.8%	3.0	1.5	16.3	12.1	3.4	5.7	11.3	27.3
II*	1.02	0.90	0.96	0.90	10	0.2	0.9	1349	2.2%	3.0	7.4	8.3	17.6	4.4	7.4	4.0	7.2
JJ*	0.99	0.90	0.96	0.90	10	0.2	0.9	1349	2.2%	3.0	7.4	8.3	17.6	4.4	7.4	3.9	7.0
KK*	1.97	0.38	0.55	0.38	100	2	10.3	206	1.0%	3.0	1.1	11.5	11.7	3.9	6.6	2.9	7.1
MM*	0.22	0.90	0.96	0.90	10	0.2	0.9	286	2.1%	3.0	1.6	5.0	11.6	5.2	8.7	1.0	1.8
NN*	0.2	0.90	0.96	0.90	10	0.2	0.9	286	2.1%	3.0	1.6	5.0	11.6	5.2	8.7	0.9	1.7
OO*	0.3	0.22	0.46	0.22	100	4	10.1	0	2.0%	3.0	0.0	10.1	10.6	4.1	6.9	0.3	1.0
PP*	0.37	0.90	0.96	0.90	10	0.2	0.9	400	1.5%	3.0	2.2	5.0	12.3	5.2	8.7	1.7	3.1
UU*	2.17	0.08	0.35	0.08	50	6	5.7	257	0.5%	2.3	1.9	7.6	11.7	4.5	7.6	0.8	5.8

\* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

\*\* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CMN  
 Date: 3/1/2018  
 Checked by: VAS

**BRANDING IRON AT STERLING RANCH FILING NO. 2**  
**FINAL DRAINAGE REPORT**  
**(Basin Routing Summary)**

From Area Runoff Coefficient Summary				OVERLAND				PIPE / CHANNEL FLOW				Time of Travel (T <sub>t</sub> )	INTENSITY **		TOTAL FLOWS		COMMENTS
DESIGN POINT	CONTRIBUTING BASINS	CA <sub>5</sub>	CA <sub>100</sub>	C <sub>s</sub>	Length (ft)	Height (ft)	T <sub>c</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>i</sub> (min)	TOTAL (min)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)	
PROPOSED DRAINAGE BASIN ROUTING SUMMARY																	
2*	B*	2.34	3.39									16.3	3.4	5.7	8.0	19.3	(2) EX. 15' AT-GRADE INLETS
5*	G*, H*, FLOWBY DP4*	1.07	3.02									11.7	3.9	6.5	4.2	19.7	EX. 15' AT-GRADE INLET
6*	I*, J*, K*, L*	3.50	3.97									10.8	4.0	6.7	14.1	26.7	EX. 15' AT-GRADE INLET
18*	GG*, II* FLOWBY DP5*	4.14	7.30									16.3	3.4	5.7	14.1	41.6	EX. 15' AT-GRADE INLET
19	BB, DD, FF, HH, JJ* FLOWBY DP 6*	5.53	8.34									13.2	3.7	6.2	20.5	52.0	EX. 15' AT-GRADE INLET
20*	KK*, MM* FLOWBY DP 18*	1.53	4.89									16.3	3.4	5.7	5.2	27.9	EX. 15' AT-GRADE INLET
21	LL, NN* FLOWBY DP 19*	1.72	4.92									13.2	3.7	6.2	6.4	30.7	EX. 15' AT-GRADE INLET
24	RR, SS	2.28	3.36									15.2	3.5	5.9	8.0	19.8	PROP. 15' SUMP INLET
26	TT	0.50	0.73									10.5	4.1	6.8	2.0	4.9	PROP. 5' SUMP INLET
27	UU*, PR2, PR20*, PR23*, PR26*	14.73	23.15									16.3	3.4	5.7	50.0	132.0	CUMULATIVE DETENTION POND 8 2.91'x9' OUTLET STRUCT.

\* For detailed information on Design Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

\*\* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: CMN

Date: 9/20/2019

Checked by: VAS

***BRANDING IRON AT STERLING RANCH FILING NO. 2***  
***FINAL DRAINAGE REPORT***  
***(Storm Sewer Routing Summary)***

<b><i>PIPE RUN</i></b>	<b><i>Contributing Pipes/Design Points</i></b>	<b><i>Equivalent CA<sub>5</sub></i></b>	<b><i>Equivalent CA<sub>100</sub></i></b>	<b><i>Maximum T<sub>C</sub></i></b>	<b><i>Intensity*</i></b>		<b><i>Flow</i></b>		<b><i>Pipe Size</i></b>
					<b><i>I<sub>5</sub></i></b>	<b><i>I<sub>100</sub></i></b>	<b><i>Q<sub>5</sub></i></b>	<b><i>Q<sub>100</sub></i></b>	
<b><i>1</i></b>	<b><i>DP24</i></b>	2.28	3.36	15.2	3.5	5.9	<b><i>8.0</i></b>	<b><i>19.8</i></b>	24" RCP
<b><i>2</i></b>	<b><i>DP26, PR1</i></b>	2.78	4.09	16.1	3.4	5.7	<b><i>9.5</i></b>	<b><i>23.5</i></b>	EX 24" RCP

\* Intensity equations assume a minimum travel time of 5 minutes.

DP - Design Point

EX - Existing Design Point

FB- Flow By from Design Point

INT- Intercepted Flow from Design Point

Calculated by: CMN

Date: 9/20/2019

Checked by: VAS

# Minor Storm Capacity Rating Table for Collector Section

## Project Description

Friction Method

Manning Formula

Solve For

Discharge

## Input Data

Channel Slope

0.02000 ft/ft

Normal Depth

0.49 ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.70
0+10	0.50
0+10	0.50
0+10	0.00
0+12	0.13
0+30	0.49
0+48	0.13
0+50	0.00
0+50	0.50
0+51	0.50
0+60	0.70

## Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.70)	(0+10, 0.50)	0.020
(0+10, 0.50)	(0+51, 0.50)	0.016
(0+51, 0.50)	(0+60, 0.70)	0.020

Channel Slope (ft/ft)	Discharge (cfs)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)
0.00000			8.12	41.00	40.00

# Minor Storm Capacity Rating Table for Collector Section

Input Data

Channel Slope (ft/ft)	Discharge (cfs)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.00250	11.32	1.39	8.12	41.00	40.00
0.00500	16.01	1.97	8.12	41.00	40.00
0.00750	19.30	2.41	8.12	41.00	40.00
0.01000	22.64	2.79	8.12	41.00	40.00
0.01250	25.31	3.12	8.12	41.00	40.00
0.01500	27.72	3.41	8.12	41.00	40.00
0.01750	29.95	3.69	8.12	41.00	40.00
0.02000	32.01	3.94	8.12	41.00	40.00
0.02250	33.96	4.18	8.12	41.00	40.00
→ 0.02500	35.79	4.41	8.12	41.00	40.00
0.02750	37.54	4.62	8.12	41.00	40.00
0.03000	39.21	4.83	8.12	41.00	40.00
0.03250	40.81	5.03	8.12	41.00	40.00
0.03500	42.35	5.22	8.12	41.00	40.00
0.03750	43.84	5.40	8.12	41.00	40.00
0.04000	45.27	5.58	8.12	41.00	40.00
0.04250	46.67	5.75	8.12	41.00	40.00
0.04500	48.02	5.91	8.12	41.00	40.00
0.04750	49.34	6.08	8.12	41.00	40.00
0.05000	50.62	6.23	8.12	41.00	40.00

# Major Storm Capacity Rating Table for Collector Section

## Project Description

Friction Method

Manning Formula

Solve For

Discharge

## Input Data

Channel Slope

Normal Depth

0.02000 ft/ft

Section Definitions

0.70 ft

Station (ft)	Elevation (ft)
0+00	0.70
0+10	0.50
0+10	0.50
0+10	0.00
0+12	0.13
0+30	0.49
0+48	0.13
0+50	0.00
0+50	0.50
0+51	0.50
0+60	0.70

## Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.70)	(0+10, 0.50)	0.020
(0+10, 0.50)	(0+51, 0.50)	0.016
(0+51, 0.50)	(0+60, 0.70)	0.020

Channel Slope (ft/ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)
0.00000			18.62	61.02	60.00

# Major Storm Capacity Rating Table for Collector Section

Input Data:

Channel Slope (ft/ft)	Discharge (cfs)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)
0.00250	36.15	1.94	18.62	61.02	60.00
0.00500	51.12	2.75	18.62	61.02	60.00
0.00750	62.61	3.36	18.62	61.02	60.00
0.01000	72.30	3.88	18.62	61.02	60.00
0.01250	80.83	4.34	18.62	61.02	60.00
0.01500	88.55	4.76	18.62	61.02	60.00
0.01750	95.64	5.14	18.62	61.02	60.00
0.02000	102.25	5.49	18.62	61.02	60.00
0.02250	108.45	5.82	18.62	61.02	60.00
0.02500	114.32	6.14	18.62	61.02	60.00
0.02750	119.90	6.44	18.62	61.02	60.00
0.03000	125.23	6.73	18.62	61.02	60.00
0.03250	130.34	7.00	18.62	61.02	60.00
0.03500	135.26	7.26	18.62	61.02	60.00
0.03750	140.01	7.52	18.62	61.02	60.00
0.04000	144.60	7.77	18.62	61.02	60.00
0.04250	149.05	8.00	18.62	61.02	60.00
0.04500	153.37	8.24	18.62	61.02	60.00
0.04750	157.57	8.46	18.62	61.02	60.00
0.05000	161.67	8.68	18.62	61.02	60.00

## **HYDRAULIC CALCULATIONS**

# **BRANDING IRON AT STERLING RANCH FILING NO. 2**

## **FINAL DRAINAGE REPORT**

### **(CDOT Type R Inlet Calculations - Sump Condition)**

Urban Minor Arterial Roadway-100' ROW-62' Pavement-6" Vertical Curb  
Maximum allowable depth for **MINOR (0.485')** & **MAJOR (0.64')** storm

Inlet Length	Storm	Depth	Eqn. 7-31	Eqn. 7-32	Eqn. 7-29
			$Q_w = C_w N_w L_e D^{3/2}$	$Q_o = C_o N_o (L_e H_c) (2g(D - 0.5H_c))^{1/2}$	$Q_m = C_m (Q_w Q_o)^{1/2}$
5	Q5	0.485	6.1	6.5	5.9
5	Q100	0.64	9.2	8.4	8.2
6	Q5	0.485	7.3	7.8	7.0
6	Q100	0.64	11.1	10.1	9.8
8	Q5	0.485	9.7	10.4	9.4
8	Q100	0.64	14.7	13.4	13.1
10	Q5	0.485	12.2	13.0	11.7
10	Q100	0.64	18.4	16.8	16.4
12	Q5	0.485	14.6	15.6	14.0
12	Q100	0.64	22.1	20.1	19.6
14	Q5	0.485	17.0	18.2	16.4
14	Q100	0.64	25.8	23.5	22.9
15	Q5	0.485	18.2	19.5	17.6
15	Q100	0.64	27.6	25.2	24.5
16	Q5	0.485	19.5	20.9	18.7
16	Q100	0.64	29.5	26.9	26.2
18	Q5	0.485	21.9	23.5	21.1
18	Q100	0.64	33.2	30.2	29.4
20	Q5	0.485	24.3	26.1	23.4
20	Q100	0.64	36.9	33.6	32.7
22	Q5	0.485	26.8	28.7	25.8
22	Q100	0.64	40.6	36.9	36.0

**DESIGN POINT 26  
(DP26)**

**DESIGN POINT 24  
(DP24)**

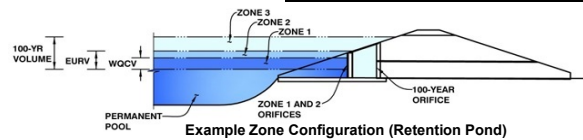
Table 7-7. Coefficients for various inlets in sumps

Inlet Type	Nw	Cw	No	Co	Cm
CDOT Type 13 Grate	0.7	3.3	0.43	0.6	0.93
Denver No. 16 Grate	0.73	3.6	0.31	0.6	0.9
Curb Opening for Type 13/No. 16 Combination	1	3.7	1	0.66	0.86
CDOT Type R Curb Opening	1	3.6	1	0.67	0.93

# BRANDING IRON AT STERLING RANCH FIL. NO.2

## DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 8

### Required Volume Calculation

Selected BMP Type =	<b>EDB</b>	
Watershed Area =	35.20	acres
Watershed Length =	2,151	ft
Watershed Slope =	0.021	ft/ft
Watershed Imperviousness =	53.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths = User Input		
Water Quality Capture Volume (WQCV) =	0.630	acre-feet
Excess Urban Runoff Volume (EURV) =	2.004	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.671	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	2.524	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	3.238	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	4.235	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	5.066	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	6.013	acre-feet
500-yr Runoff Volume (P1 = 6.53 in.) =	16.565	acre-feet
Approximate 2-yr Detention Volume =	1.581	acre-feet
Approximate 5-yr Detention Volume =	2.320	acre-feet
Approximate 10-yr Detention Volume =	2.537	acre-feet
Approximate 25-yr Detention Volume =	2.653	acre-feet
Approximate 50-yr Detention Volume =	2.952	acre-feet
Approximate 100-yr Detention Volume =	3.543	acre-feet

Top of MP=7014.54

### Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.630	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.374	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.540	acre-feet
Total Detention Basin Volume =	3.543	acre-feet
Initial Surcharge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth ( $H_{t\text{avail}}$ ) =	user	ft
Depth of Trickle Channel ( $H_{TC}$ ) =	user	ft
Slope of Trickle Channel ( $S_{TC}$ ) =	user	ft/ft
Slopes of Main Basin Sides ( $S_{\text{main}}$ ) =	user	H:V
Basin Length-to-Width Ratio ( $R_{L/W}$ ) =	user	

Optional User Input  
1-hr Precipitation

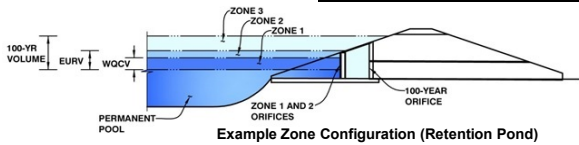
[illegible]

# BRANDING IRON AT STERLING RANCH FIL. NO.2

## Detention Basin Outlet Structure Design

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 8



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.94	0.630	Orifice Plate
Zone 2 (EURV)	4.92	1.374	Orifice Plate
Zone 3 (100-year)	6.64	1.540	Weir&Pipe (Restrict)
		3.543	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  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 =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  inches  
Orifice Plate: Orifice Area per Row =  inches

Calculated Parameters for Plate

WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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	1.60	3.20	4.80				
Orifice Area (sq. inches)	2.87	2.90	4.38	2.88				

	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 =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>
Vertical Orifice Centroid =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	<input type="text" value="4.74"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="9.00"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Slope =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	<input type="text" value="2.91"/>	<input type="text" value="N/A"/>	feet
Overflow Grate Open Area % =	<input type="text" value="70%"/>	<input type="text" value="N/A"/>	% grate open area/total area
Debris Clogging % =	<input type="text" value="50%"/>	<input type="text" value="N/A"/>	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>1</sub> =	<input type="text" value="5.47"/>	<input type="text" value="N/A"/>	feet
Over Flow Weir Slope Length =	<input type="text" value="3.00"/>	<input type="text" value="N/A"/>	feet
Grate Open Area / 100-yr Orifice Area =	<input type="text" value="4.90"/>	<input type="text" value="N/A"/>	should be ≥ 4
Overflow Grate Open Area w/o Debris =	<input type="text" value="18.90"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	<input type="text" value="9.45"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>

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 =	<input type="text" value="0.00"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="30.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="22.00"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	<input type="text" value="3.86"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>
Outlet Orifice Centroid =	<input type="text" value="1.02"/>	<input type="text" value="N/A"/>	feet
Half-Central Angle of Restrictor Plate on Pipe =	<input type="text" value="2.06"/>	<input type="text" value="N/A"/>	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

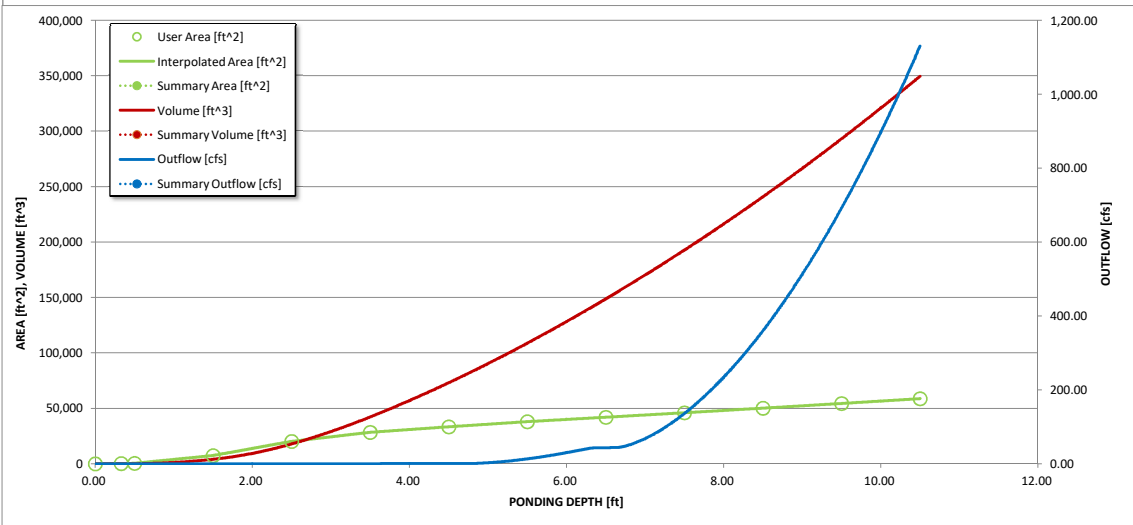
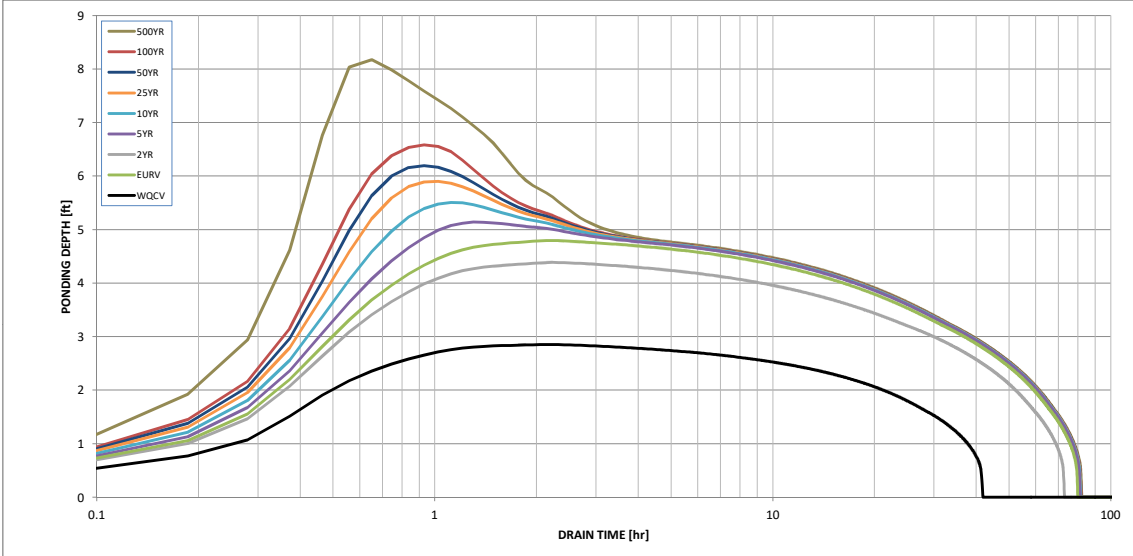
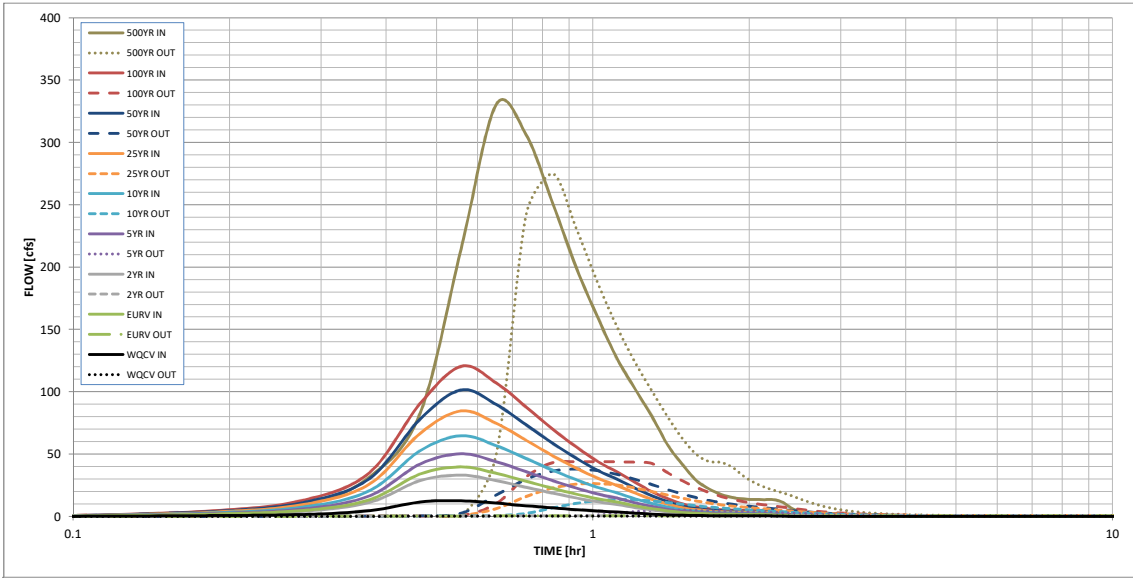
Calculated Parameters for Spillway

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

### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	6.53
Calculated Runoff Volume (acre-ft) =	0.630	2.004	1.671	2.524	3.238	4.235	5.066	6.013	16.565
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.629	2.003	1.670	2.523	3.237	4.233	5.062	6.008	16.555
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.17	0.34	0.78	1.01	1.29	1.83
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	6.0	12.0	27.5	35.6	45.6	64.5
Peak Inflow Q (cfs) =	12.5	39.7	33.2	50.2	64.6	84.7	101.4	120.4	329.9
Peak Outflow Q (cfs) =	0.3	0.8	0.5	5.0	13.4	26.3	37.8	43.8	274.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.1	1.0	1.1	1.0	4.3
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.01	N/A	0.2	0.7	1.3	1.9	2.3	2.6
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) =	39	72	66	72	70	67	65	63	47
Time to Drain 99% of Inflow Volume (hours) =	41	77	70	77	77	76	75	74	65
Maximum Ponding Depth (ft) =	2.85	4.80	4.39	5.14	5.51	5.90	6.19	6.59	8.17
Area at Maximum Ponding Depth (acres) =	0.53	0.80	0.75	0.83	0.87	0.91	0.94	0.97	1.12
Maximum Volume Stored (acre-ft) =	0.584	1.902	1.585	2.179	2.495	2.851	3.119	3.490	5.152

Detention Basin Outlet Structure Design



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

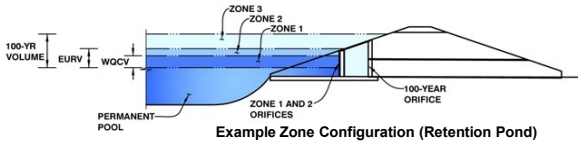
## DETENTION BASIN STAGE-STORAGE TABLE BUILDER

# STERLING RANCH FILING NOS. 1&2 MDDP (PREVIOUS VERSION)

## Detention Basin Outlet Structure Design

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 8



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.73	0.518	Orifice Plate
Zone 2 (EURV)	4.47	1.131	Orifice Plate
Zone 3 (100-year)	5.98	1.268	Weir&Pipe (Restrict)
		2.917	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  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 =  ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  inches  
Orifice Plate: Orifice Area per Row =  inches

Calculated Parameters for Plate

WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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	1.49	2.98					
Orifice Area (sq. inches)	2.49	2.49	5.50					

	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)

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

Vertical Orifice Area =  ft<sup>2</sup>  
Vertical Orifice Centroid =  feet

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

Overflow Weir Front Edge Height, H<sub>o</sub> =  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

Height of Grate Upper Edge, H<sub>1</sub> =  feet  
Over Flow Weir Slope Length =  feet  
Grate Open Area / 100-yr Orifice Area =  should be ≥ 4  
Overflow Grate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris =  ft<sup>2</sup>

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

Depth to Invert of Outlet Pipe =  ft (distance below basin bottom at Stage = 0 ft)  
Outlet Pipe Diameter =  inches  
Restrictor Plate Height Above Pipe Invert =  inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Outlet Orifice Area =  ft<sup>2</sup>  
Outlet Orifice Centroid =  feet  
Half-Central Angle of Restrictor Plate on Pipe =  radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

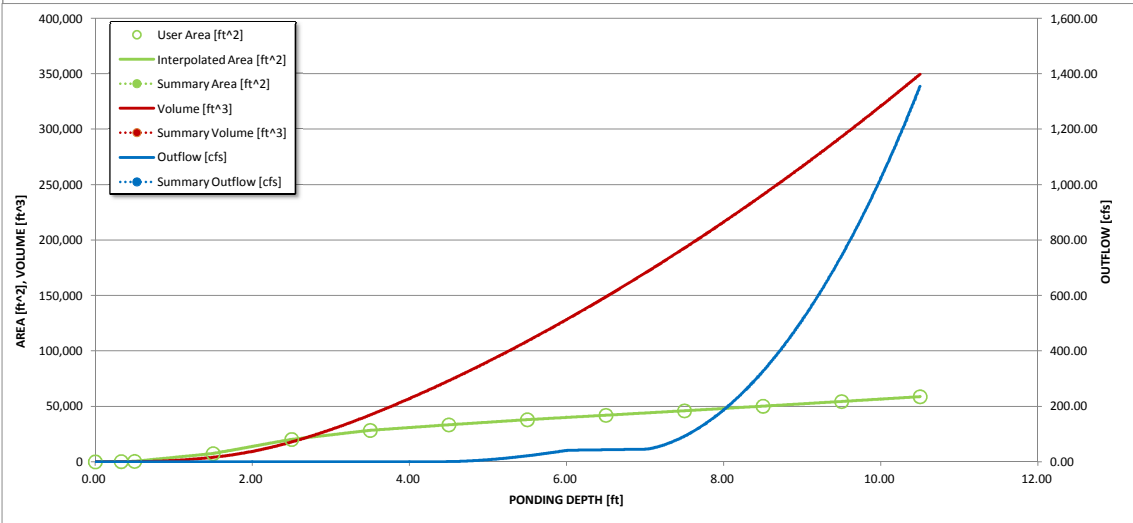
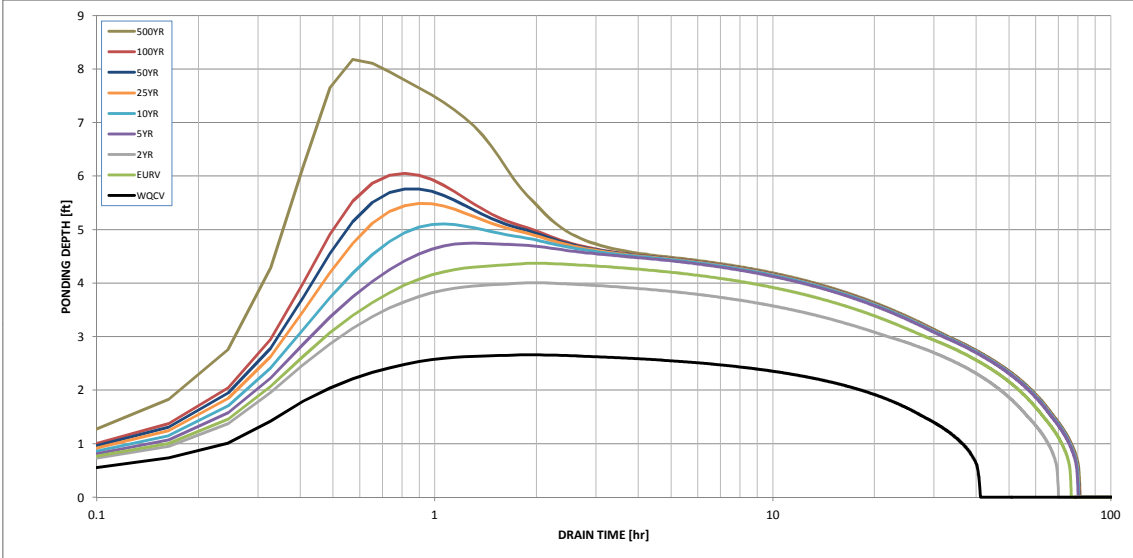
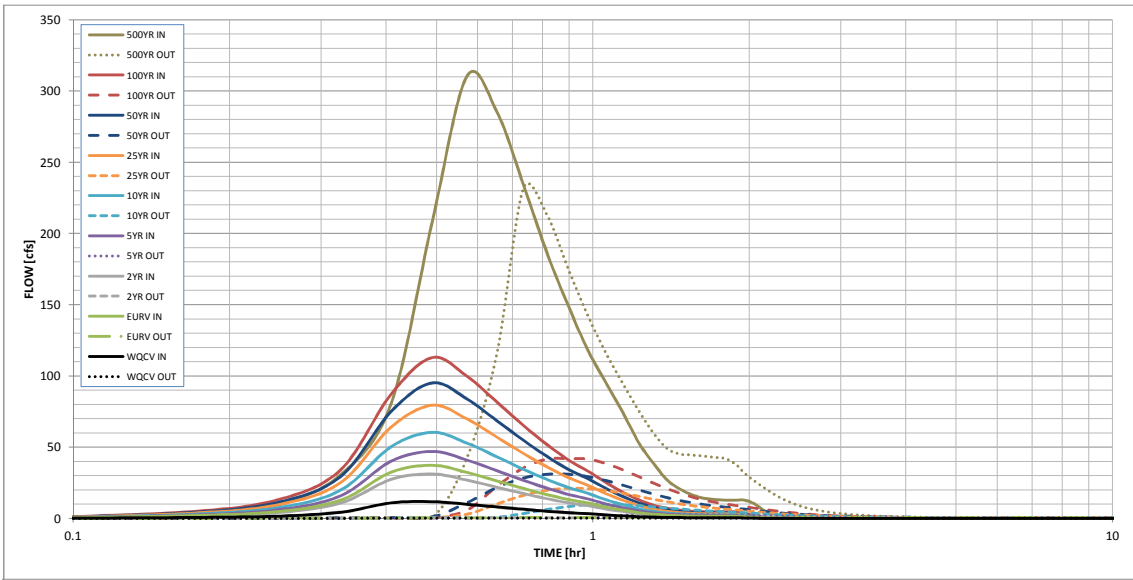
Spillway Design Flow Depth =  feet  
Stage at Top of Freeboard =  feet  
Basin Area at Top of Freeboard =  acres

### Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	6.53
Calculated Runoff Volume (acre-ft) =	0.518	1.650	1.376	2.078	2.666	3.486	4.171	4.951	13.638
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.519	1.650	1.376	2.080	2.667	3.489	4.174	4.948	13.639
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.20	0.40	0.91	1.18	1.50	2.12
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	5.9	11.7	26.4	34.1	43.4	61.3
Peak Inflow Q (cfs) =	11.8	37.3	31.2	47.0	60.4	79.3	95.1	112.8	310.3
Peak Outflow Q (cfs) =	0.2	0.5	0.5	2.9	9.9	21.2	31.0	41.7	231.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.8	0.8	0.9	1.0	3.8
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.5	1.1	1.6	2.2	2.6
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) =	38	69	63	71	69	66	65	63	46
Time to Drain 99% of Inflow Volume (hours) =	40	73	68	76	76	75	74	73	64
Maximum Ponding Depth (ft) =	2.66	4.37	4.01	4.74	5.11	5.49	5.76	6.05	8.18
Area at Maximum Ponding Depth (acres) =	0.49	0.75	0.71	0.79	0.83	0.87	0.90	0.92	1.12
Maximum Volume Stored (acre-ft) =	0.482	1.577	1.307	1.863	2.154	2.477	2.716	2.988	5.152

STERLING RANCH FILING NOS. 1&2 MDDP (PREVIOUS VERSION)

Detention Basin Outlet Structure Design



S-A-V-D Chart Axis Override

	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



PROJECT: STERLING Ranch FILING No. 1

DATE: POND 8

### FOREBAY VOLUMES FOR POND 8

SIZE OF TOTAL CONTRIBUTING AREA = 35.2 ACRES

MIN FOREBAY VOLUME = 3% OF WQCV (UP TO T5, EDB 4)

$$\text{WQCV POND 8} = 0.584 \text{ AC-FT} \times 3\% = 0.0175 \text{ AC-FT} \times \frac{42560 \text{ CF}}{1 \text{ AC-FT}} = 763.17 \text{ CF} \approx 763 \text{ CF}$$

NUMBER OF FOREBAYS = 2

CONTRIBUTING AREA TO SOUTH FOREBAY = 1.26 AC

% OF CONTRIBUTING AREA =  $1.26 \text{ AC} / 35.2 \text{ AC} = 3.6\% \approx 4\%$

VOLUME REQ. =  $4\% \times 763 \text{ CF} = 30.52 \text{ CF} \approx 31 \text{ CF} < 33.85 \text{ CF}$  SIZE OF  
PREVIOUSLY IN SR FILING 1

REMAINDER OF AREA TO NORTH FOREBAY

$96\% \times 763 \text{ CF} = 732 \text{ CF}$  REQ VOLUME

VOLUME PROVIDED  $570 \text{ SQ FT} \times 1.5 = 855 \text{ CF}$

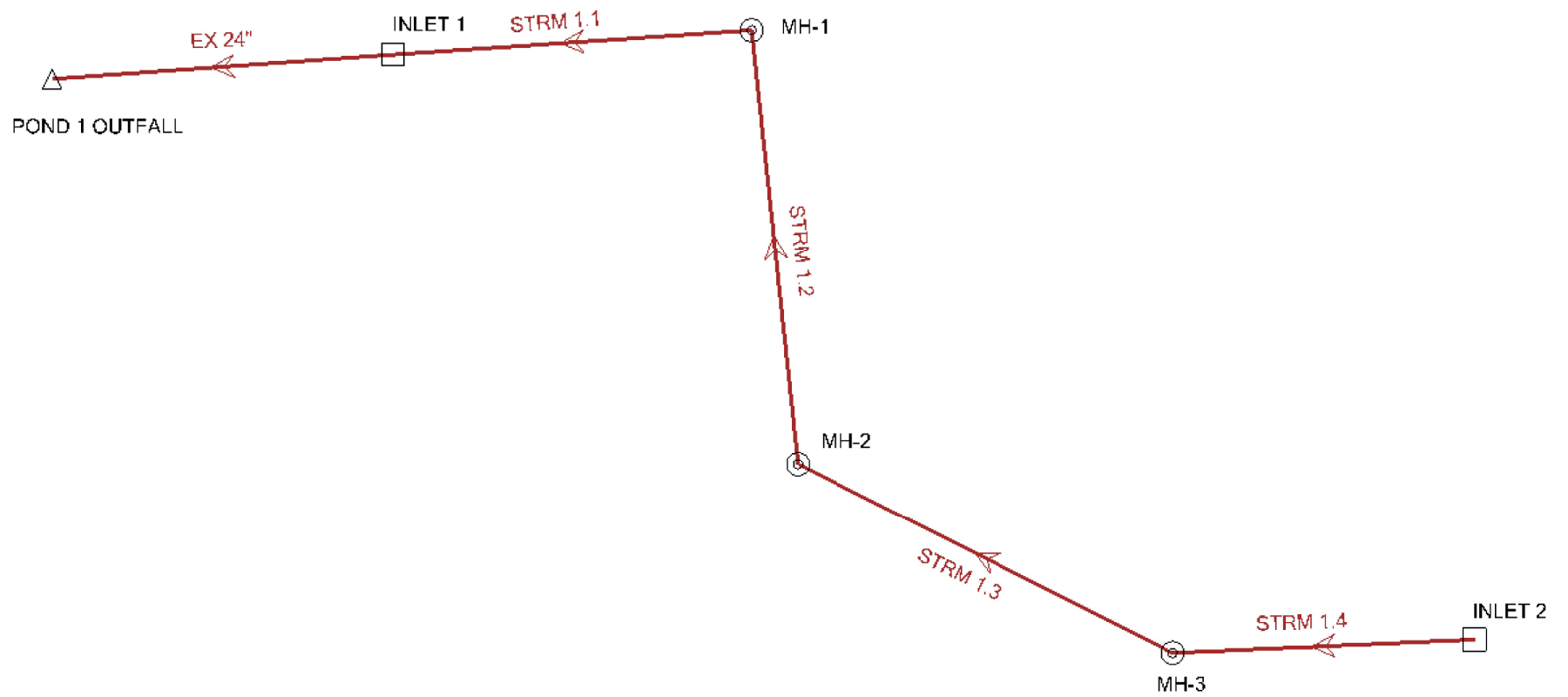
855 CF PROVIDED > 732 CF REQ OK

# DESIGN POINT 24

## EMERGENCY OVERFLOW PATH

The open channel flow calculator			
<p style="color: red;">Select Channel Type:</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Trapezoid ▾</div>	<div style="display: flex; justify-content: space-around; font-weight: bold; font-size: small;"> <span>Rectangle</span> <span>Trapezoid</span> <span>Triangle</span> <span>Circle</span> </div>		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">Velocity(V)&amp;Discharge(Q) ▾</div>	<p style="color: red;">Select unit system:</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Feet(ft) ▾</div>		
<p>Channel slope: <input style="width: 50px;" type="text" value="0.034"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft/ft</div>	<p>Water depth(y): <input style="width: 50px;" type="text" value="0.46"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft</div>	<p>Bottom width(b) <input style="width: 50px;" type="text" value="6"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft</div>	
<p>Flow velocity <span style="color: red;">5.7606</span></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft/s</div>	<p>LeftSlope (Z1): <input style="width: 50px;" type="text" value="3"/> to 1 (H:V)</p>		<p>RightSlope (Z2): <input style="width: 50px;" type="text" value="3"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">to 1 (H:V)</div>
<p>Flow discharge <span style="color: red;">19.556</span></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft^3/s</div>	<p>Input n value <input style="width: 50px;" type="text" value="0.025"/> or select n</p>		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">Calculate!</div>	<p>Status: <span style="color: red;">Calculation finished</span></p>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">Reset</div>	
<p>Wetted perimeter <input style="width: 50px;" type="text" value="8.91"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft</div>	<p>Flow area <input style="width: 50px;" type="text" value="3.39"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft^2</div>	<p>Top width(T) <input style="width: 50px;" type="text" value="8.76"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft</div>	
<p>Specific energy <input style="width: 50px;" type="text" value="0.98"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft</div>	<p>Froude number <input style="width: 50px;" type="text" value="1.63"/></p>		<p>Flow status <input style="width: 50px;" type="text" value="Supercritical flow"/></p>
<p>Critical depth <input style="width: 50px;" type="text" value="0.62"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft</div>	<p>Critical slope <input style="width: 50px;" type="text" value="0.0117"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft/ft</div>	<p>Velocity head <input style="width: 50px;" type="text" value="0.52"/></p> <div style="border: 1px solid black; padding: 2px; font-size: x-small;">ft</div>	

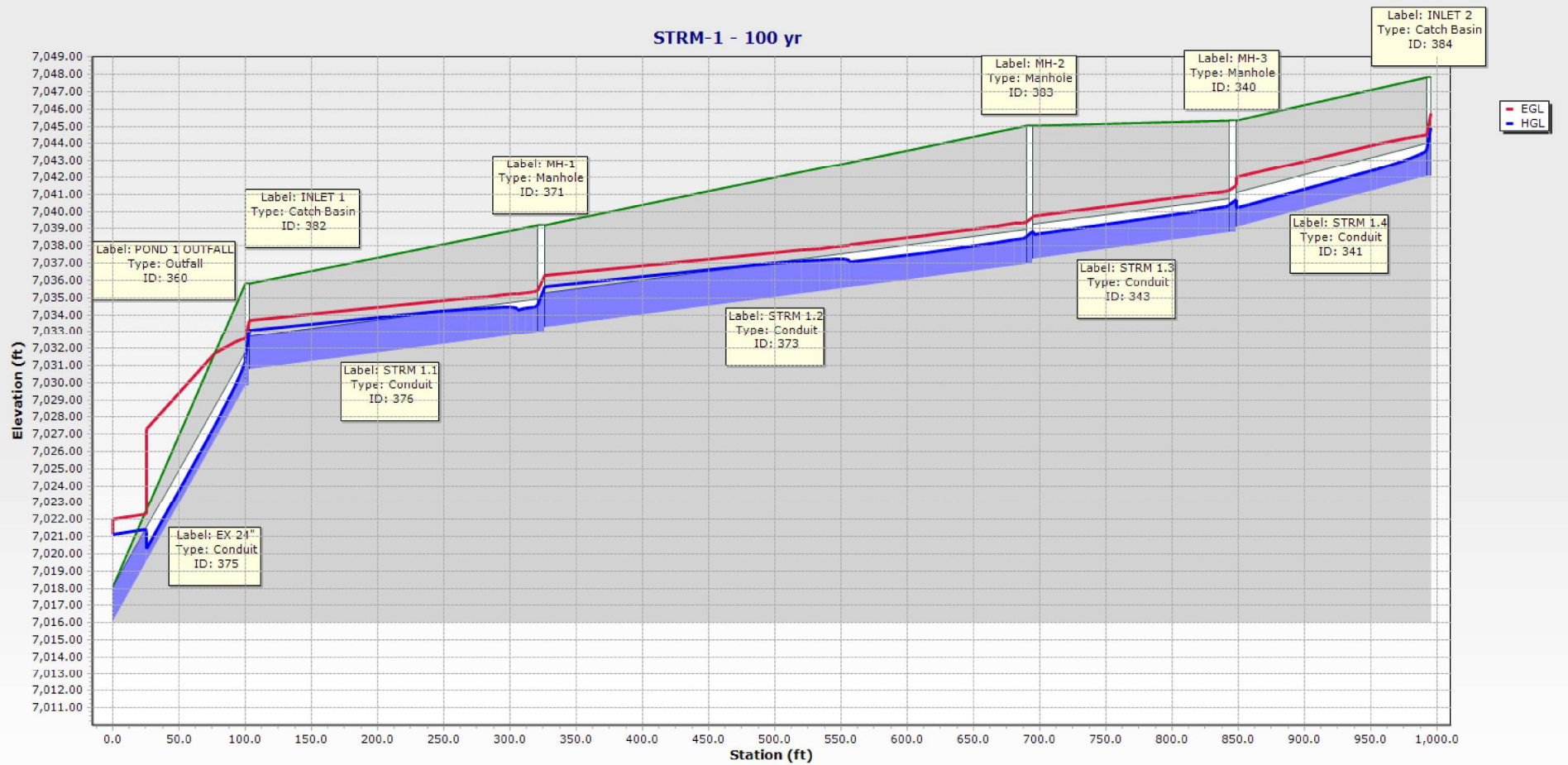
## STORM 1 INDEX MAP



Conduit FlexTable: STORM 1 100 YR

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)
STRM 1.4	341	INLET 2	19.80	61.9	148.2	10.71	1.955	1.14	1.60	7,044.48	7,041.52	7,043.64	7,040.71	2.92	7,044.90
STRM 1.3	343	MH-3	19.80	87.3	153.3	8.13	1.229	1.45	1.60	7,041.22	7,039.68	7,040.38	7,038.88	1.50	7,040.71
STRM 1.2	373	MH-2	19.80	87.5	368.9	8.12	1.225	1.45	1.60	7,039.38	7,036.28	7,038.54	7,035.66	2.88	7,038.88
EX 24"	375	INLET 1	23.50	28.3	101.8	22.75	5.476	0.73	1.72	7,032.56	7,022.00	7,031.52	7,021.13	10.39	7,033.08
STRM 1.1	376	MH-1	19.80	87.6	221.5	8.11	1.223	1.45	1.60	7,035.39	7,033.69	7,034.55	7,033.08	1.47	7,035.66
Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description								
7.35	1.500	1.26	7,047.83	7,045.36	7,042.04	7,039.08	Circle - 24.0 in								
7.20	0.400	0.34	7,045.36	7,045.05	7,038.78	7,037.24	Circle - 24.0 in								
7.20	0.400	0.34	7,045.05	7,039.21	7,036.94	7,033.25	Circle - 24.0 in								
6.30	1.500	1.56	7,035.81	7,018.06	7,029.80	7,016.06	Circle - 24.0 in								
6.30	1.320	1.11	7,039.21	7,035.81	7,032.95	7,030.74	Circle - 24.0 in								

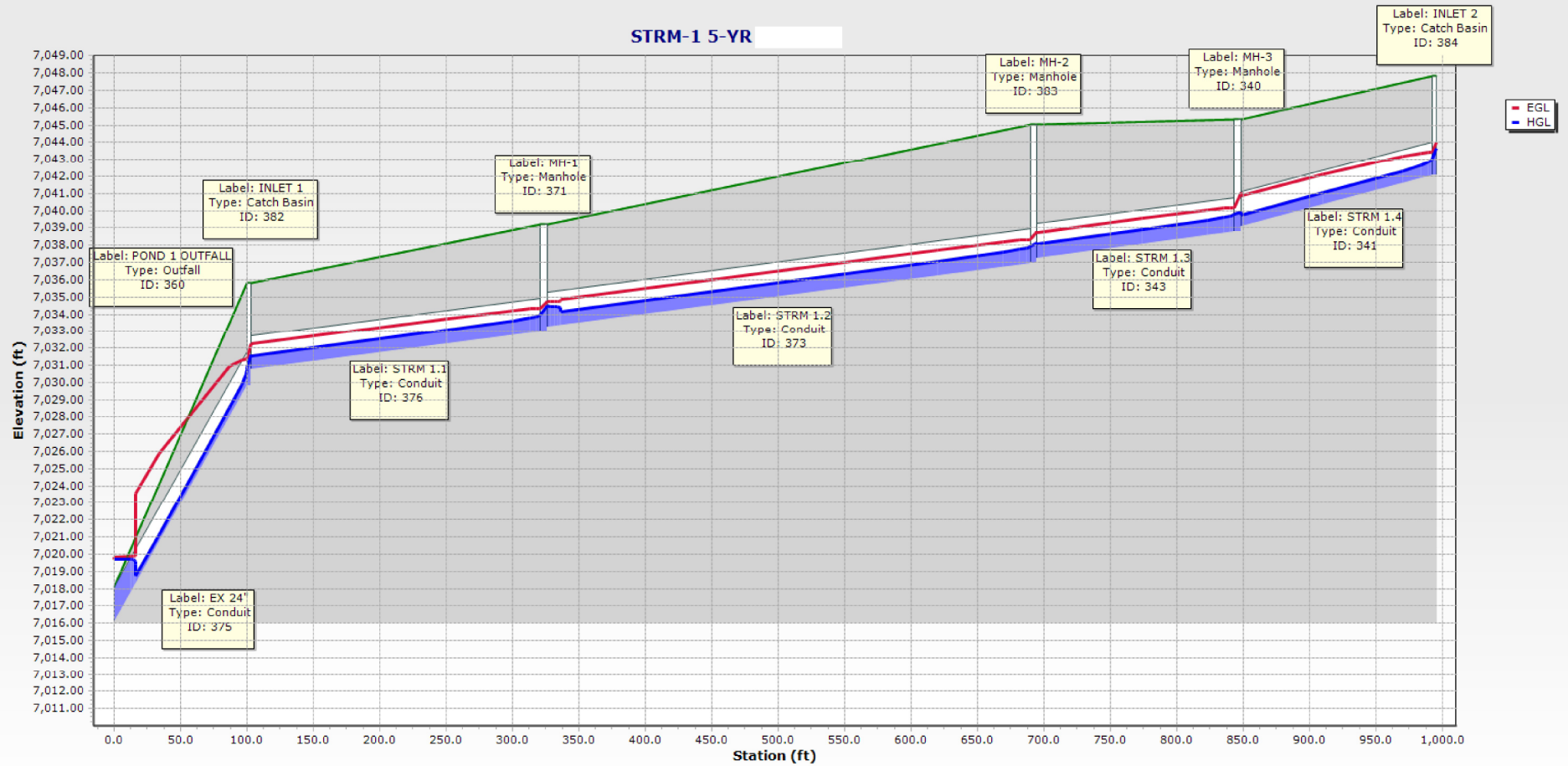
# STRM-1 - 100 yr



Conduit FlexTable: STORM 1 5 YR

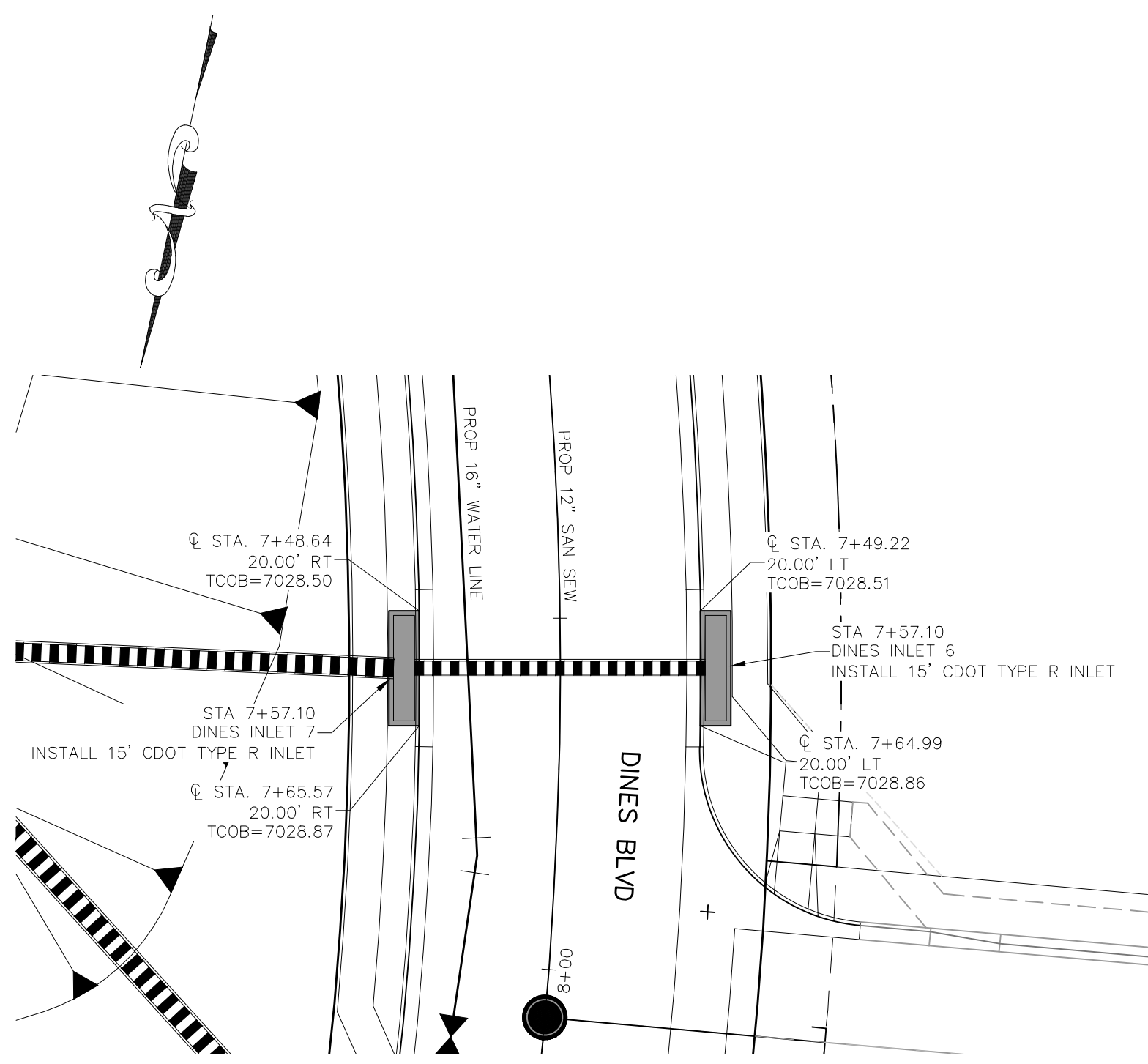
Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)
STRM 1.4	341	INLET 2	8.00	25.0	148.2	8.46	2.112	0.68	1.01	7,043.44	7,040.87	7,043.05	7,039.76	3.29	7,043.64
STRM 1.3	343	MH-3	8.00	35.3	153.3	6.59	1.480	0.82	1.01	7,040.18	7,038.74	7,039.79	7,038.06	1.73	7,039.95
STRM 1.2	373	MH-2	8.00	35.4	368.9	6.58	1.476	0.82	1.01	7,038.34	7,034.72	7,037.95	7,034.48	3.47	7,038.11
EX 24"	375	INLET 1	9.50	11.4	101.8	17.59	5.468	0.46	1.10	7,031.35	7,019.83	7,030.90	7,019.69	11.21	7,031.57
STRM 1.1	376	MH-1	8.00	35.4	221.5	6.58	1.475	0.82	1.01	7,034.35	7,032.23	7,033.96	7,031.56	2.40	7,034.48
Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Conduit Description								
5.05	1.500	0.59	7,047.83	7,045.36	7,042.04	7,039.08	Circle - 24.0 in								
8.46	0.400	0.16	7,045.36	7,045.05	7,038.78	7,037.24	Circle - 24.0 in								
6.59	0.400	0.16	7,045.05	7,039.21	7,036.94	7,033.25	Circle - 24.0 in								
6.58	1.500	0.67	7,035.81	7,018.06	7,029.80	7,016.06	Circle - 24.0 in								
3.95	1.320	0.52	7,039.21	7,035.81	7,032.95	7,030.74	Circle - 24.0 in								

# STRM-1 5-YR

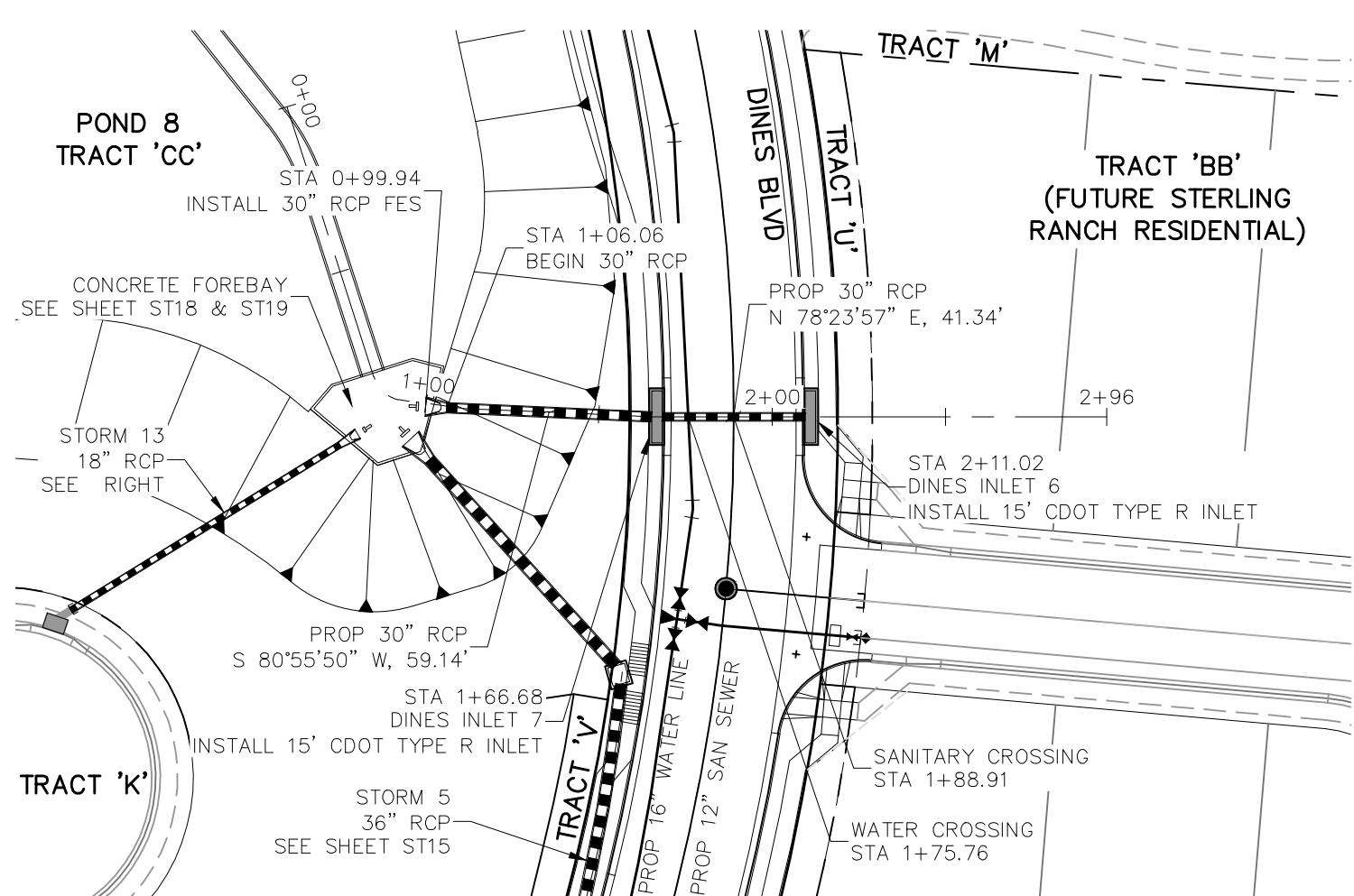


## **MODIFICATIONS TO POND 8**

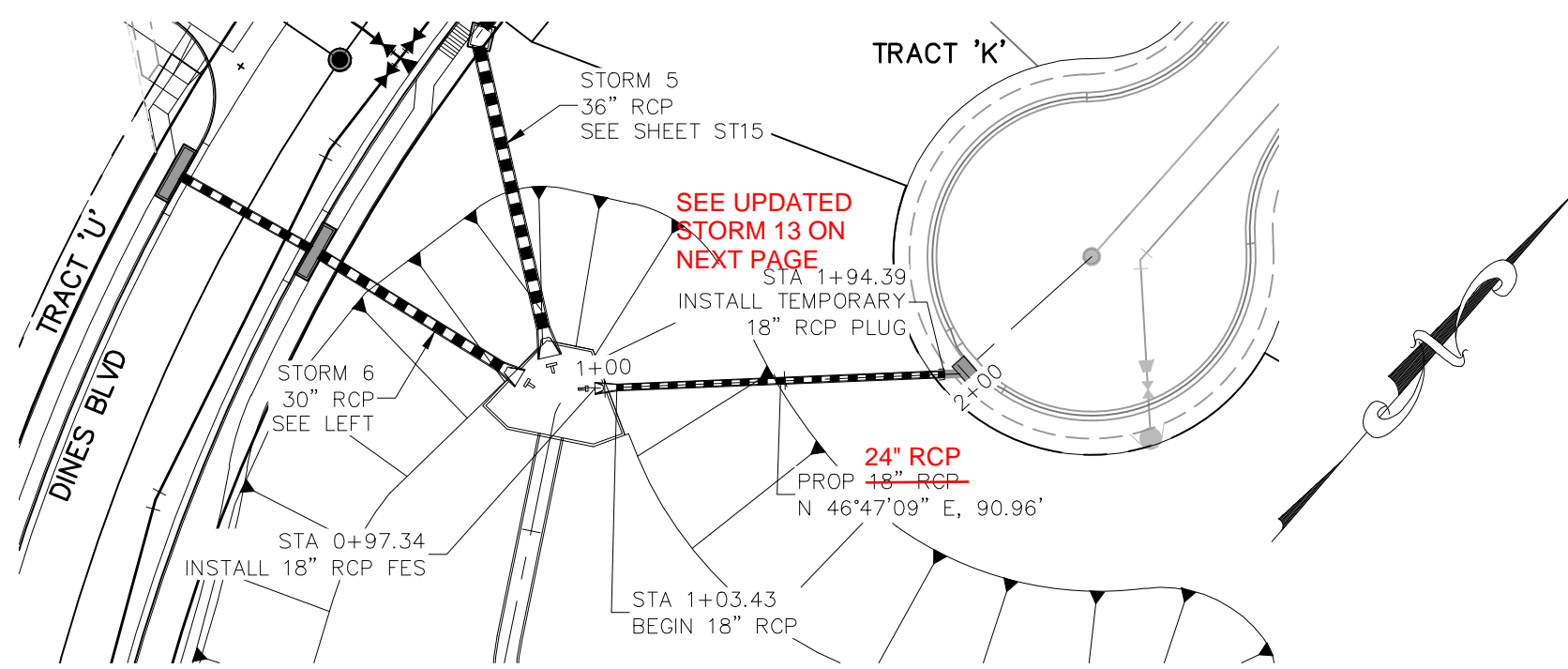
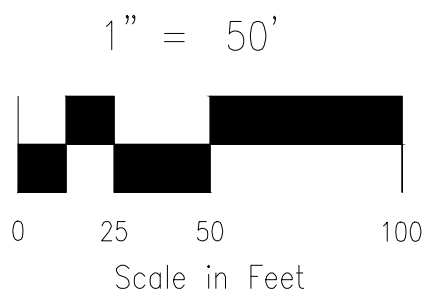
File: c:\09002A\Sterling Ranch District\dwg\Const Dwg\Storm - District\ST16.dwg Plotstamp: 2/7/2017 2:17 PM



**STORM 6  
INLET DETAILS**  
SCALE: 1"=20'



**STORM 6**

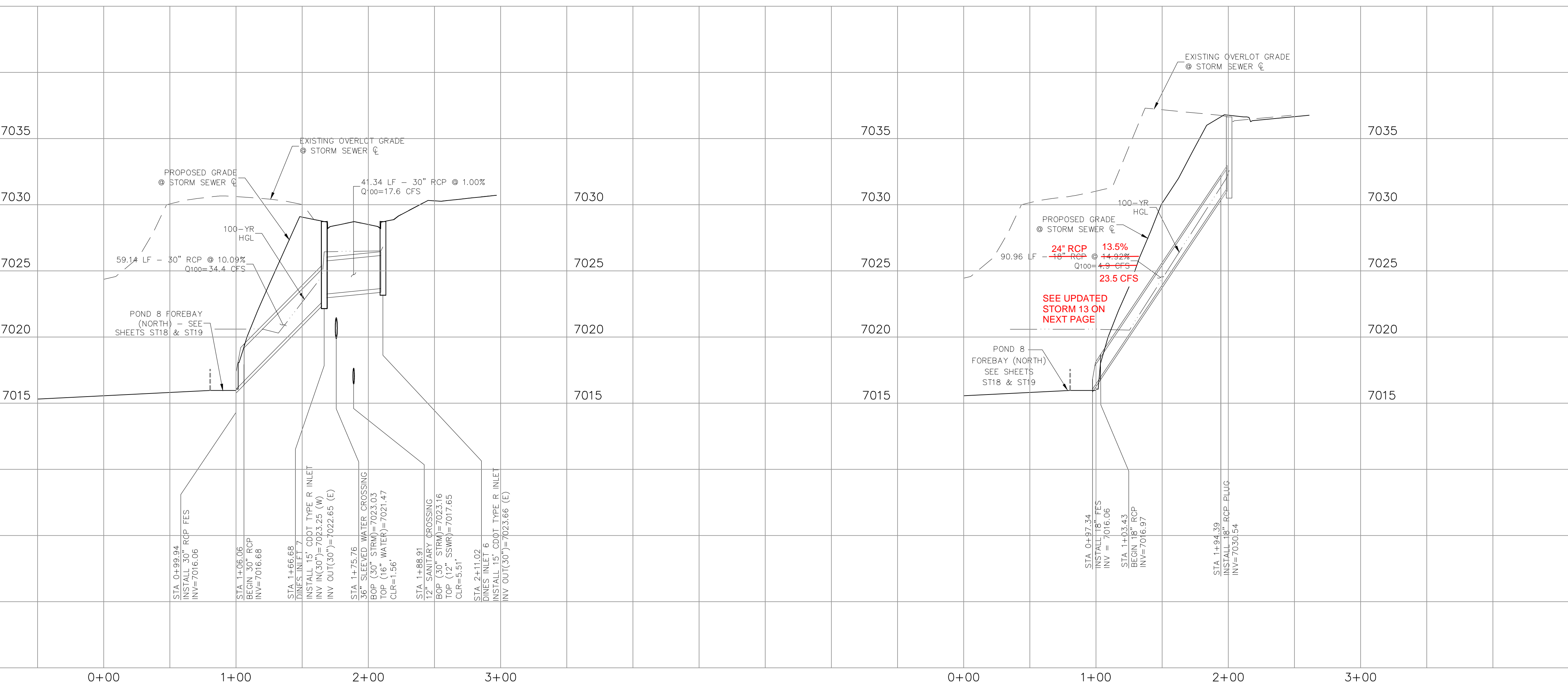


**STORM 13 STA 0+97.34 TO 1+94.39**

NOTES:  
STA 0+99.94 TO STA 1+24.00  
(NEXT FULL JOINT) TIE PIPE  
SEGMENTS TOGETHER W/4-3"  
CANOPY TYPE ROD LUG JOINT  
FASTENERS.

REINFORCED CONCRETE PIPE INSTALLED  
BETWEEN STA 0+99.94 AND STA 1+66.68  
SHALL BE FABRICATED USING A CONCRETE  
MIX DESIGN THAT RESULTS IN A MIN. 5000 PSI  
COMPRESSIVE STRENGTH.

NOTE:  
STA 1+00.00 TO STA 1+24.00 (NEXT FULL  
JOINT) TIE PIPE SEGMENTS TOGETHER  
W/4-3" CANOPY TYPE ROD LUG JOINT  
FASTENERS.



**STORM 6**

**STORM 13 STA 0+97.34 TO 1+94.39**

FOR LOCATING  
& MARKING  
GAS,  
ELECTRIC,  
WATER &  
TELEPHONE  
LINES  
FOR BURIED UTILITY INFORMATION  
48 HRS BEFORE YOU DIG  
CALL 1-800-922-1987

STERLING RANCH FILING NO. 1

STORM SEWER PLANS

PROJECT NO. 09-002

FILE: \Lang\Const Dwg\Storm - District\ST16.dwg

DESIGNED BY: ET

DRAWN BY: ELY

CHECKED BY: WAS

DATE: 01/02/2018

SCALE: HORIZ: 1"=50' VERT: 1"=5'

ST16

20 BOULDER CRESCENT SUITE 110  
COLORADO SPRINGS, CO 80903  
PHONE: 719.555.5485

CIVIL CONSULTANTS, INC.

FOR AND ON  
BEHALF OF  
M&S CIVIL  
CONSULTANTS,  
INC.

37160

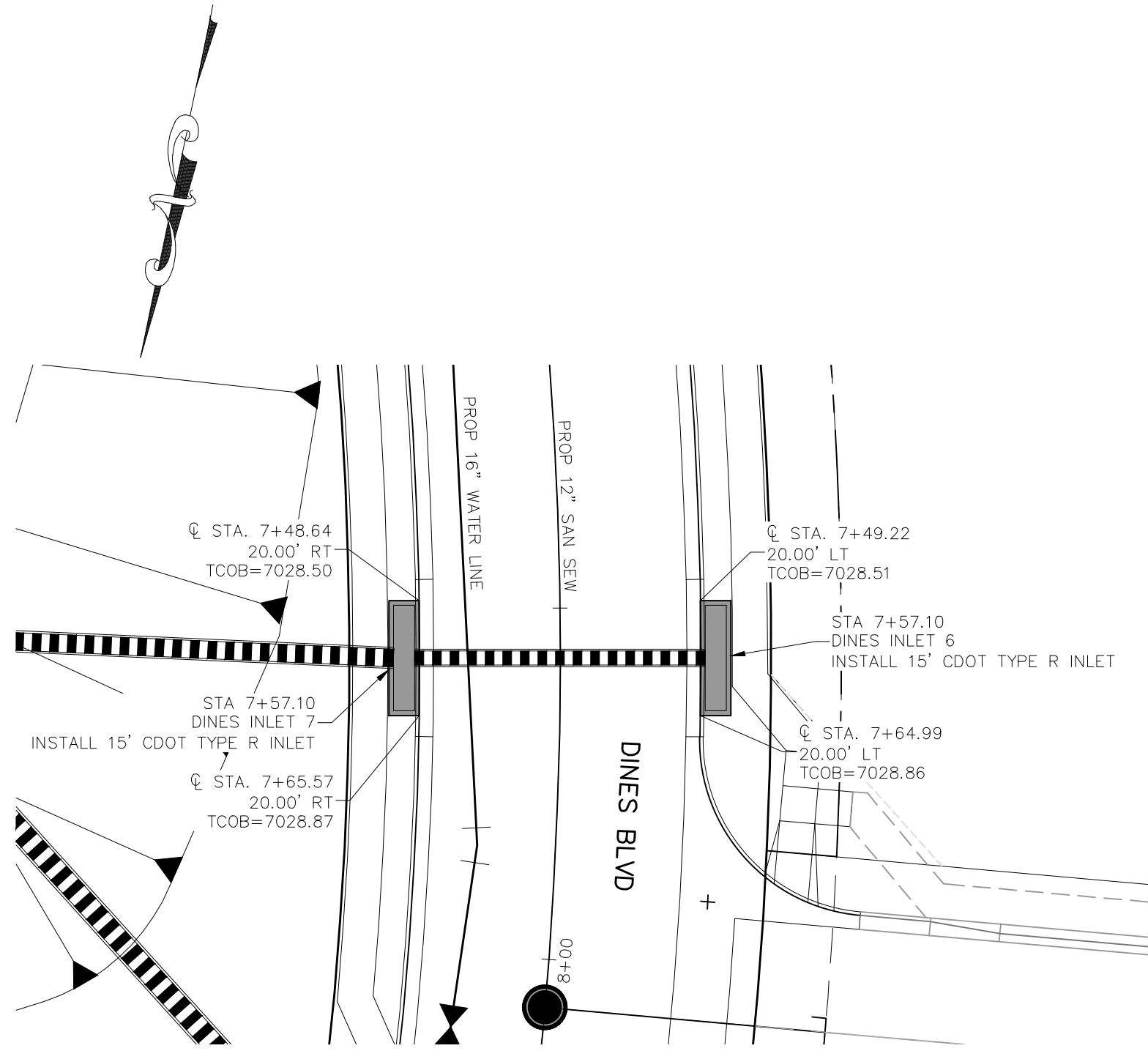
REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APPROVED BY:	DATE:

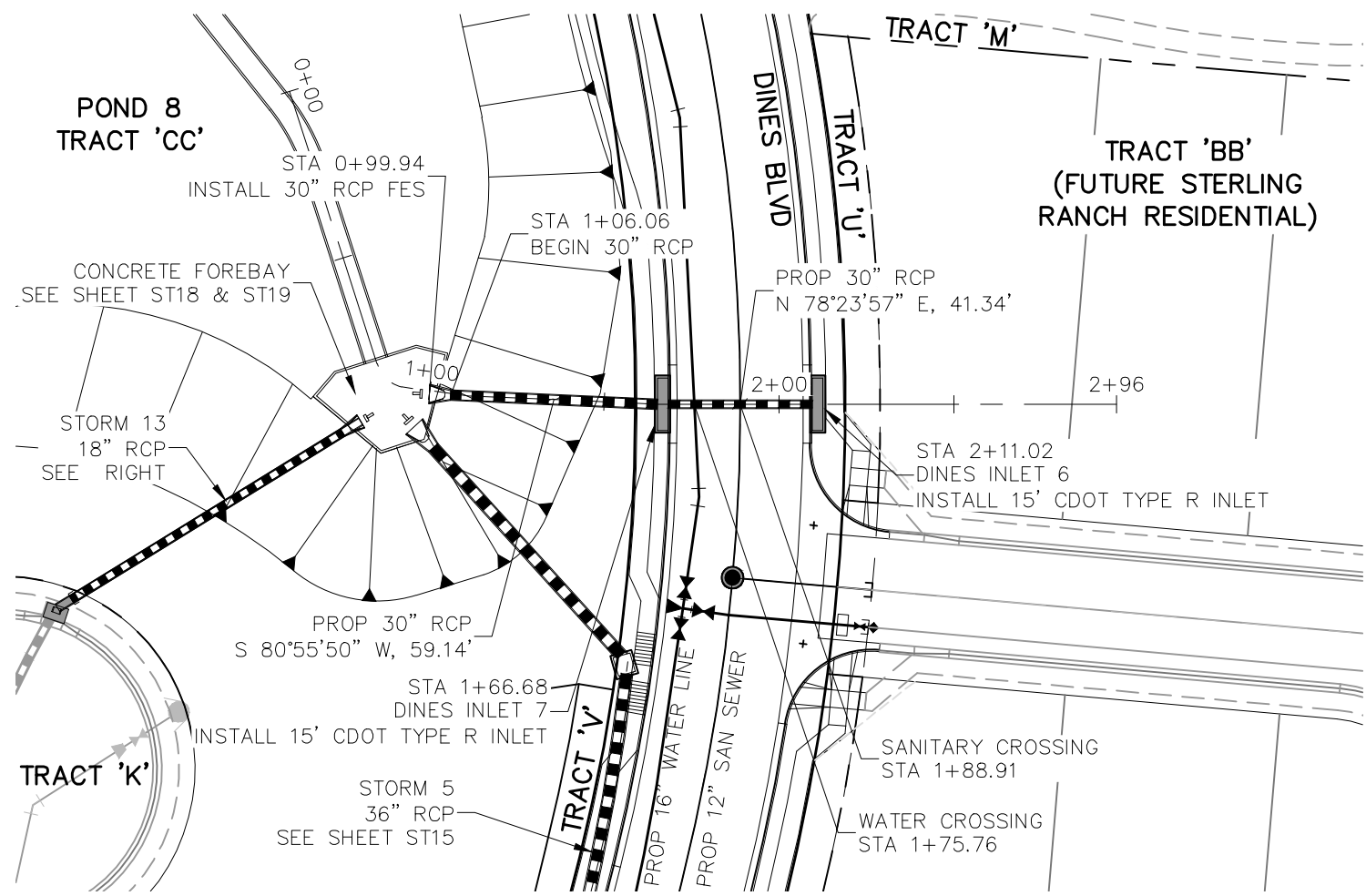
THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR  
USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER  
OF THESE PLANS.

CAUTION

File: c:\09002A\Sterling Ranch District\dwg\Const Dwg\Storm - District\ST16.dwg Plotstamp: 4/11/2018 11:10 AM



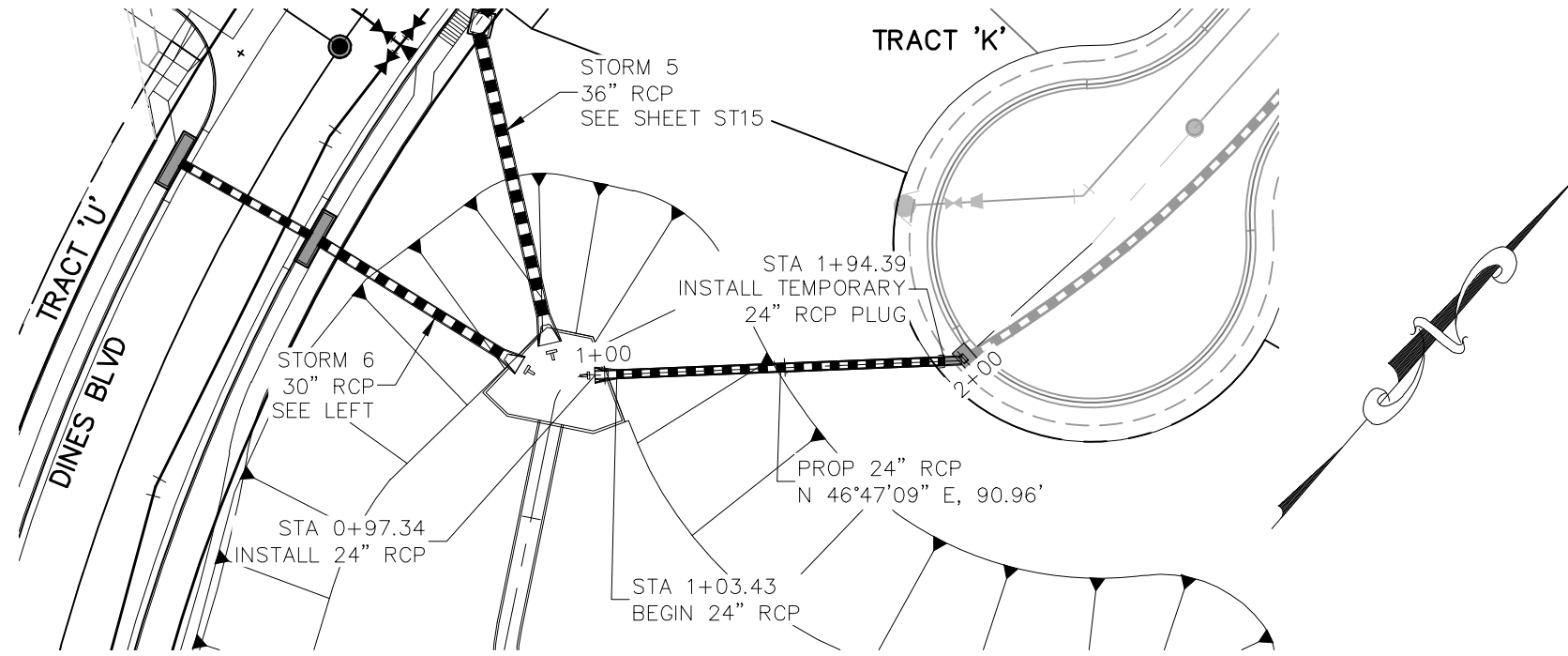
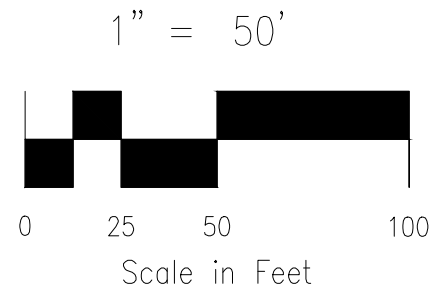
**STORM 6  
INLET DETAILS**  
SCALE: 1"=20'



**STORM 6**

NOTES:  
STA 0+99.94 TO STA 1+24.00  
(NEXT FULL JOINT) TIE PIPE  
SEGMENTS TOGETHER W/4-3"  
CANOPY TYPE ROD LUG JOINT  
FASTENERS.

REINFORCED CONCRETE PIPE INSTALLED  
BETWEEN STA 0+99.94 AND STA 1+66.68  
SHALL BE FABRICATED USING A CONCRETE  
MIX DESIGN THAT RESULTS IN A MIN. 5000 PSI  
COMPRESSIVE STRENGTH.

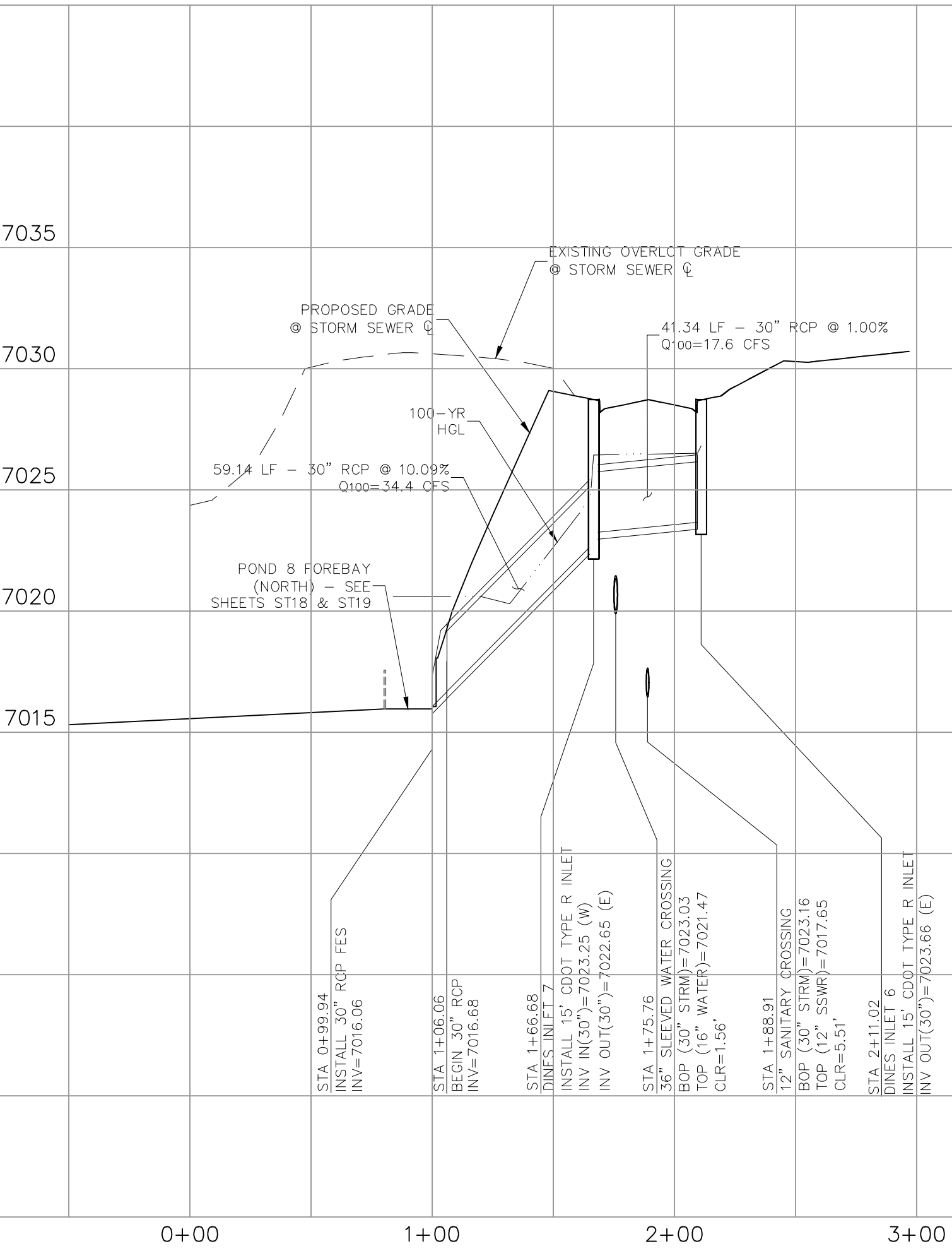


**STORM 13 STA 0+97.34 TO 1+94.39**

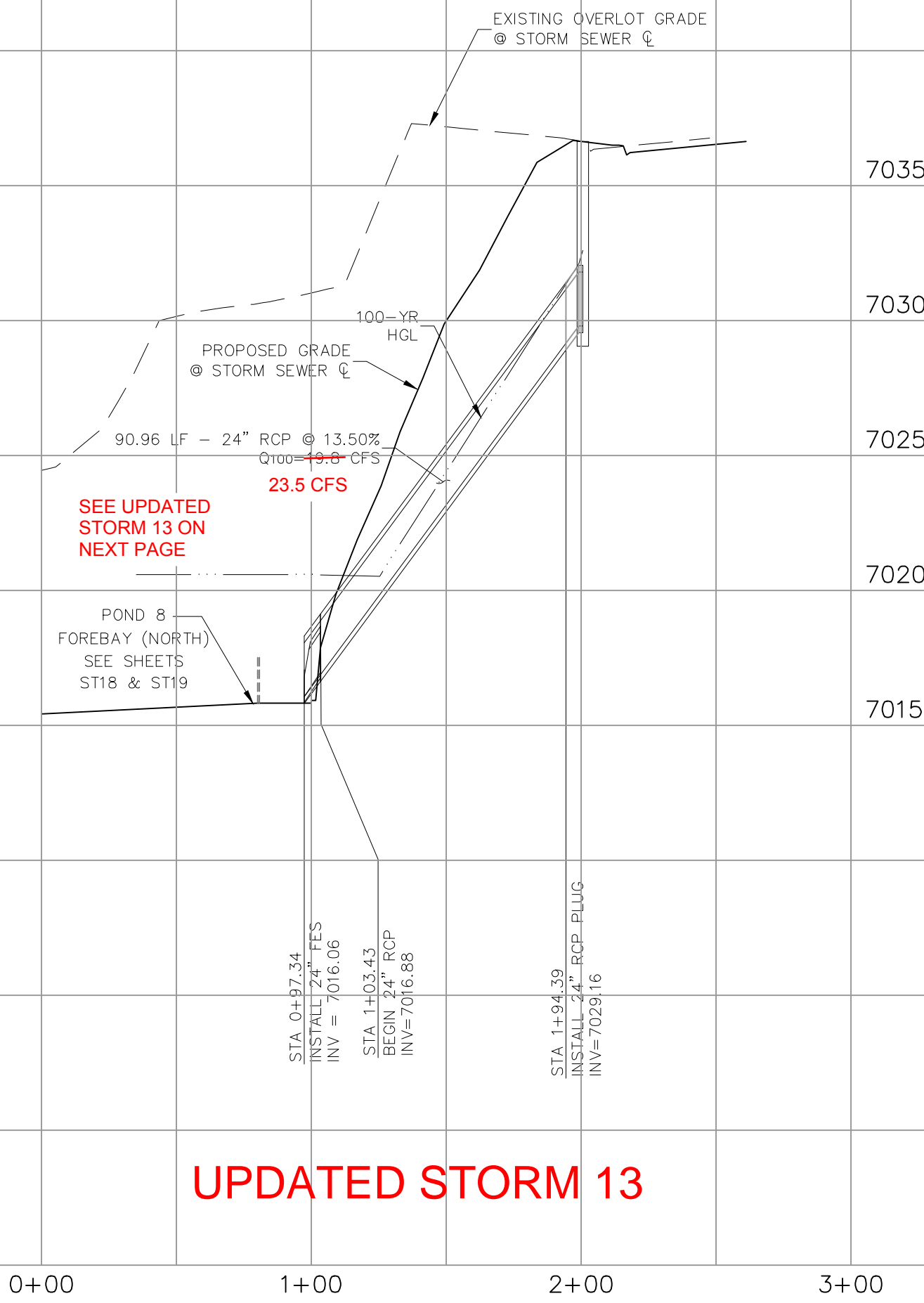
**UPDATED STORM 13**

**UPSIZE PIPE TO  
EITHER 24" OR 30"  
(SHOWN AS 24")**

NOTE:  
STA 1+00.00 TO STA 1+24.00 (NEXT FULL  
JOINT) TIE PIPE SEGMENTS TOGETHER  
W/4-3" CANOPY TYPE ROD LUG JOINT  
FASTENERS.



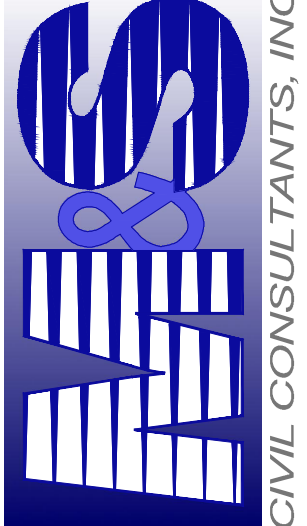
**STORM 6**

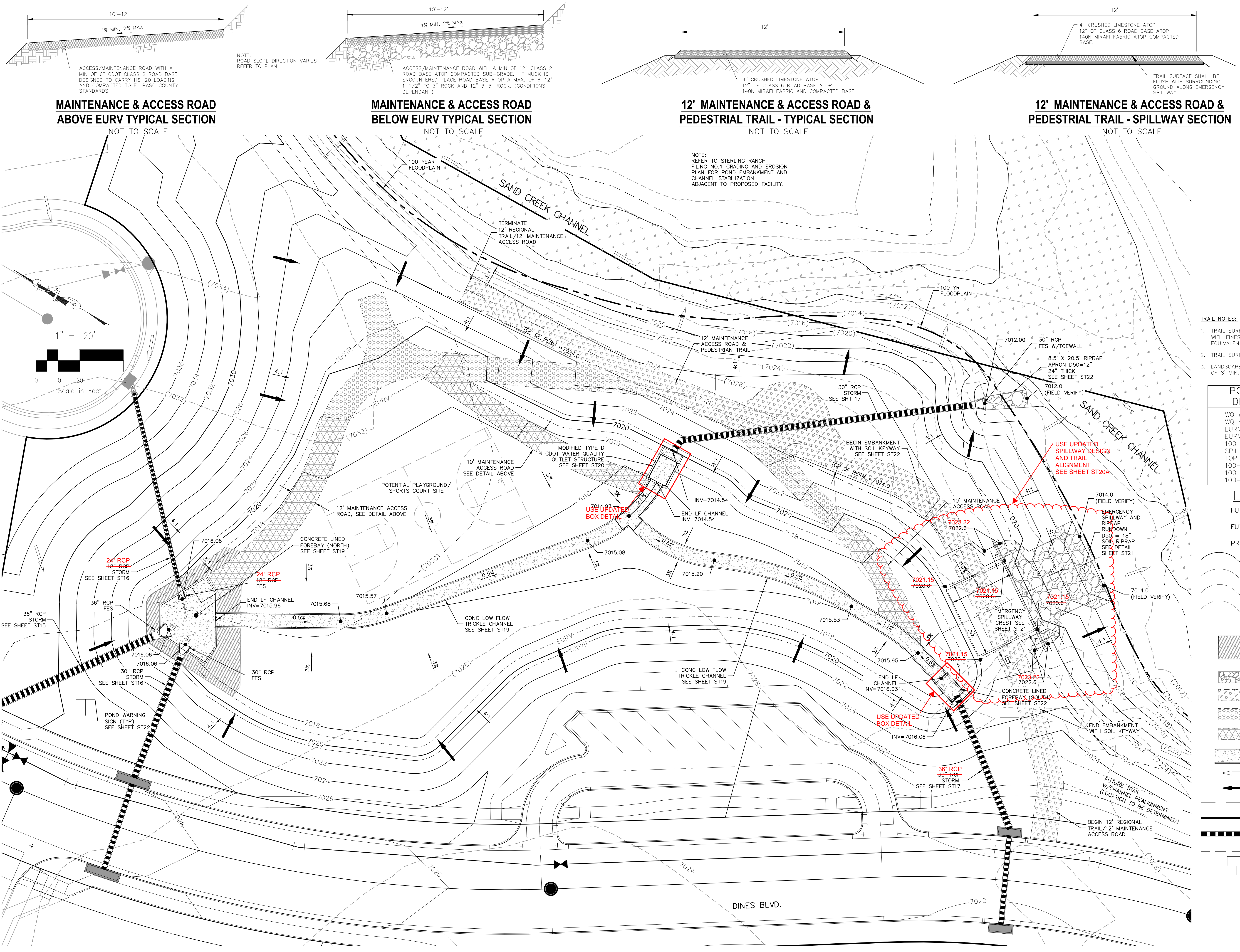


**UPDATED STORM 13**

**STORM 13 STA 0+97.34 TO 1+94.39**

FOR LOCATING  
& MARKING  
GAS,  
ELECTRIC,  
WATER &  
TELEPHONE  
LINES  
FOR BURIED UTILITY INFORMATION  
48 HRS BEFORE YOU DIG  
CALL 1-800-922-1987

STERLING RANCH FILING NO. 1	
STORM SEWER PLANS	
PROJECT NO. 09-002	FILE: \Lang\Const Dwg\Storm - District\ST16.dwg
DESIGNED BY: ET	SCALE: 01/02/2018
DRAWN BY: ELY	HORIZ: 1"=50'
CHECKED BY: WAS	VERT: 1"=5'
20 BOULDER CRESCENT SUITE 110 COLORADO SPRINGS, CO 80903 PHONE: 719.555.5485	
 CIVIL CONSULTANTS, INC.	
FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.	
REVISIONS:	APPROVED BY: DATE:
NO. DATE: BY: DESCRIPTION:	
THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.	
CAUTION	



FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES

FOR BURIED UTILITY INFORMATION 48 HRS BEFORE YOU DIG CALL 1-800-922-1987

- TRAIL NOTES:**
- TRAIL SURFACING SHALL BE CURSHED LESTON 3/8" MINUS WITH FINES, CASTLE CONCRETE "COLORADO WHITE FINES" OR EQUIVALENT.
  - TRAIL SURFACING SHALL BE COMPACTED WITH A ROLLER
  - LANDSCAPE FABRIC SHALL BE MIRAFI 140N WITH A RUNNING WITH OF 8' MIN.

POND 8 FULL SPECTRUM DETENTION BASIN DATA	
WQ WATER SURFACE EL=7017.20	
WQ VOLUME=0.48 AC-FT	
EURV WATER SURFACE EL=7018.91	
EURV VOLUME=1.58 AC-FT	
100-YR WATER SURFACE EL=7020.60	
SPILLWAY CREST EL=7020.6	
TOP OF EMBANKMENT EL=7024.0	
100-YR VOLUME=2.99 AC-FT	
100-YR INFLOW=112.8	
100-YR RELEASE=41.7 CFS	

**LEGEND**

FUT	EXISTING
FUT	FUTURE
PROP	PROPOSED
—	PROP MAJ CONT
—	PROP MIN CONT
—	EXIST MAJ CONT
—	EXIST MIN CONT

	PERM. EROSION CONTROL BLANKET
	RIPRAP
	REGIONAL TRAIL/MAINT. ROAD
	STABILIZED MAINTENANCE ROAD ABOVE EURV
	STABILIZED MAINT. ROAD BELOW EURV
	CONC LOW FLOW CHANNEL
	EX. FLOW ARROW
	PROP. FLOW ARROW
	CONSTRUCTION LIMITS
	PROPERTY LINE
	PROP STORM SEWER PIPE
	EASEMENT LINE
	WARNING SIGN

**FULL SPECTRUM DETENTION POND 8 SITE PLAN**  
SCALE 1"=20'

STERLING RANCH FILING NO. 1	
FULL SPECTRUM DET. POND 8 SITE PLAN	
PROJECT NO. 09-002	FILE: Yang\Const Dwg\Storm - District\ST18.dwg
DESIGNED BY: ET	SCALE: DATE: 01/02/2018
DRAWN BY: ELY	HORIZ: 1"=20'
CHECKED BY: VAS	VERT: N/A
SHEET 22 OF 28	
ST18	

20 BOULDER CREEK SUITE 110		CIVIL CONSULTANTS, INC.
COLORADO SPRINGS, CO 80903		
PHONE: 719.555.5485		

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.	
Virgil A. Sanchez, P.E. No. 37160	
APPROVED BY: DATE:	

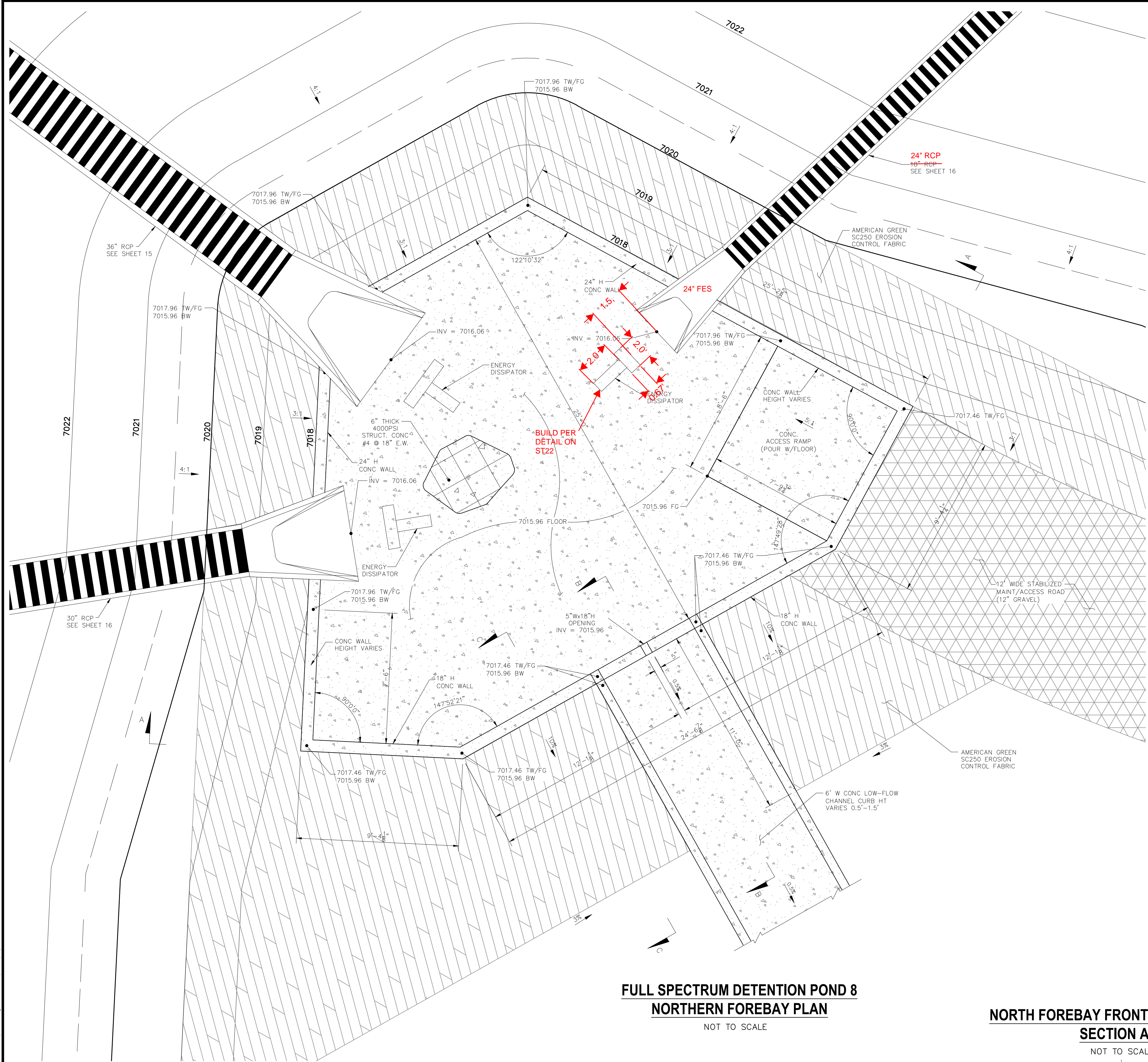
  

REVISIONS:	NO.	DATE:	BY:	DESCRIPTION:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

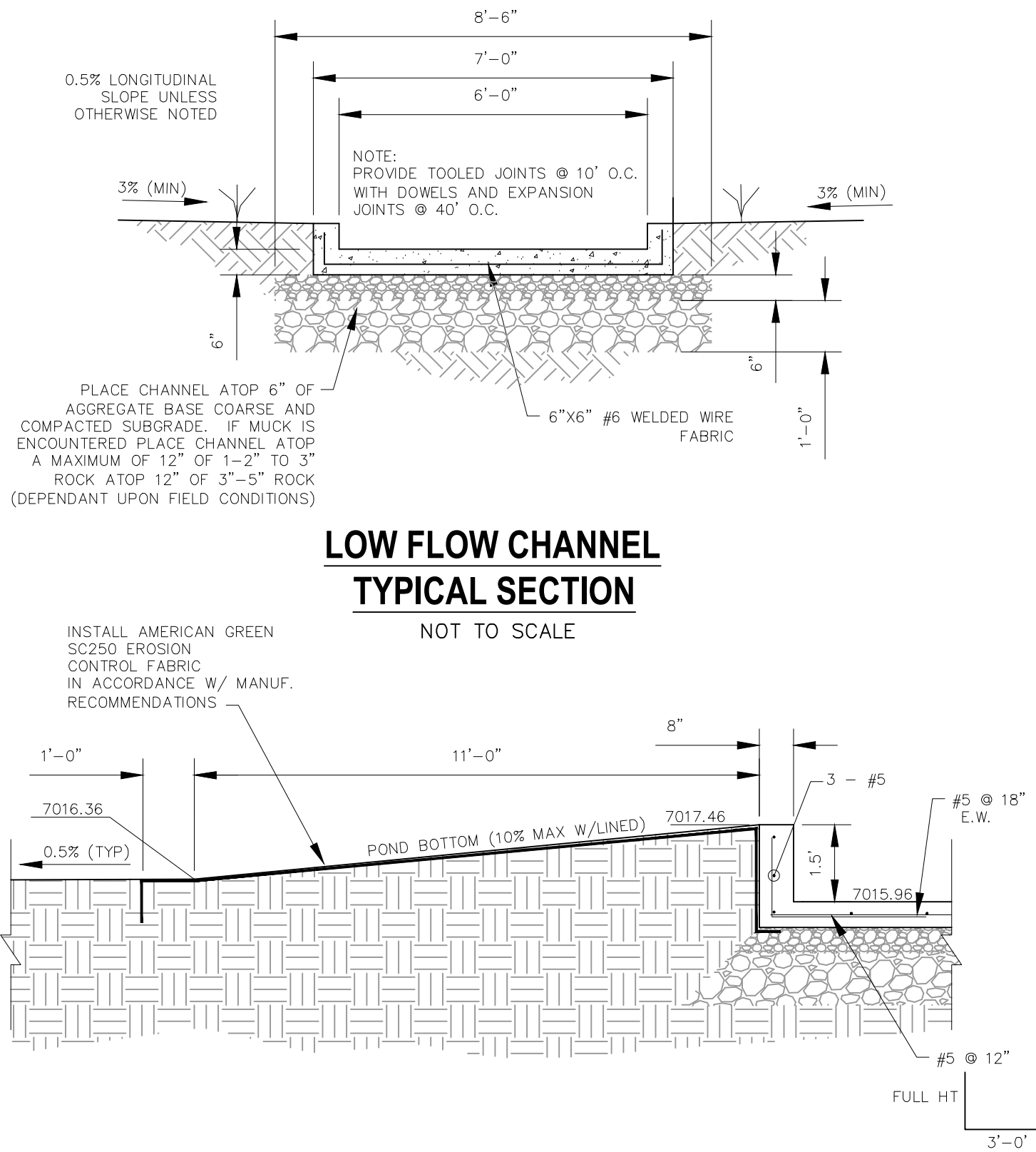
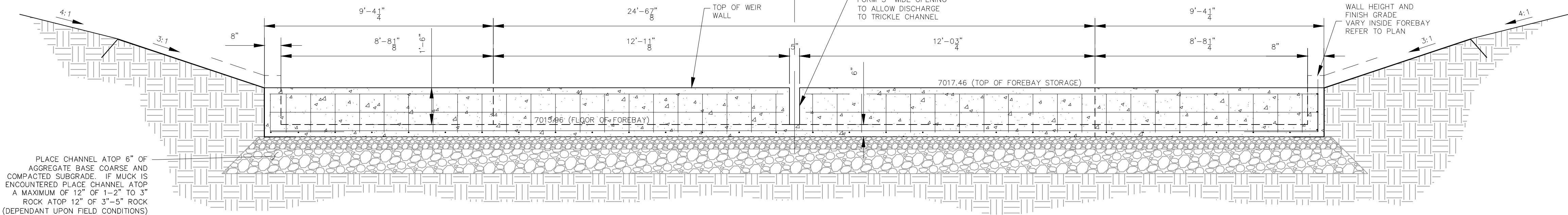
CAUTION

File: Q:\09002A\Sterling Ranch District\Eng\Const Dwg\Storm - District\ST19.dwg Plotstamp: 2/7/2017 1:34 PM

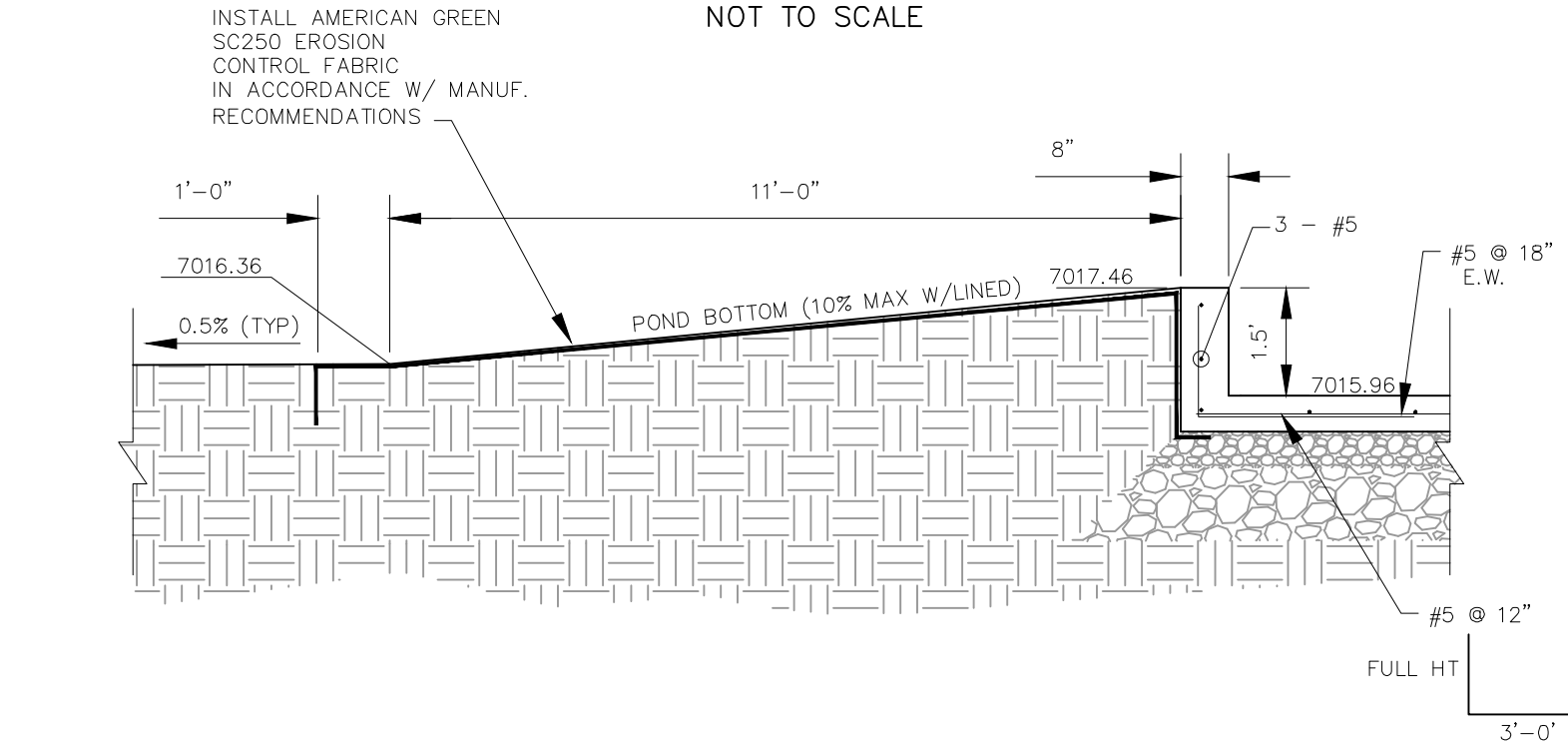


FULL SPECTRUM DETENTION POND 8  
NORTHERN FOREBAY PLAN  
NOT TO SCALE

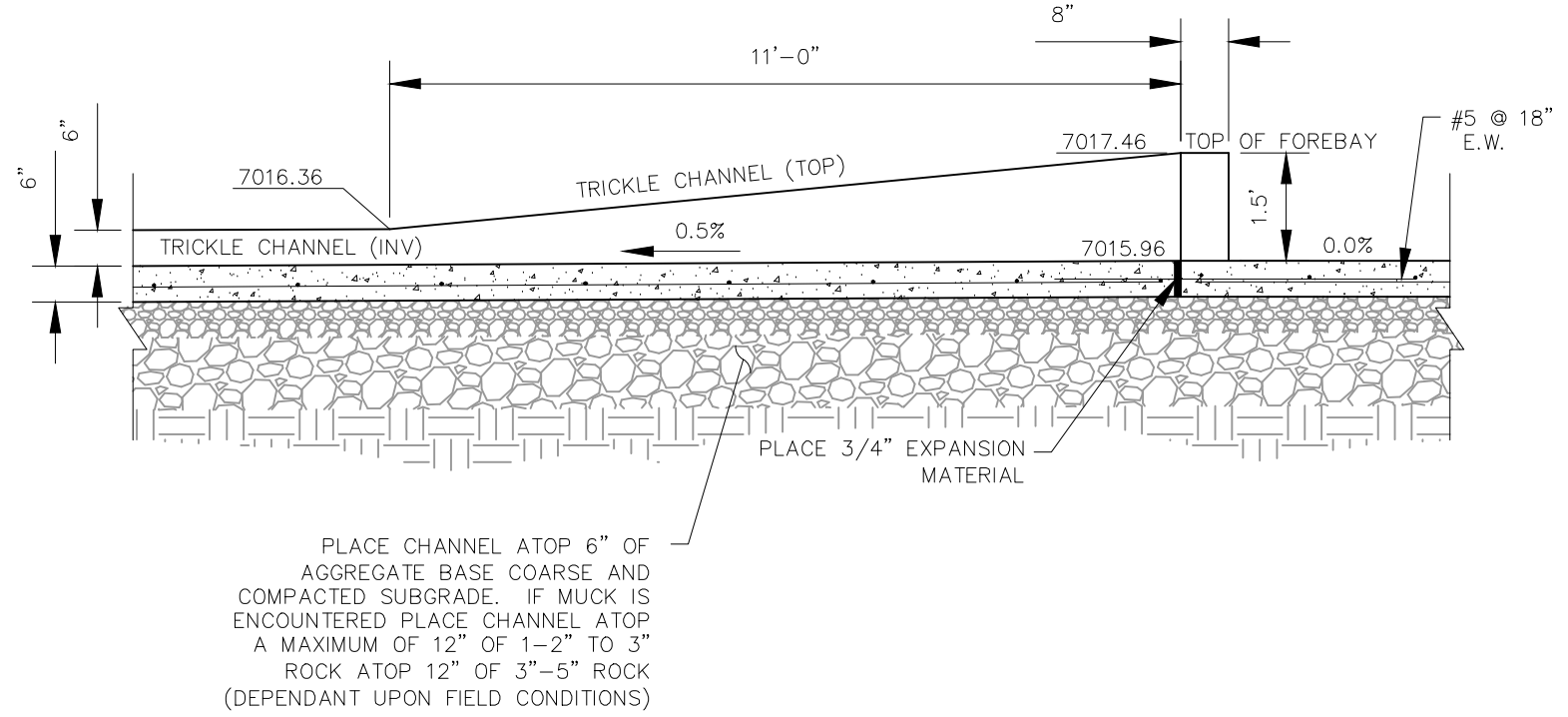
NORTH FOREBAY FRONT WALL W/NOTCH  
SECTION A-A  
NOT TO SCALE



LOW FLOW CHANNEL  
TYPICAL SECTION  
NOT TO SCALE



SLOPE GRADING BELOW NORTHERN FOREBAY  
SECTION C-C  
NOT TO SCALE



LOW FLOW CHANNEL AT NORTH FOREBAY  
SECTION B-B  
NOT TO SCALE



FOR LOCATING  
& MARKING  
GAS,  
ELECTRIC,  
WATER &  
TELEPHONE  
LINES

FOR BURIED UTILITY INFORMATION  
48 HRS BEFORE YOU DIG  
CALL 1-800-922-1987

STERLING RANCH FILING NO. 1

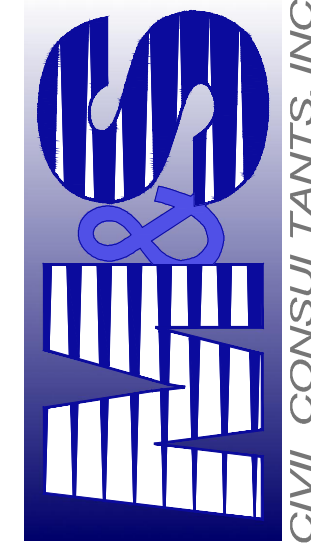
FULL SPECTRUM DET. POND 8 DETAILS

PROJECT NO. 09-002  
DESIGNED BY: ET  
DRAWN BY: ELY  
CHECKED BY: VAS

FILE: \eng\Const Dwg\Street & Storm Plans\ST19.dwg  
DATE: 01/02/2018  
SCALE: 1"=50'  
VERT: 1"=5'

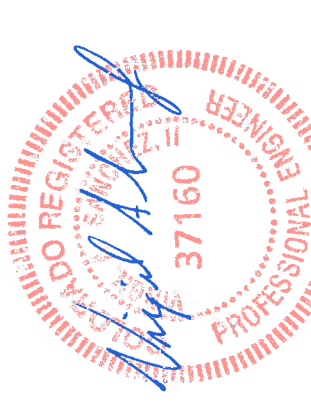
ST19  
SHEET 23 OF 28

20 BOULDER CRESCENT SUITE 110  
COLORADO SPRINGS, CO 80903  
PHONE: 719.555.5485



CIVIL CONSULTANTS, INC.

FOR AND ON  
BEHALF OF  
M&S CIVIL  
CONSULTANTS,  
INC.

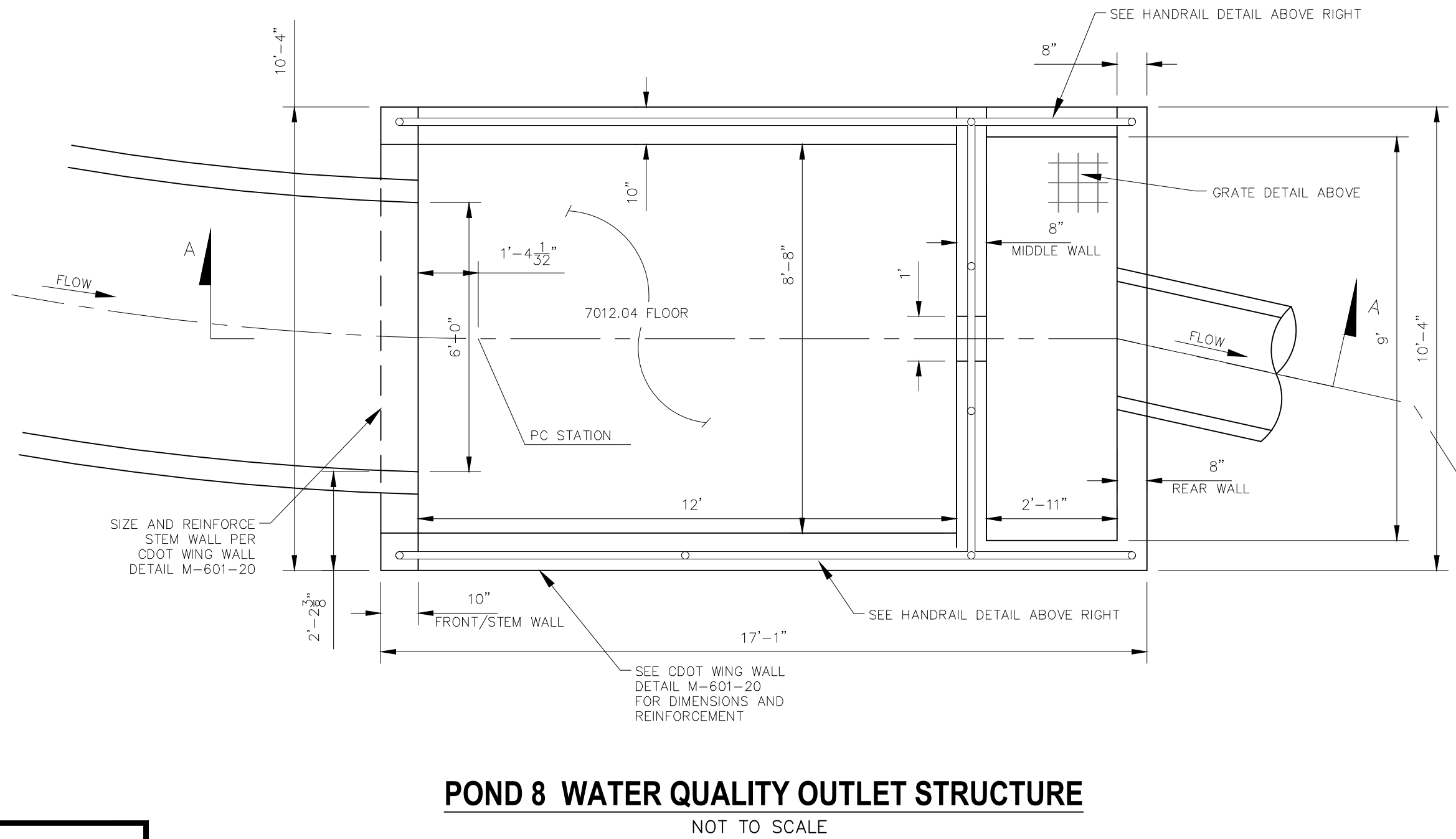
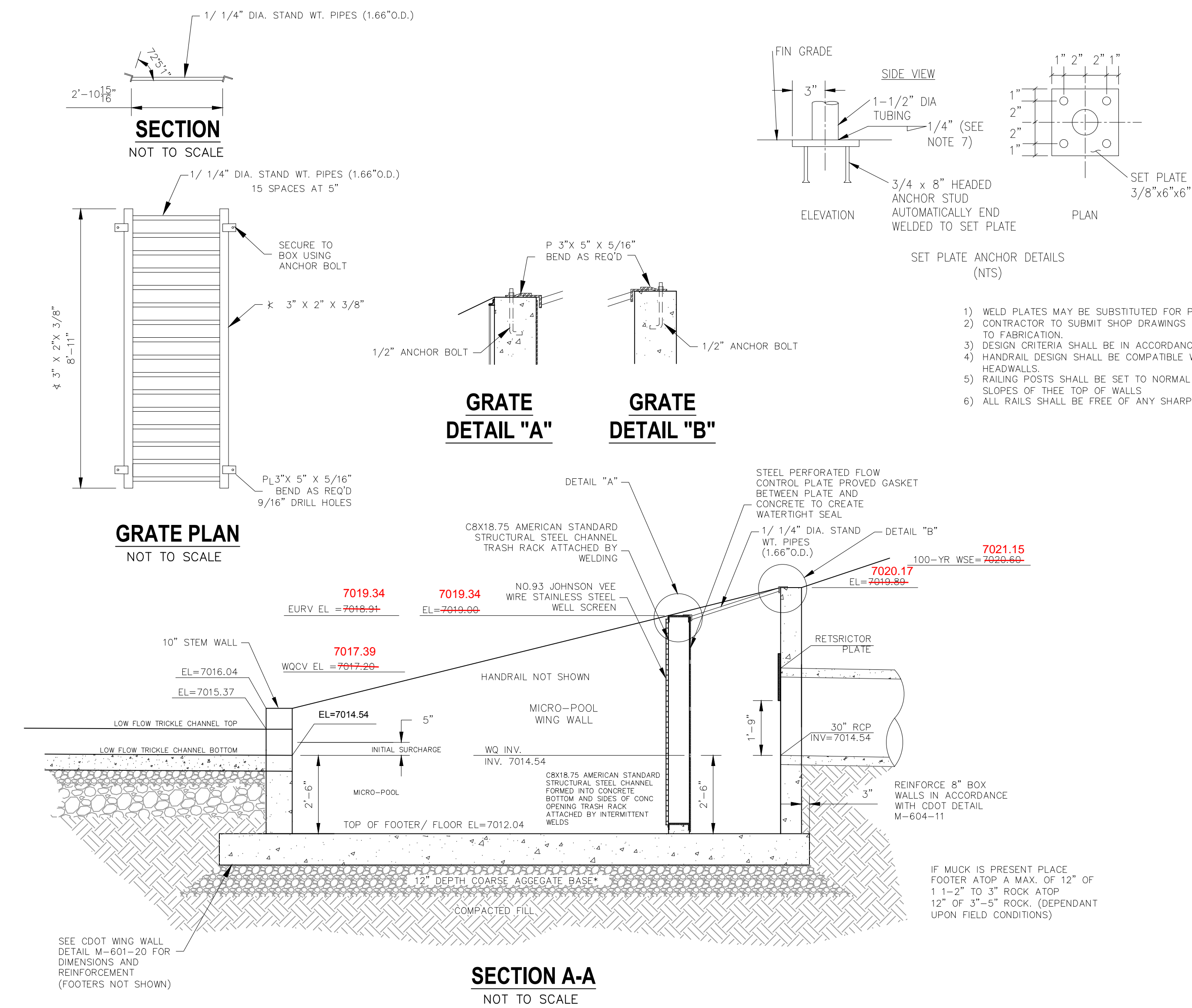


PROFESSIONAL  
37160

REVISIONS:  
NO. DATE: BY: DESCRIPTION: APPROVD. BY: DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR  
USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER  
OF THESE PLANS.

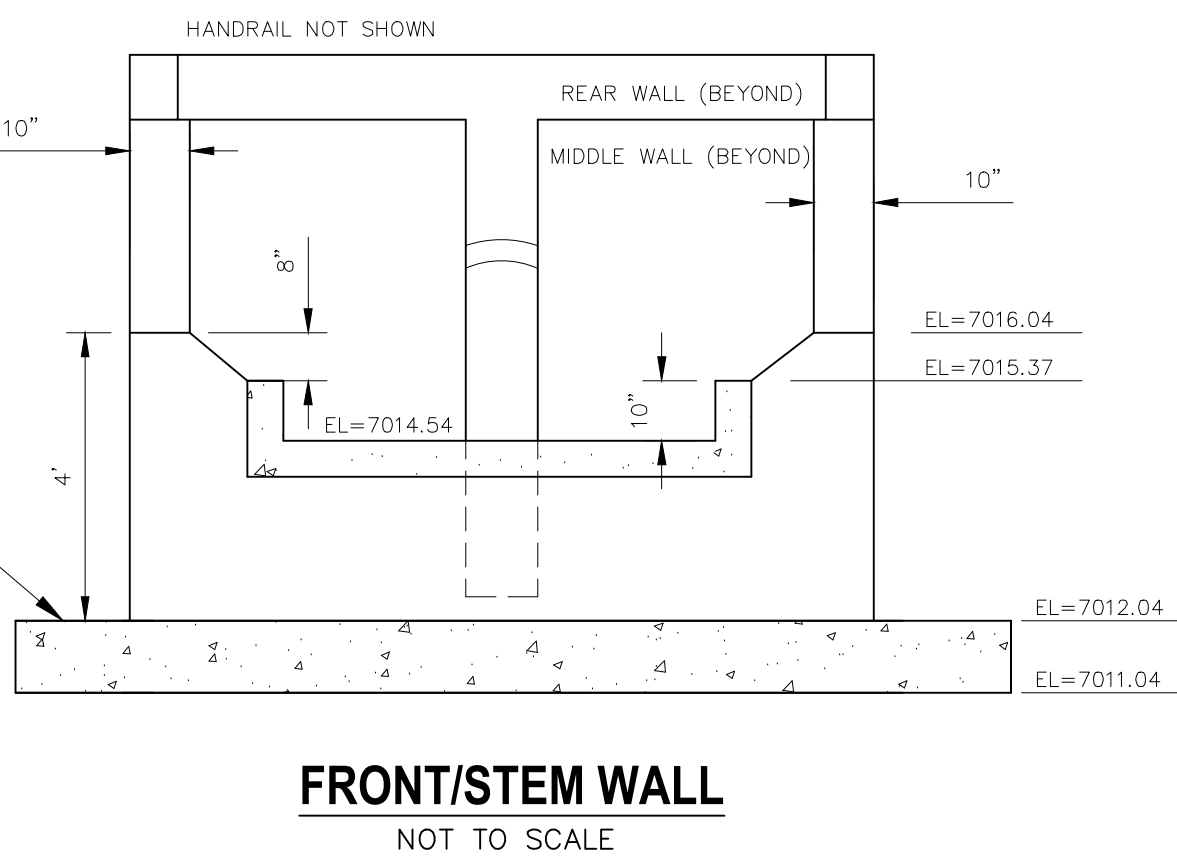
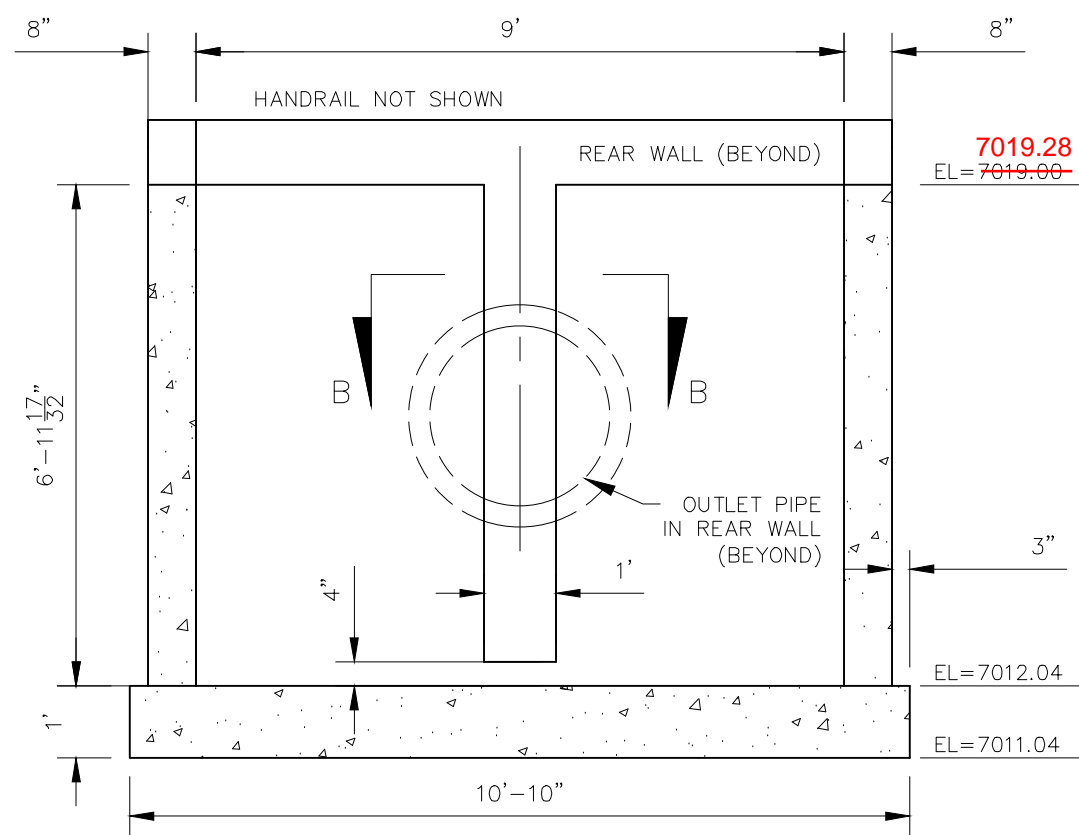
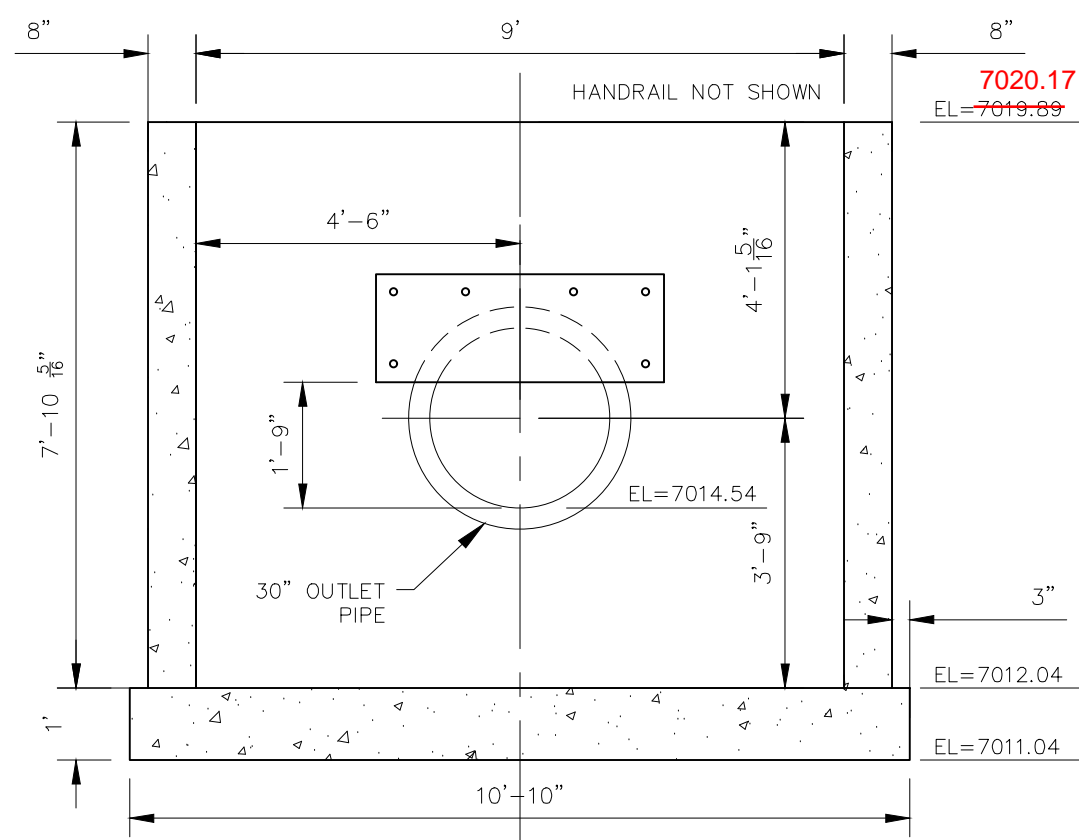
CAUTION



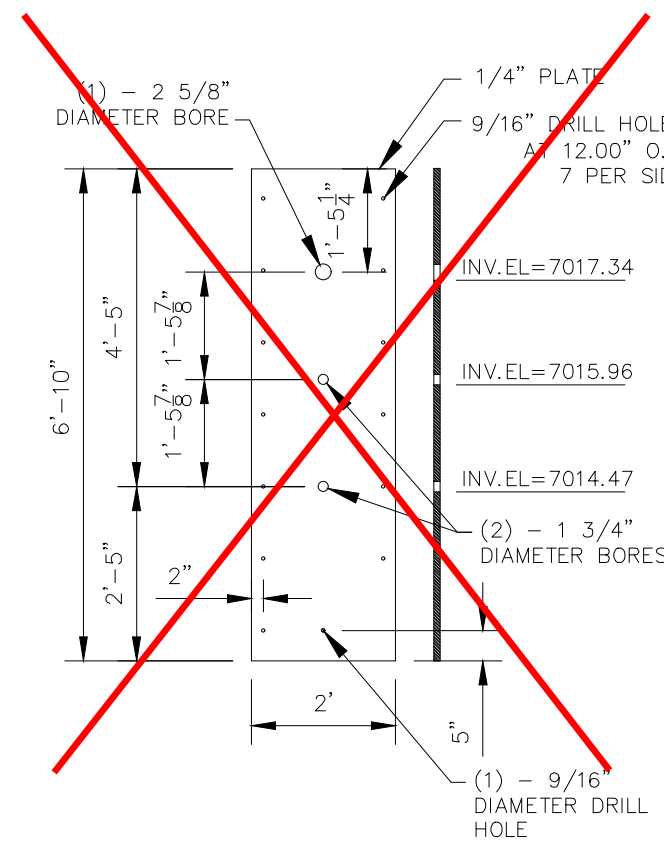
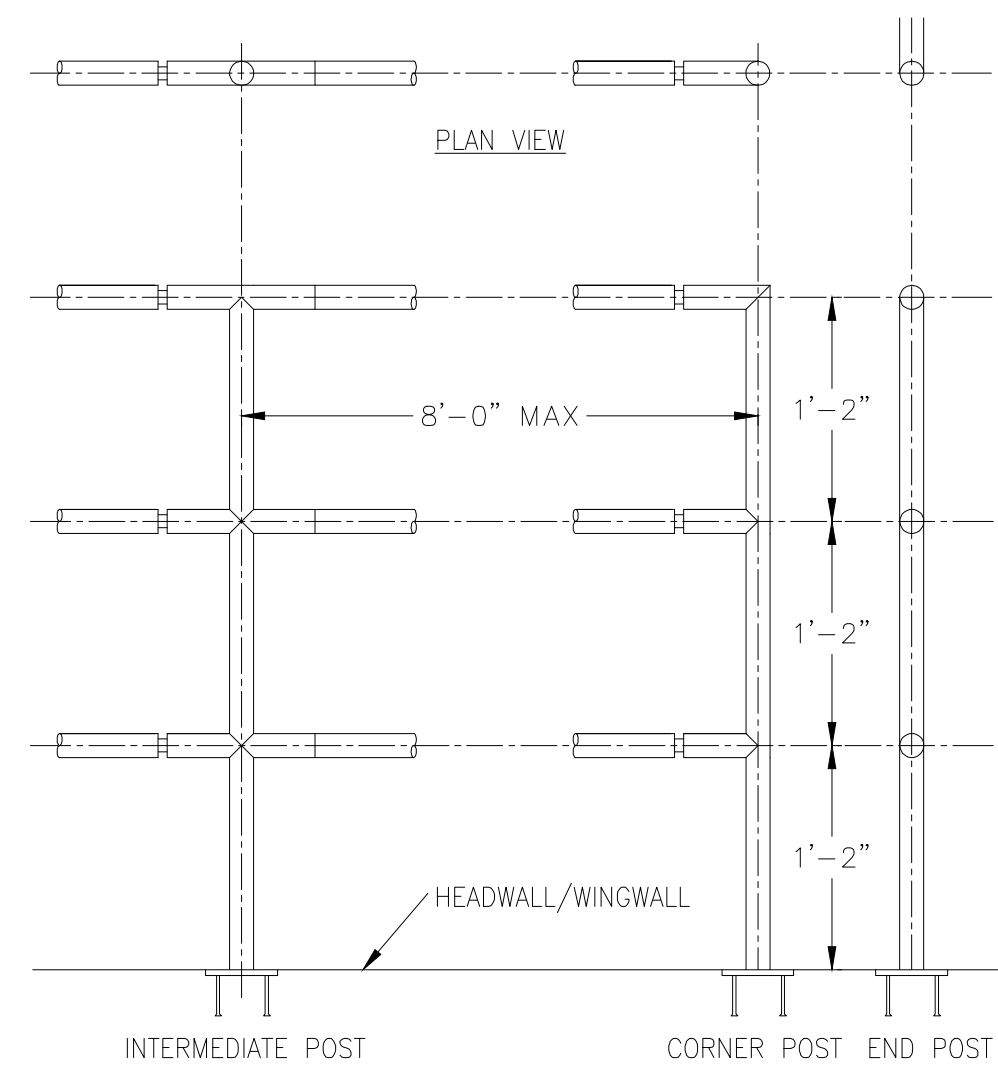
- 1) WELD PLATES MAY BE SUBSTITUTED FOR PIPE EMBEDMENT.
- 2) CONTRACTOR TO SUBMIT SHOP DRAWINGS TO ENGINEER OF RECORD FOR APPROVAL PRIOR TO FABRICATION.
- 3) DESIGN CRITERIA SHALL BE IN ACCORDANCE WITH AASHTO STANDARDS.
- 4) HANDRAIL DESIGN SHALL BE COMPATIBLE WITH THE DESIGN OF THE WINGWALLS AND HEADWALLS.
- 5) RAILING POSTS SHALL BE SET TO NORMAL TO GRADE. RAILS SHALL RUN PARALLEL TO THE SLOPES OF THE TOP OF WALLS.
- 6) ALL RAILS SHALL BE FREE OF ANY SHARP EDGES OR CORNERS.

### HANDRAIL ASSEMBLY DETAILS

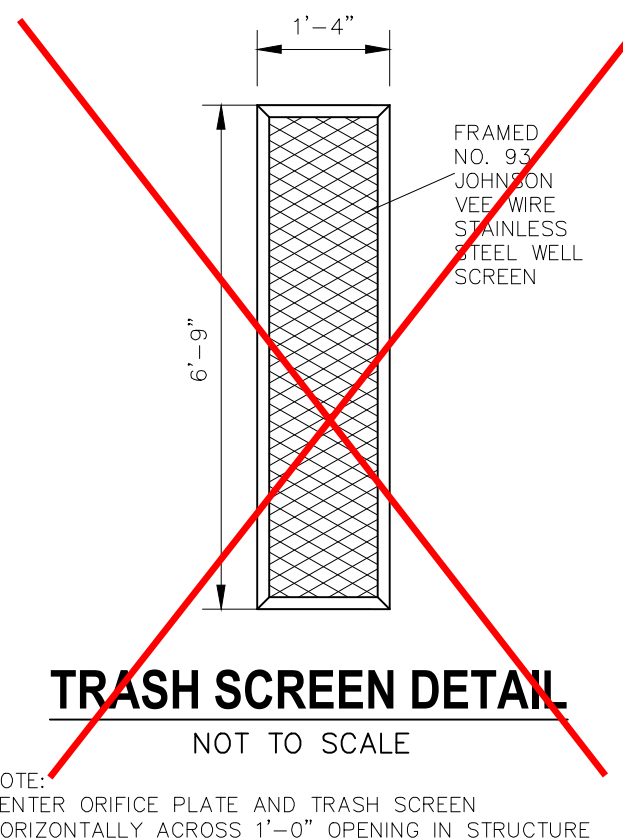
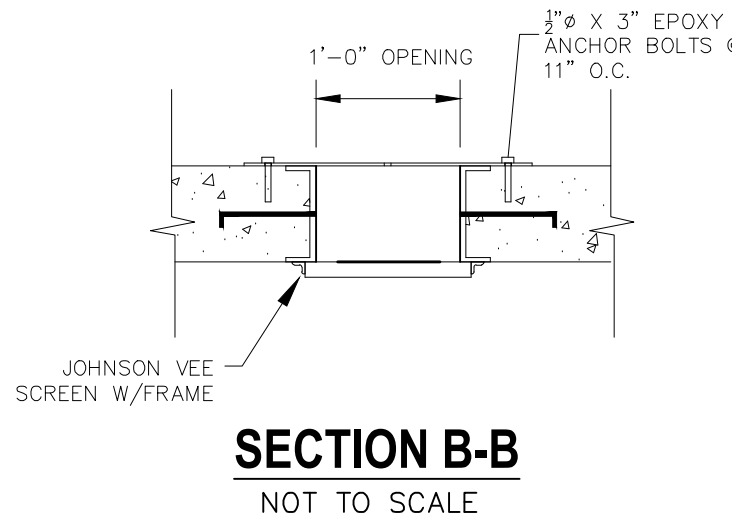
NOT TO SCALE





NOTE:  
ALL GRATES, IMBEDS, AND FASTENERS SHALL BE FABRICATED USING GALVANIZED STEEL, UNLESS OTHERWISE NOTED.  
ALL GRATE DIMENSIONS TO BE FIELD VERIFIED PRIOR TO FABRICATION. ALL GRATE MATERIAL SHALL BE GALVANIZED.



SEE UPDATED ORIFICE PLATE DETAIL ON NEXT PAGE SHEET ST20A



SEE UPDATED TRASH SCREEN DETAIL ON NEXT PAGE SHEET ST20A

STERLING RANCH FILING NO. 1									
FULL SPECTRUM DET. POND 8 DETAILS									
PROJECT NO. 09-002		FILE: \\wg\Const\DWG\Storm - District\ST20.dwg		DATE: 01/02/2018		DESIGNED BY: ET		SCALE: N/A	
						DRAWN BY: ELY		HORIZ: N/A	
						CHECKED BY: WS		VERT: N/A	
						SHEET 24 OF 28		ST20	
<div>20 BOULDER CRESCENT, SUITE 110 COLORADO SPRINGS, CO 80903 PHONE: 719.555.5485</div> <div> CIVIL CONSULTANTS, INC.</div>									
<div>FOR AND ON BEHALF OF M&amp;S CIVIL CONSULTANTS, INC.</div> <div></div> <div>APPROVED BY: DATE:</div>									
REVISIONS:									
NO.	DATE:	BY:	DESCRIPTION:	APPROVED BY:	DATE:				
						THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.			
CAUTION									

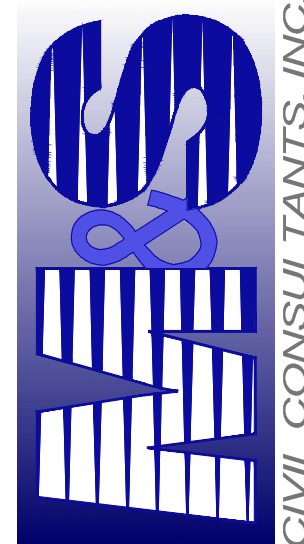
[illegible]

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

**CAUTION**

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

FOR AND ON  
BEHALF OF  
M&S CIVIL  
CONSULTANTS,  
INC.



20 BOULDER CRESCENT, SUITE 110  
COLORADO SPRINGS, CO 80903  
PHONE: 719.955.5485

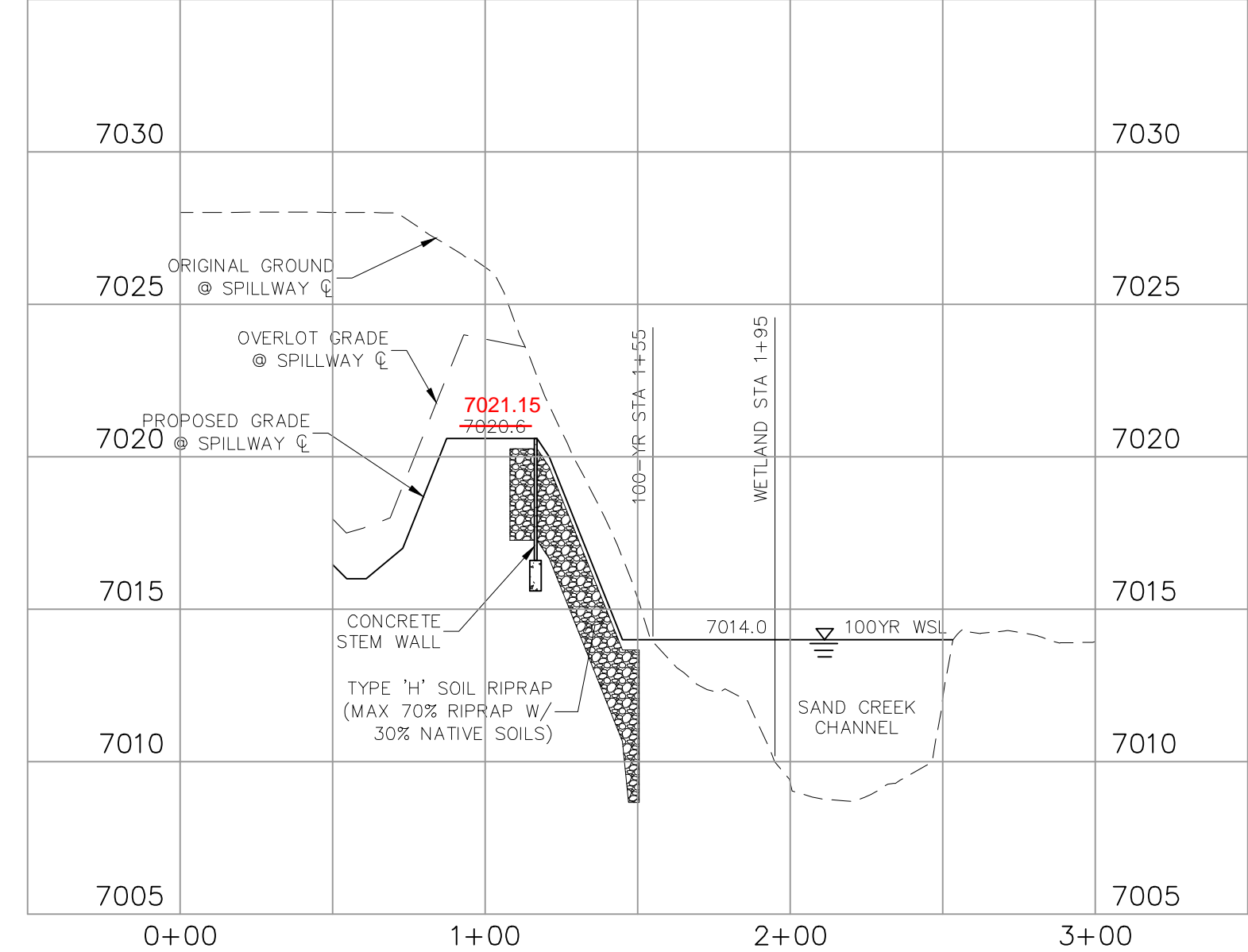
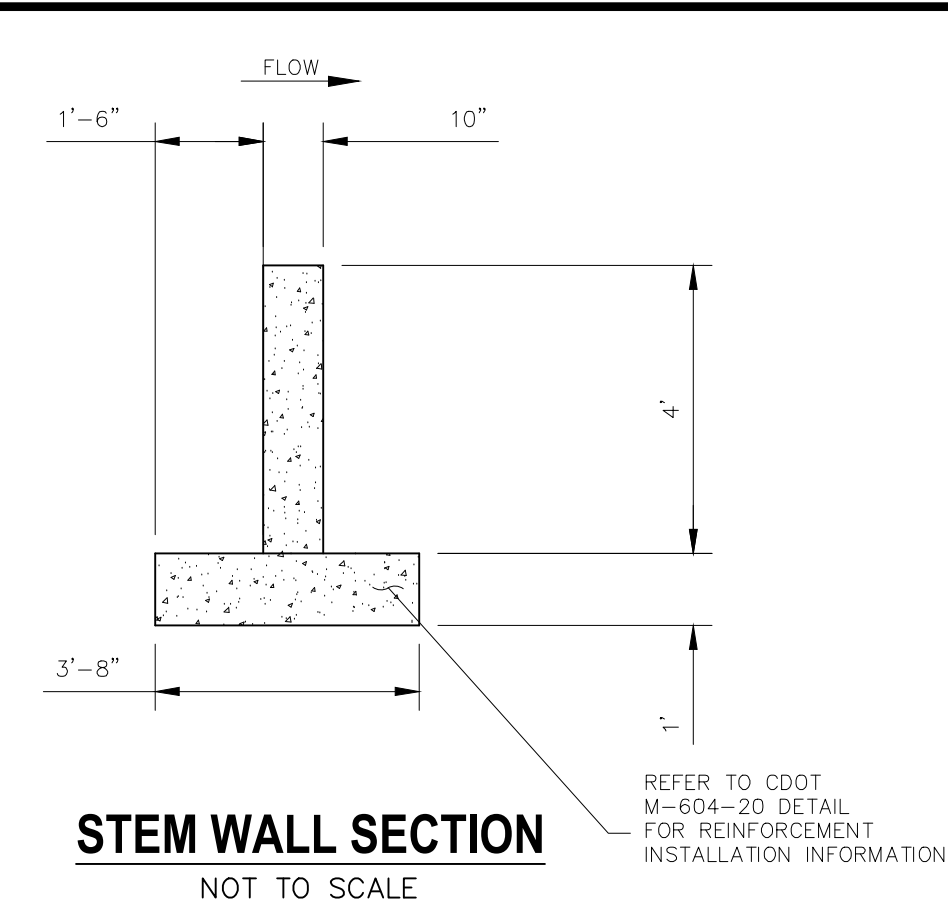
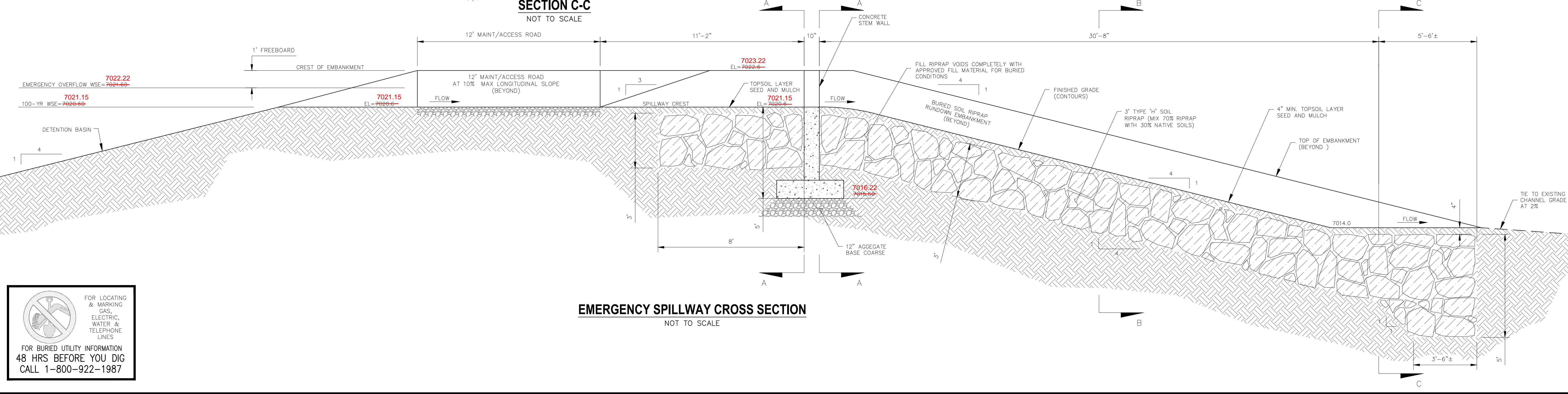
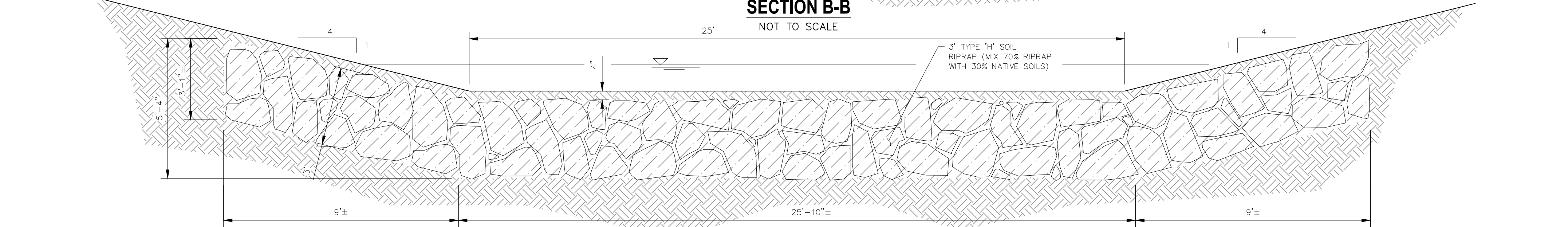
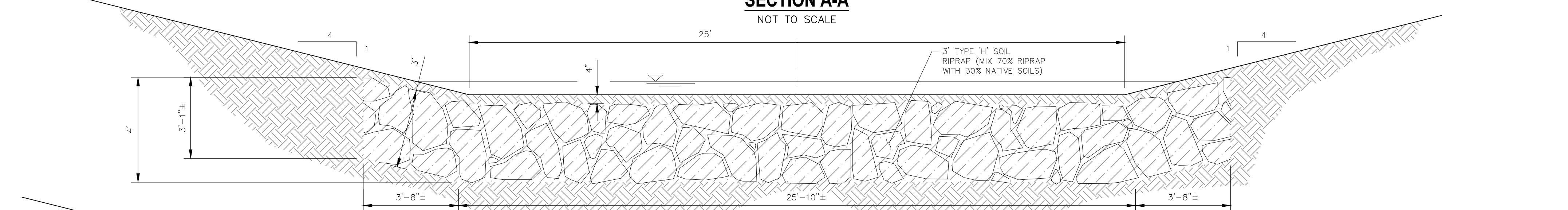
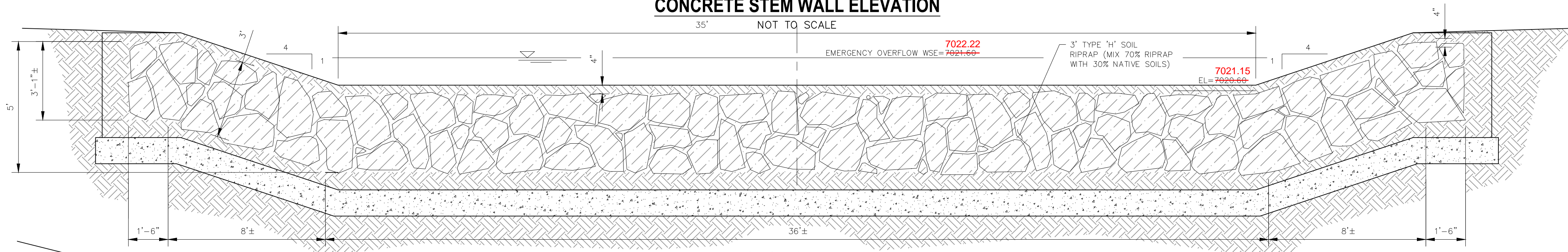
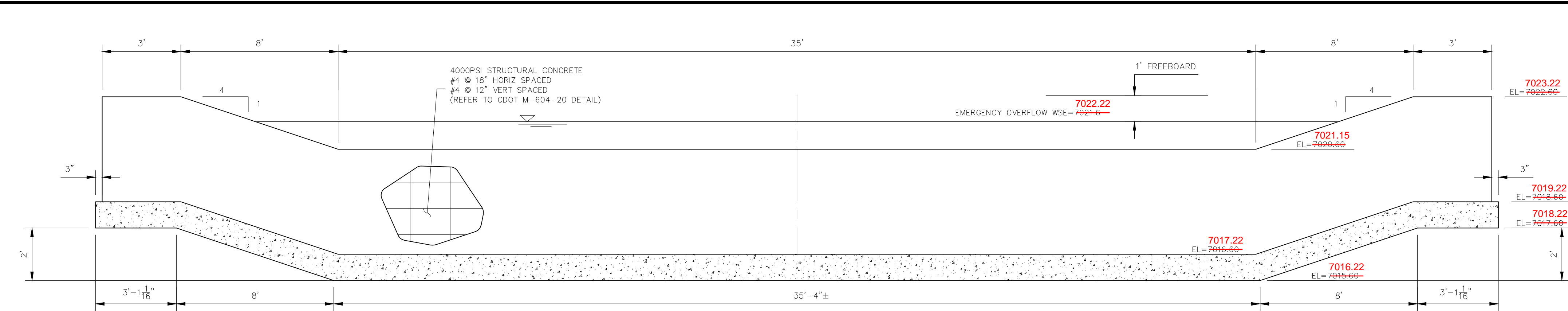
STERLING RANCH FILING NO. 1

UPDATED FULL SPEC. DET. POND 8 DETAILS

PROJECT NO. 09-002	FILE: \dwg\Const Dwg\Storm - District\ST20A.dwg	
DESIGNED BY	SCALE	DATE: 01/02/2018

DESIGNED BY:	ELY	HORIZ:	N/A	SHEET 20 OF 28	ST20A
DRAWN BY:	ELY	VERT:	N/A		
CHECKED BY:	VAS				

File: G:\09002A\Sterling Ranch District\Eng\Const\DWG\Storm - District\ST21.dwg Plotstamp: 12/5/2016 11:18 AM



HORIZ. SCALE: 1"=50'  
VERT. SCALE: 1"=5'



STERLING RANCH FILING NO. 1	
FULL SPECTRUM DET. POND 8 DETAILS	
PROJECT NO. 09-002	FILE: Yang\Const\DWG\Storm - District\ST21.dwg
DESIGNED BY: ET	SCALE: DATE: 01/02/2018
DRAWN BY: ELY	HORIZ AS NOTED
CHECKED BY: WAS	VERT: AS NOTED
SHEET 25 OF 28	
ST21	

20 BOULDER CRESCENT SUITE 110  
COLORADO SPRINGS, CO 80903  
PHONE: 719.555.5485

**W&S**  
CIVIL CONSULTANTS, INC.

FOR AND ON  
BEHALF OF  
W&S CIVIL  
CONSULTANTS,  
INC.

VERCIL A. SANCHEZ, COLORADO P.E. NO. 37160

PROFESSIONAL ENGINEER  
NO. 37160

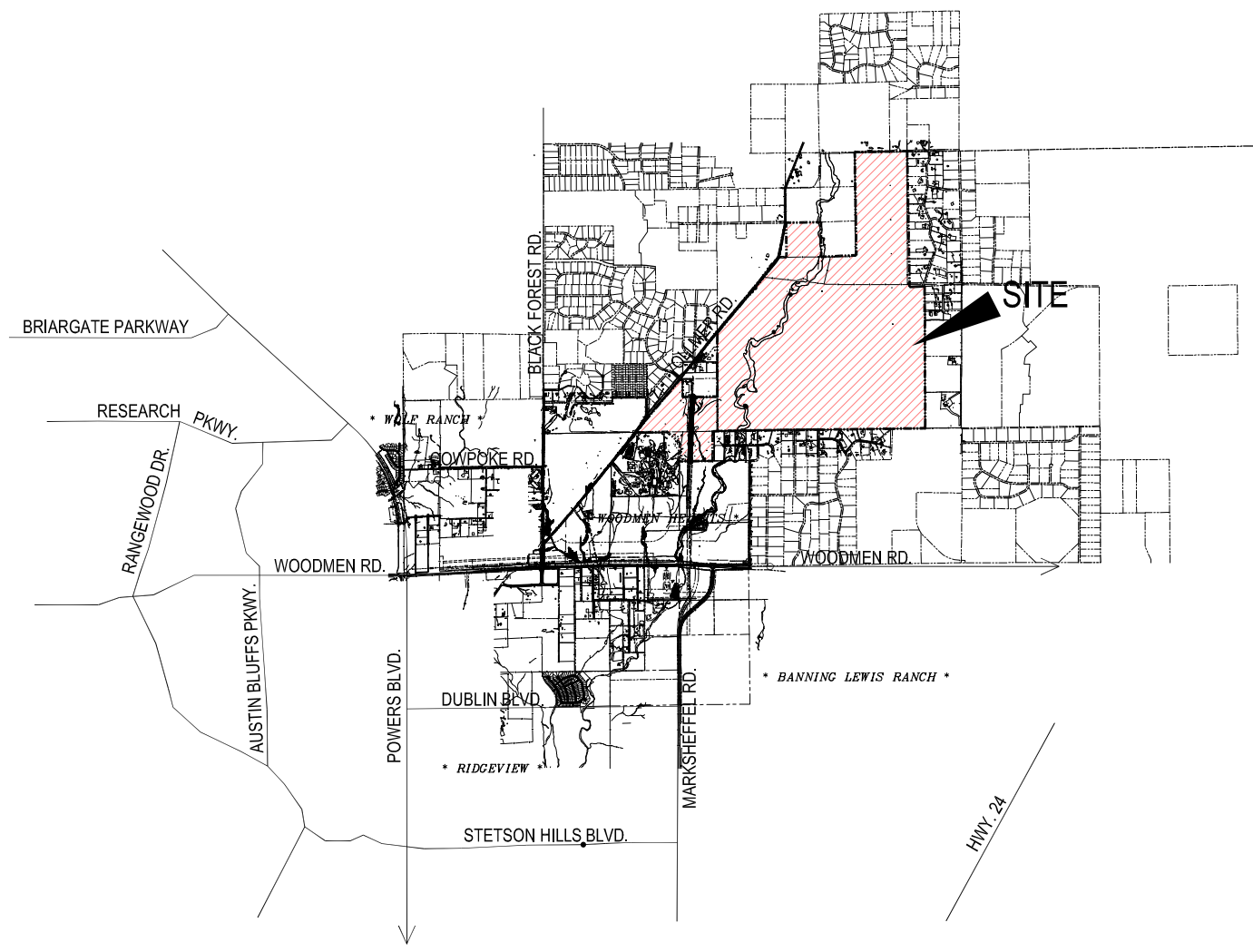
NO.	DATE:	BY:	DESCRIPTION:	APPROV. BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR  
USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER  
OF THESE PLANS.

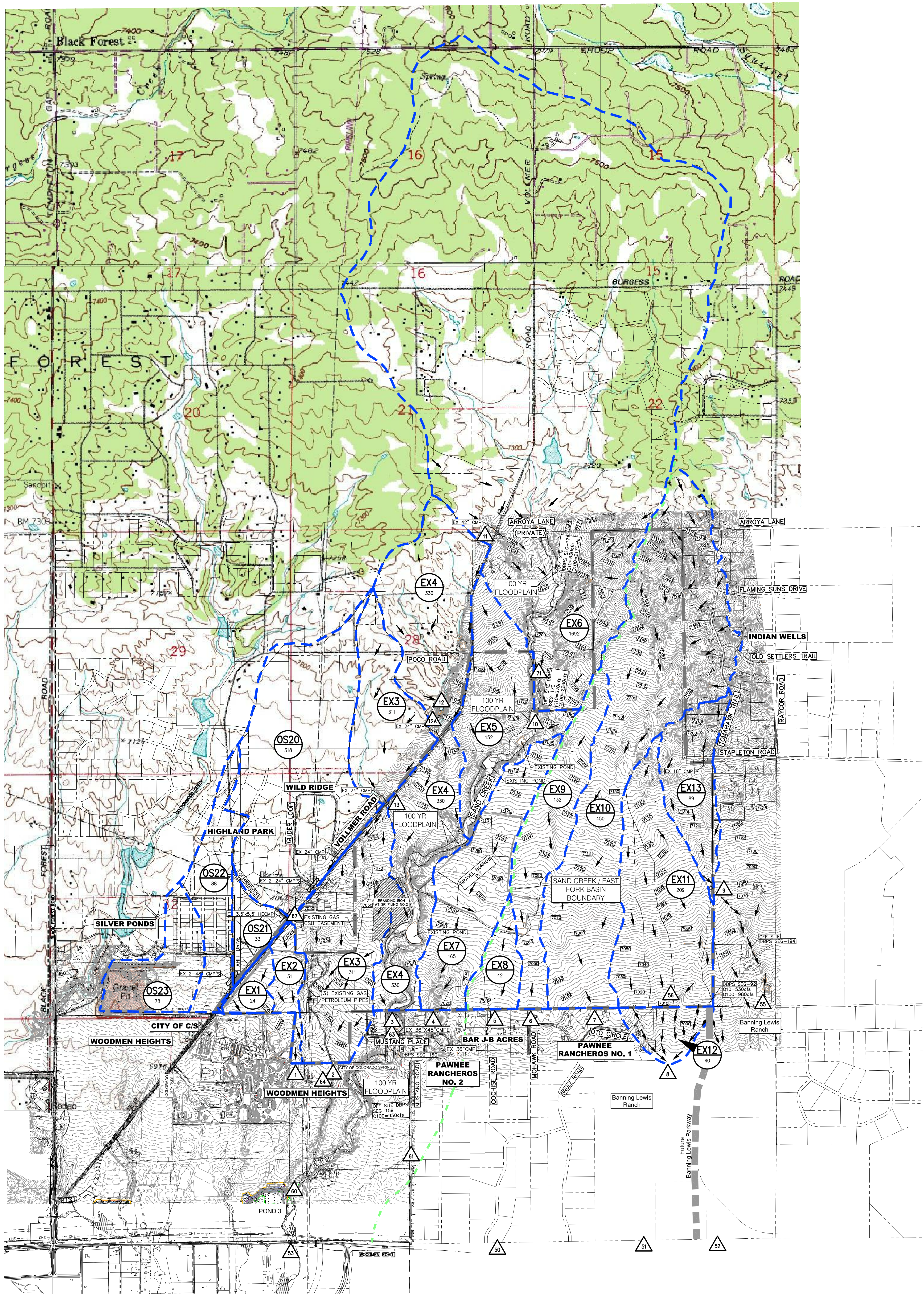
CAUTION



**HISTORIC, EXISTING & PROPOSED  
DRAINAGE MAP**



STERLING RANCH  
N.T.S.



HISTORIC CONDITION

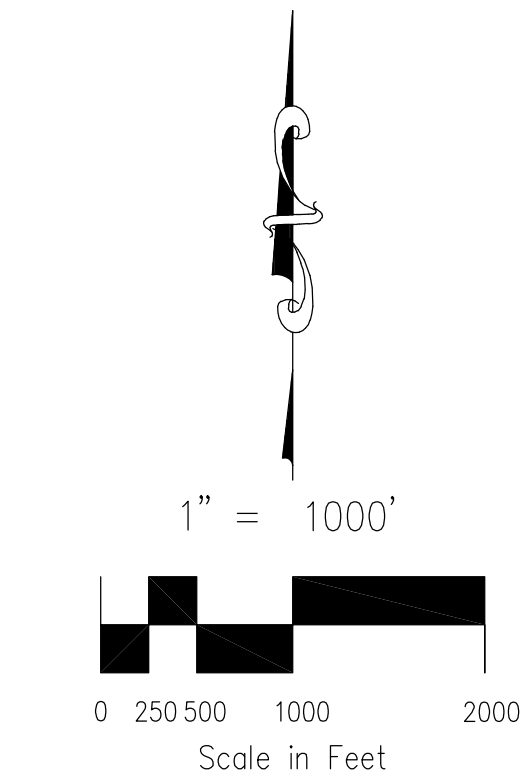
BASIN SUMMARY			
BASIN	AREA (ACRES)	Q <sub>s</sub> (CFS)	Q <sub>100</sub> (CFS)
EX-1	24	3	40
EX-2	31	3	45
EX-3	311	49	341
EX-4	330	71	352
EX-5	152	14	209
EX-6	1692	118	2168
EX-7	165	12	197
EX-8	42	4	64
EX-9	132	11	149
EX-10	450	48	474
EX-11	209	17	261
EX-12	40	5	65
EX-13	89	6	114
OS-20	318	61	310
OS-21	33	8	38
OS-22	88	18	91
OS-23	78	34	84

\* NOTE: BASIN S OS-22 & OS-23 NOT PART OF THIS REPORT. FLOWS FOLLOW HISTORIC PATTERNS ON THE WEST SIDE OF VOLLMER ROAD.

HISTORIC CONDITION

DESIGN POINTS					
DESIGN POINT	SQ. MI.	Q <sub>s</sub> (CFS)	Q <sub>100</sub> (CFS)	SQ. MI.	DBPS Q <sub>100</sub> DP / D
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		

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



- LEGEND
- EX1 312 EXISTING MDDP BASIN ACREAGE
  - E1 EXISTING FLOW RELEASE POINT
  - FLOW DIRECTION
  - - - BASIN BOUNDARY
  - PROPERTY BOUNDARY
  - - - 6920 EXISTING CONTOUR
  - CULVERT PIPE

**MS**  
CIVIL CONSULTANTS, INC.  
15 NORTH NEVADA AVENUE  
COLORADO SPRINGS, CO 80903  
(719) 955-5485, FAX (719) 471-4812

STERLING RANCH			
HISTORIC - DRAINAGE MAP			
PROJECT NO. 09-002	FILE: 0:\dwg\Eng Exhibits\MDDP HISTORIC	DATE: 09/19/16	
DESIGNED BY: VAS	SCALE		
DRAWN BY: VAS	HORIZ: 1"=1000'		
CHECKED BY: VAS	VERT: N/A		
			SHEET 1 OF 1



