AMENDMENT NO. 1

TO THE

FINAL DRAINAGE REPORT

FOR

TIMBERLINE STORAGE YARD
EL PASO COUNTY, COLORADO

MARCH 2020

Prepared for:

Timberline Landscaping, Inc.
20625 Andalusian View
Pueblo, CO 81008
(719)-638-1000

Prepared by:

CIVIL CONSULTANTS, INC.

20 Boulder Crescent, Suite 110
Colorado Springs, CO 80903
(719) 955-5485

Project #43-095

PCD Project No. PPR-17-018/PPR-19-042

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DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was 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 omission on my part in preparing this report.

COLORADO REGISTERED
VIRGIL A. SANCHEZ
37160
PROFESSIONAL ENGINEER

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:_____

TITLE: President
DATE: 4/8/2020

ADDRESS: Timberline Landscaping, Inc.
20625 Andalusian View
Pueblo, CO 81008

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 Manual, as amended.

BY:_____ DATE:_____
Jennifer Irvine, P.E.
County Engineer

CONDITIONS:

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TABLE OF CONTENTS

APPENDIX

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TIMBERLINE STORAGE YARD

PURPOSE

This document is intended to serve as the first amendment to the Final Drainage Report for the Timberline Storage Yard. 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 development plan for the site will consist of a storage yard with an office/warehouse building and wash bay. The site will also have roadway drive isles constructed from asphalt and asphalt millings, concrete and asphalt parking areas, landscaping and lighting and a full spectrum extended detention basin as well as underground utilities. The parcel is zoned "M" and the proposed use is permissible within the Industrial zoning criteria. The amendment is required to as the site plan is being expanded to utilize the parcel in its entirety.

GENERAL LOCATION AND DESCRIPTION

Timberline Storage Yard is located in the north and southeast quarter of the southwest quarter of Section 28, Township 13 South, Range 65 West of the 6th P.M. in El Paso County, Colorado. The parcel is bound to the north, south, and east by other vacant parcels of land. Adjacent to the southwest corner of the site, is an existing development that consists of a light industrial/storage and a maintenance yard. As shown on the enclosed FIRM panel, a channel known as the East Fork of Sand Creek Sub-tributary flows from east to west along the northern boundary of the site. Due to the presence of an existing railroad embankment, the sub-tributary does not influence the subject site. The site is located with the greater Sand Creek Drainage Basin and is tributary to the Sand Creek Channel via the East Fork Sand Creek Sub-Tributary. A vicinity map showing the location of the proposed development has been provided in the appendix of this report.

In the existing condition, both the parcel and offsite contributing watershed lands are sparsely vegetated, with ground cover consisting primarily of native grasses ranging in density from fair to good. Slopes across the development typically range between 2% to 7% while offsite slopes located to the east of the nearly 38 acres, reach grades of 10:1. Offsite flows reaching development are mainly from small fringe areas located along the north and western boundaries. A ridgeline which bisects the parcel, north to south functions to direct runoff to the southern boundary where it has historically collected.

As discussed, the proposed development will construct an office/warehouse building, a car wash bay, and gravel and asphalt parking areas, lighting, and landscaping, as well as build an access road from existing Capitol Drive. Two temporary modular buildings will be moved onsite until the primarily office building can be completed. The majority of the site will be utilized for the storage of landscaping related materials such as various types of rock, gravel, boulders and mulch along with other commercial related landscaping products, vehicles and trailers.

Runoff entering the subject site from offsite areas, as well as flows produced within the development will be collected by proposed storm sewer improvements and routed to a proposed full spectrum detention (FSD) pond located along the southern boundary and access roadway into the development. Also a temporary FSD is proposed on the adjacent site to treat a minor runoff from the site to the west. Addition detailed discussion regarding these improvements is discussed in subsequent sections of this report.

SOILS

Soils for this project are delineated by the map in the appendix as Blakeland loamy sand (8) and Blendon Sandy Loam (10) is characterized as Hydrologic Soil Types "A" & "B". Soils in the study area are shown as mapped by Soil Conservation Service in the "Soils Survey of El Paso County Area".

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 are included in the appendix of this report.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0543 G, effective date December 7, 2018 no portion of this site is located within the 100- year floodplain.

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current El Paso County Drainage Criteria Manual and where applicable the City of Colorado Springs DCM Volume 1 dated May 2014 effective January 2015. Hydrologic calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method as required for basins having areas less than 130 acres (in accordance with Chapter 6 of the City of Colorado Springs DCM Volume 1). Full spectrum detention facilities have been designed in accordance with Section 3.2.1. of Chapter 13 of the City of Colorado Springs DCM Volume 1, dated May 2014, effective January 31, 2015 and Urban Drainage and Flood Control District Manuals dated January 2016.

FOUR STEP PROCESS

Step 1 Employ Runoff Reduction Practices. – Approx. 1.5 acres of the proposed developed 37.95 Acres of ground within the project is being set aside for a Full Spectrum Detention (FSD) Pond. Whenever possible runoff produced within developable area containing impervious surfaces will be routed through landscaped areas or earthen swales to minimize direct connection of impervious surfaces.

Step 2 Stabilize drainage ways –The Timberline Storage Yard site proposes a Full Spectrum Detention (FSD) pond to control developed runoff that is discharging to the historic drainage way that crosses the vacant parcel located to the south of the subject site. The FSD outlet structure has been designed to drain the water quality event storm in 40 hours, while reducing the 100 year peak discharge to approximately 90% of the predevelopment conditions. The development of this site is not anticipated to have negative effects on downstream drainage ways.

Step 3 Provide water quality capture volume. – A Full Spectrum Detention Basin is proposed to reduce peak discharge rates and provide water quality treatment. The WQCV will be released over a 40 hour period while larger event storms will be released in periods of times between 64-80 hours.

Step 4 Consider Need for Industrial and Commercial BMP's – This submittal provides a final grading and erosion control plans with BMPs in place. The proposed project will use silt fence, a vehicle tracking control pad, concrete washout area, mulching and reseeding to mitigate the potential for erosion across the site.

EXISTING DRAINAGE CONDITIONS

The Timberline Storage Yard site consists of 37.95 acres and is situated west of the East Fork Reach of the Sand Creek Watershed. Prior to construction associated with this development there were no existing structures within the planned Timberline Storage Yard site. An existing (historic) conditions hydrologic analysis was performed to determine existing flow quantities entering and exiting the subject site so a comparison to post development discharge rates could be made. As shown on the Historic Drainage Maps, located in the appendix of this report, the existing site terrain within the parcel generally slopes from north to south at grades that vary between 2% and 7%. An area east of the proposed site contributes to the overall drainage reaching the discharge point located to the south of the subject site.

Basin EX-1 consists of native grass covered un-platted hillside located to the east of the parcel property boundary. Runoff produced by the 22.9 acre area of land has been calculated to be 7.6 cfs in the 5-year storm event and 51.0 cfs in the 100-year storm event. Runoff from this basin is conveyed as sheet flow to the west towards **Basin EX-2**.

Basin EX-2 consists of grass covered un-platted lands to the east of a ridgeline that bisects the nearly 38 acre parcel. Runoff produced by the 23.6 acre area has been calculated to reach peak flow rates of 5.0 cfs in the 5-year storm event and 33.6 cfs in the 100-year storm event. Runoff from Basin EX-2 combines with runoff produced within **Basin EX-1** at **Design Point 1** located at the southeast corner of the proposed development boundary. The total calculated surface runoff at **DP1** is 11.5 cfs in the 5-year storm event and 77.3 cfs in the 100-year storm event.

Basin OS1 consists of offsite native grass covered un-platted lands located and adjacent to the west of the property line. Runoff produced by the 2.42 acre area of land has been calculated to be 0.8 cfs in the 5-year storm event and 5.1 cfs in the 100-year storm event. Runoff from this basin is conveyed to the south to **Basin EX3**.

Basin EX-3 consists of native grass covered un-platted lands located within and adjacent to the western property line. Runoff produced by the 20.7 acre area of land has been calculated to be 4.2 cfs in the 5-year storm event and 28.4 cfs in the 100-year storm event. Runoff from **Basin EX-3** combines with runoff from **DP 1** and **DP2** at **Design Point 3**, at a small channelized drainage way located adjacent to the southern boundary of the planned development. The total calculated surface runoff at **DP3** is 14.2 cfs in the 5-year storm event and 95.4 cfs in the 100-year storm event. Runoff reaching this point continues south through the adjacent un-platted offsite parcel.

Basin EX-4 consists of native grass covered un-platted lands located along west property at the southwest corner of the site. Runoff produced by the **Basin EX-4,** 1.32 acre area of land has been calculated to reach 0.4 cfs in the 5-year storm event and 2.7 cfs in the 100-year storm event.

Basin OS2 consists of native grass covered un-platted lands located offsite, adjacent to the west property line. Runoff produced by the 0.57 acre area of land has been calculated to be 0.2 cfs in the 5-year storm event and 1.3 cfs in the 100-year storm event. Runoff from **Basin OS2** combines with runoff from **Basin EX-4** at **Design Point 4**, at the end of Capital Drive. The total calculated surface runoff at **DP4** is 0.6 cfs in the 5-year storm event and 3.8 cfs in the 100-year storm event. Runoff reaching this point continues south along the existing Capital Drive shoulders.

Basin OS3 consists of offsite native grass covered un-platted lands located to the west of the property. Runoff produced by the 12.72 acre area of land has been calculated to be 3.6 cfs in the 5-year storm event and 24.4 cfs in the 100-year storm event. Runoff from this basin is conveyed to the south as sheet flow to an existing swale and west to **Basin OS6**.

Basin OS4 consists of offsite native grass covered un-platted lands located to the west of the property. Runoff produced by the 0.66 acre area of land has been calculated to be 0.2 cfs in the 5-year storm event and 1.6 cfs in the 100-year storm event. Runoff from this basin is conveyed to the northwest as sheet flow to the existing East Fork Sand Creek Subtributary channel, **Design Point 5**.

Basin OS5 consists of offsite native grass covered un-platted lands located to the west of the property. Runoff produced by the 3.19 acre area of land has been calculated to be 1.0 cfs in the 5-year storm event and 6.7 cfs in the 100-year storm event. Runoff from this basin is conveyed to the west as sheet flow to the existing East Fork Sand Creek Subtributary channel, **Design Point 6**.

Basin OS6 consists of native grass covered un-platted lands located offsite, adjacent to the west property line. Runoff produced by the 0.36 acre area of land has been calculated to be 0.1 cfs in the 5-year storm event and 0.7 cfs in the 100-year storm event. Runoff from **Basin OS6** combines with runoff from **Basin OS3** at **Design Point 7**, at the existing East Fork Sand Creek Subtributary channel. The total calculated surface runoff at **DP7** is 3.1 cfs in the 5-year storm event and 20.8 cfs in the 100-year storm event.

PROPOSED DRAINAGE CHARACTERISTICS

General Proposed Conditions Drainage Discussion

The parcel housing the proposed development is approximately 37.95 acres in size and is currently zoned "M" for industrial. The site is to consist of a large gravel storage yard, an office/warehouse building, a car wash bay, with asphalt and gravel parking areas, lighting, landscaping, and access entryways. Approximately two-thirds of the development will be utilized for the storage of materials and vehicles associated with commercial landscaping.

Runoff produced offsite along the majority of the north and west sides of the proposed site development areas will mimic the historic drainage patterns by sheet flowing to the development boundary lines (see attached proposed drainage map in the appendix) where it will combine with runoff generated onsite within the storage yard and from the east half of the warehouse building. Proposed earthen swales and proposed rip rap lined rundowns will convey the collected runoff to a proposed Full Spectrum Detention pond located along the southern boundary of the site. Runoff generated from the proposed landscaping area directly in front of the warehouse building will combine with runoff generated within the adjacent access road where it will be routed via curb and gutter to a concrete swale and then routed to the proposed pond. Runoff produced offsite to the east will combine with onsite flows with the eastern half of the development (which is to be utilized for material storage) and directed to a proposed riprap rundown which will convey the collected flows to the FSD pond. The runoff reaching the pond will be detained and discharged via a staged outlet box and proposed RCP storm system to the historic drainage way located south of the site below historic flow rates.

Runoff generated from the west half of the proposed warehouse building and west parking lot and a small portion of the proposed access/entrance roadway will be discharge into the temporary DWIRE pond. The proposed discharge from this portion of the site, post construction, is just slightly higher than historic. The runoff reaching this temporary pond will be detained and discharged via a staged 36" CMP riser and proposed RCP storm system to the existing East Fork Sand Creek Subtributary channel located west of the site below historic flow rates. It should be noted that a shared access and drainage easement has been signed by the adjacent property owner permit access to the west side of the building and to allow for developed discharge onto the site. A maintenance agreement is included with this report and submittal.

Proposed Conditions Detailed Drainage Discussion

Basin OS-1, 1.47 acres, (Q5=0.4cfs, Q100=2.8cfs), consists of undeveloped un-platted offsite lands located along the north boundary of the proposed development. Runoff from **Basin OS-1** is tributary to **Basin A.**

Basin A, 5.87 acres, (Q5=5.8cfs, Q100=17.3cfs), consists primarily of portions of the proposed gravel storage, greenbelt/agricultural land and access roads located near the north and west boundaries. Runoff produced within **Basin A** combines with runoff from **Basins OS-1** and enters **Basin B**.

Basin OS-2, 2.59 acres, (Q5=2.2cfs, Q100=7.0cfs), consists of undeveloped un-platted offsite lands located along the west boundary of the proposed development. Runoff from **Basin OS-2** is tributary to **Basin B.**

Basin C, 2.47 acres, (Q5=2.3cfs, Q100=6.9cfs), consists primarily of portions of the proposed gravel storage, greenbelt/agricultural land and access roads located adjacent to **Basin A** and **B**. Runoff from **Basin C** is tributary to **Basin B**.

Basin B, 7.91 acres, (Q5=10.4cfs, Q100=25.9cfs), consists primarily of a proposed gravel storage yard as well as a portion of the proposed office/warehouse building, wash bay, associated concrete aprons, and asphalt parking areas located along the northeast corner of the building. Runoff produced within **Basin B** combines with runoff from **Basins OS-1, OS-2, A and C** at **Design Point 1** (Q5=16.0cfs, Q100=45.6cfs). Runoff reaching **DP-1** will be directed to a proposed Full Spectrum Detention Pond at **Design Point 4** via a 4'bw 3:1 SS trapezoidal 25% rundown lined with D50=18" riprap atop a gravel and fabric liner. A pair of 4:1SS, 1' min. deep v-shaped earthen swales graded at a min of 1% are recommended to be constructed along the northern exterior of the pond embankment to intercept runoff that might otherwise erode the pond side slopes. An 18" deep concrete lined forebay is to be constructed at the bottom of the rundown to collect any conveyed sediment.

Basin D, 0.65 acres, (Q5=2.3cfs, Q100=4.6cfs), consists of the southwestern quarter of the proposed office/warehouse building, a portion of the east paved parking lot, landscaping and a portion of the gravel drive isles. Runoff produced within **Basin D** flows east toward a low point located at **Design Point 2.**

Basin E, 0.37 acres, (Q5=0.9cfs, Q100=1.8cfs), consists of a landscaped area, portions of the east paved parking lot, as well as portions of the asphalt millings access roadway planned along the southern boundary line. Runoff generated by this basin are directed eastward via the proposed curb and gutter to a 6' wide concrete swale. The 6' wide concrete swale will direct flow to a lowpoint at **Design Point 2** (Q5=2.8cfs, Q100=5.6cfs). Runoff reaching **DP-2** will be directed to a proposed Full Spectrum Detention via a 2.5'bw 2:1 SS trapezoidal 25% rundown lined with D50=18" riprap atop a gravel and fabric liner to **Design Point 4.** A 12" deep concrete lined forebay is to be constructed at the bottom of the rundown to collect any conveyed sediment.

Basin OS-3, 0.56 acres, (Q5=0.2cfs, Q100=1.2cfs), consists of small offsite area located between the permanent site improvements and the historic drainage channel along the southern boundary of the proposed development. Runoff produced within **OS-3** sheet flows to the south to the historic drainage channel at **Design Point 6**.

Basin OS-4, 3.08 acres, (Q5=1.0cfs, Q100=6.6cfs), consists of undeveloped offsite lands located along the northern boundary of the proposed development. Runoff from **Basin OS-4** is tributary to **Basin G.**

Basin OS-5, 21.36 acres, (Q5=6.6cfs, Q100=44.4cfs), consists of an undeveloped hillside located directly east of the subject site. Runoff from this site will continue to discharge into the subject site as in the historic condition. Runoff from **Basin OS-5** is tributary to **Basin G.**

Basin G, 16.67 acres, (Q5=13.6cfs, Q100=40.9cfs), consists of the eastern half of the development which is planned to be utilized for primarily for storing landscaping materials. Approximately 14.17 acres is to be utilized for storing landscape materials and 2.5 acres will be reseeded and mulched. The upper storage area will flow through the lower portion of **Basin G** which will be reseeded and mulched to minimize sediment transport. Runoff from this basin and the surrounding offsite areas are to be conveyed overland to a low point located at **Design Point 3** (Q5=20.4cfs, Q100=85.9cfs). Runoff reaching **DP-3** will be directed to a

proposed Full Spectrum Detention via a 3.0'bw 2:1 SS trapezoidal 25% rundown lined with D50=18" riprap atop a gravel and fabric liner to **Design Point 4.** A 1.5' deep low tailwater riprap basin is to be constructed at the bottom of the rundown to collect any conveyed sediment.

Basin F, 1.55 acres, (Q5=0.9cfs, Q100=4.4cfs), consists of a portion of land dedicated to a proposed **Full Spectrum Detention (FSD)** pond. Runoff from **Design Points 1, 2 &** 3 contribute to the proposed **FSD** pond at **Design Point 4** at a combined peak flow rate of Q5=36.4cfs, Q100=127.6cfs. The proposed **FSD** Pond 1 was sized utilizing the UDFCD UD-Detention Worksheet, Vol 3.07. Based upon the contributing watershed size, characteristics and planned imperviousness the pond required a minimum of 2.721 acre feet of storage in the 100-year event to limit the discharge to a maximum of 71.5cfs. A proposed 42" RCP with riprap lined outfall will convey runoff to offsite down-gradient property. A proposed riprap outfall will slow and disperse flows as to not impact the historic drainage way located to the south of the site. The crest of the spillway is set above the 100-year water surface at 6538.5 which allows for positive drainage to a future curb line. In the interim, the spillway will outfall into a gradual slope of 1.8% which will be lined with SC250 North American Green erosion control blanket. The proposed embankment has been set at 6540.2. Should the pond outlet box become clogged storm water shall overtop the emergency spillway and outfall to the historic channel.

Basin OS-6, 3.84 acres, (Q5=1.0cfs, Q100=6.4cfs), consists of an undeveloped hillside located directly east of the subject site. Runoff from this site will continue to discharge to the south eastern boundary of the site as in the historic condition via an exising swale. Runoff from **Basin OS-6** is tributary to **Basin H and Basin OS-7.**

Basin H, 0.97 acres, (Q5=0.4cfs, Q100=2.5cfs), is a small undeveloped basin located at the southeast corner of the site. In the proposed condition, a small earthen berm is to be constructed along the north edge of **Basin H** and **Basin G** to redirect the **Basin G** flow to the proposed **FSD Pond 1**. Flows entering from **Basin OS-6** shall be routed through **Basin H** via historic drainage patterns to **Basin OS-7**. The proposed berm will function to protect the proposed improvements to the north and furthermore function to control the offsite runoff that was previously discharge as un-detained sediment laden flows to the property to the south. In the event the roadway is extended with the development of the adjacent property the earthen berm could easily be removed and other storm sewer solutions implemented.

Basin OS-7, 0.46 acres, (Q5=0.2cfs, Q100=1.2cfs), consists of a small offsite area located between the permanent site improvements and the historic drainage channel. The combined runoff from this primarily undeveloped area **Basin H**, **Basin OS3**, **Basin OS6**, **Basin OS7** and the proposed FSD detention pond outlet pipe combines at **Design Point 6** for a 5 and 100-year peak flow rates of 1.8cfs and 80.6cfs. This calculated developed discharge is below the existing runoff estimated to reaching this location of 14.2cfs and 95.4cfs in the 5 year and 100 year events respectively and therefore is not anticipated to negatively affect downstream facilities or properties.

Basin I, 1.50 acres, (Q5=4.9cfs, Q100=9.8cfs), consists of a portion of the concrete aprons, and gravel and asphalted surfaces for the purpose of parking and driveway located along the western side of the planned development as well as the western half of the proposed warehouse building. Runoff from **Basin I** is directed offsite to the adjacent property via a crosspan, curb return and proposed grading to the temporary DWIRE FSD pond.

Basin OS-8 consists of native prairie grass, gravel and paved section for a public roadway turn around, located just to the west of the property at the southwest corner of the site, offsite on the adjacent property. Runoff produced by the offsite parcel 1.44 acre area of land has been calculated to reach 2.1 cfs in the 5-year storm event and 5.2cfs in the 100-year storm event. Runoff from **Basin OS-8** and **Basin I** combine at **Design Point 7** at 5 and 100-year peak flow rates of 3.6cfs and 13.0cfs. Runoff reaching **DP7** will be directed to the temporary **Full Spectrum Detention (FSD)** via a 2.0'bw 3:1 SS trapezoidal 25% rundown lined with D50=12" riprap atop a gravel and fabric liner to **Design Point 11.**

Basin OS-9 consists of native prairie grass and gravel, located west of the property at the southwest corner of the site, offsite on the adjacent property. Runoff produced by the offsite parcel 10.24 acre area of land has been calculated to reach 9.3 cfs in the 5-year storm event and 27.3cfs in the 100-year storm event. Runoff from **Basin OS-9** will sheet flow into the temporary **FSD** to **Design Point 11.**

Basin OS-10 consists of native prairie grass, located west of the property at the northwest corner of the site, offsite on the adjacent property. Runoff produced by the offsite parcel 0.66 acre area of land has been calculated to reach 0.2 cfs in the 5-year storm event and 1.6cfs in the 100-year storm event. Runoff from this basin is conveyed to the northwest as sheet flow to the existing East Fork Sand Creek Subtributary channel, **Design Point 8**.

Basin OS-11 consists of native prairie grass and gravel, located west of the property at the west of the site, offsite on the adjacent property. Runoff produced by the offsite parcel 3.19 acre area of land has been calculated to reach 2.5 cfs in the 5-year storm event and 8.4cfs in the 100-year storm event. Runoff from this basin is conveyed to the south as sheet flow to **Basin OS12**.

Basin OS-12 consists of native prairie grass, located to the west of the property at the southwest corner of the site, offsite on the adjacent property. Runoff produced by the offsite parcel 0.14 acre area of land has been calculated to reach 0.0 cfs in the 5-year storm event and 0.3cfs in the 100-year storm event. Runoff from **Basin OS-12** and **Basin OS-11** combine at **Design Point 10** at 5 and 100-year peak flow rates of 2.6cfs and 8.7cfs. Runoff reaching **DP10** will sheet flow into the temporary **FSD** to **Design Point 11.**

Basin OS-13, 1.20 acres, (Q5=0.3cfs, Q100=2.3cfs), consists of a portion of land dedicated to a temporary **Full Spectrum Detention (FSD)** pond. Runoff from **Design Points 7, 9 & 10** contribute to the temporary FSD pond at **Design Point 11** at a combined peak flow rate of Q5=15.3cfs, Q100=49.4cfs. The temporary **FSD** Pond was sized utilizing the UDFCD UD-Detention Worksheet, Vol 3.07. Based upon the contributing watershed size, characteristics and planned imperviousness the pond required a minimum of 1.628 acre feet of storage in the 100-year event to limit the discharge to a maximum of 16.0cfs. A proposed 24" RCP with riprap lined outfall will convey runoff to the existing East Fork Sand Creek Subtributary channel. A proposed riprap lowtail water basin outfall will slow and disperse flows as to not impact the existing channel. The crest of the spillway is set above the 100-year water surface at 6533.0. The spillway will outfall into the existing channel at a 3:1 slope which will be lined with D50=12", Type M riprap. The proposed embankment has been set at 6535.0. Should the pond 36" CMP riser become clogged storm water shall overtop the emergency spillway and outfall to the existing channel. The proposed developed flows will be detained and treated within a **FSD** that is planned to be constructed with the adjacent DWIRE storage yard, to meet MS4 permit requirements.

Basin OS-14 consists of native prairie grass, located west of the property at the south corner of the site, offsite on the adjacent property. Runoff produced by the offsite parcel 1.44 acre area of land has been calculated to reach 0.5 cfs in the 5-year storm event and 3.6cfs in the 100-year storm event. Runoff from this basin is conveyed to the south as sheet flow to the existing swale and west to the East Fork Sand Creek Subtributary channel.

WATER QUALITY PROVISIONS AND MAINTENANCE

The proposed full spectrum detention (FSD) pond 1 and the DWIRE FSD pond function to provide detention and water quality for the proposed development as well as all runoff tributary to it. This includes runoff produced onsite, north of the development and parcel, as well as offsite flows adjacent to the east and west boundary of the parcel. This full spectrum detention pond 1 will function to treat approximately 63.84 acres by providing 0.623 acre-feet of storage for the water quality event, 1.350 acre feet of storage at the EURV event storm and 2.721 acre-feet of storage in the 100-year event. The temporary DWIRE FSD pond will function to treat approximately 19.362 acres by providing 0.256 acre-feet of storage for the water quality event, 0.710 acre feet of storage at the EURV event storm and 1.628 acre-feet of storage in the 100-year event. The proposed full spectrum detention pond 1 and the DWIRE pond will be private and shall be maintained by the property owner. Access shall be granted to the owner and El Paso County for access and maintenance of the private WQCV facility. A private maintenance agreement document shall accompany this report submittal.

The sizing for the full spectrum detention facility has been determined using the guidelines set forth in the Urban Drainage and Flood Control District Criteria Manual. Refer to the UDFCD UD-Detention Excel Workbook located within the appendix of this report for calculations.

OFFSITE DOWNSTREAM CHANNEL ANALYSIS

El Paso County Engineering has requested an analysis of the offsite downstream channel. The existing channel runs north to south on unplatted land owned by Weatherford Artificial (Sch. No. 5300000190). The analysis of the existing channel will be begin at the outfall of the proposed Timberline Storage to the north and will end at the two existing 48” culverts at the southwest end of the property. Runoff reaching the two culverts will ultimately be routed to the East Fork Sand Creek Subtributary. Runoff tributary to the existing channel has been accounted for, as proposed developed flow from the proposed Timberline Storage site (37.95 acres), offsite developed flow from the BLH NO.2 LLC property (22.9 acres), existing undeveloped flow from the offsite BLH NO.2 LLC property (7.7 acres) and existing undeveloped flow from the offsite Weatherford Artificial property (30.2 acres).

Analysis of the existing channel and results provided by the Hydrologic Engineering Center River Analysis System (HEC-RAS) program. Per the results provided (see Appendix), scour (see shear values) and velocities are below the maximum values as stated in the City of Colorado Springs Drainage Criteria Manual Vol.1 (DCM1). Hence erosion of the existing channel is minimal. Let it be noted that with the development of Timberline Storage, the runoff values have been reduced in part to the release rate by the EDB pond. Proposed discharge from the site, post construction, is less than historic and therefore its construction is not anticipated to negatively affect downstream facilities or properties.

EROSION CONTROL

It is the policy of the El Paso County that we submit a grading and erosion control plan with the drainage report. Proposed silt fence, vehicle traffic control, and concrete washout area are proposed as erosion control measures. The costs for these measures have been provided on the Grading and Erosion Control plan.

CONSTRUCTION COST OPINION

Private Drainage Facilities (**NON-Reimbursable**):

TIMBERLINE POND

Item	Description	Quantity		Unit Cost			Cost
1.	42" RCP	117	LF	$181	/LF		$21,177.00
2.	42” RCP FES	1	EA	$2,389	/EA		$2,389.00
3.	2.5’w,2:1SS Rundown	18	CY	$80	/CY		$1,440.00
4.	3.0’w,2:1SS Rundown	18	CY	$80	/CY		$1,440.00
5.	4.0’w, 3:1SS Rundown	29	CY	$80	/CY		$2,320.00
6.	D50=12” Riprap	35	CY	$65	/CY		$2,275.00
7.	Low Tailwater Basin	17	CY	$65	/CY		$1,105.00
8.	Concrete Forebays	1	LS	$6,345	/LS		$6,345.00
9.	Type 1 MH	1	EA	$6,458	/EA		$6,458.00
10.	Modified Type D Outlet	1	EA	$20,500	/EA		$20,500.00
11.	FSD Pond 1	1	EA	$10,000	/EA		$10,000.00
						Total $	$75,449

DWIRE POND

Item	Description	Quantity		Unit Cost			Cost
1.	24" RCP	69	LF	$104	/LF		$7,176.00
2.	24” RCP FES	1	EA	$1,046	/EA		$1,046.00
3.	D50=12” Riprap	56	CY	$65	/CY		$3,640.00
4.	Low Tailwater Basin	7	CY	$65	/CY		$415.00
5.	36” CMP Riser Outlet	1	EA	$5,000	/EA		$5,000.00
6.	Temp FSD Pond	1	EA	$8,000	/EA		$ 8,000.00
						Total $	$25,227.00

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above and below is only an estimate of the facility cost amounts in 2019. This parcel is not being platted, thus no drainage basin fees are required with this development.

SUMMARY

The proposed Amendment to the Final Drainage Report for the Timberland Storage Yard is located within the Sand Creek Drainage Basin. Developed runoff both offsite and onsite basins are collected and conveyed to full spectrum detention facilities located in the south edge of the site and minimal flow that is discharged to the west. All stormwater collected by pond 1 and the DWIRE FSD pond will be detained, treated, and released in accordance with the requirements of El Paso County and the City of Colorado Springs Drainage Criteria. The proposed drainage facilities recommended within this report will adequately convey, detain and route runoff from the planned development to the historic drainage ways at peak flow rates which are in line with historic rates, therefore developed runoff discharged from the Timberland Storage Yard is not anticipated to adversely affect the surrounding and downstream developments.

REFERENCES

1.) "El Paso County and City of Colorado Springs Drainage Criteria Manuals".

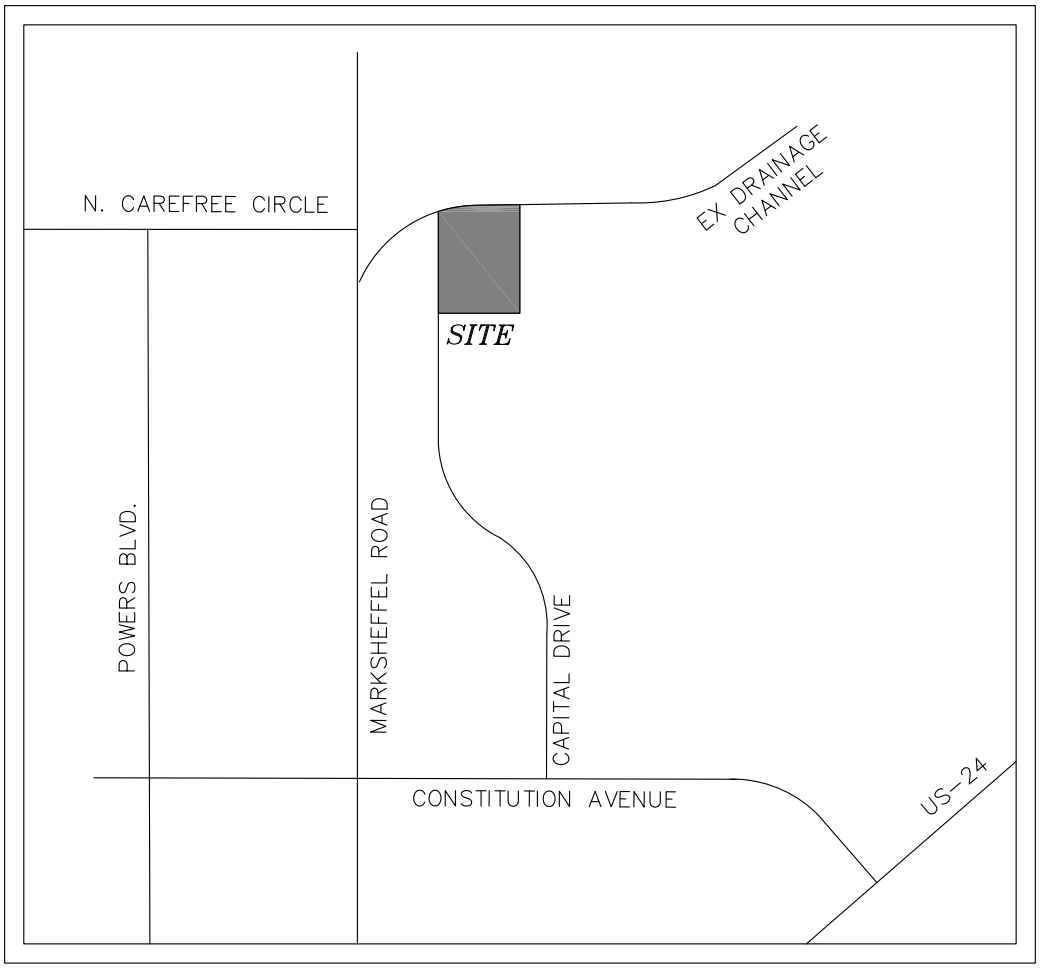
2.) "Urban Storm Drainage Criteria Manual"

3.) SCS Soils Map for El Paso County.

4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date December 7, 2018.

APPENDIX

VICINITY MAP

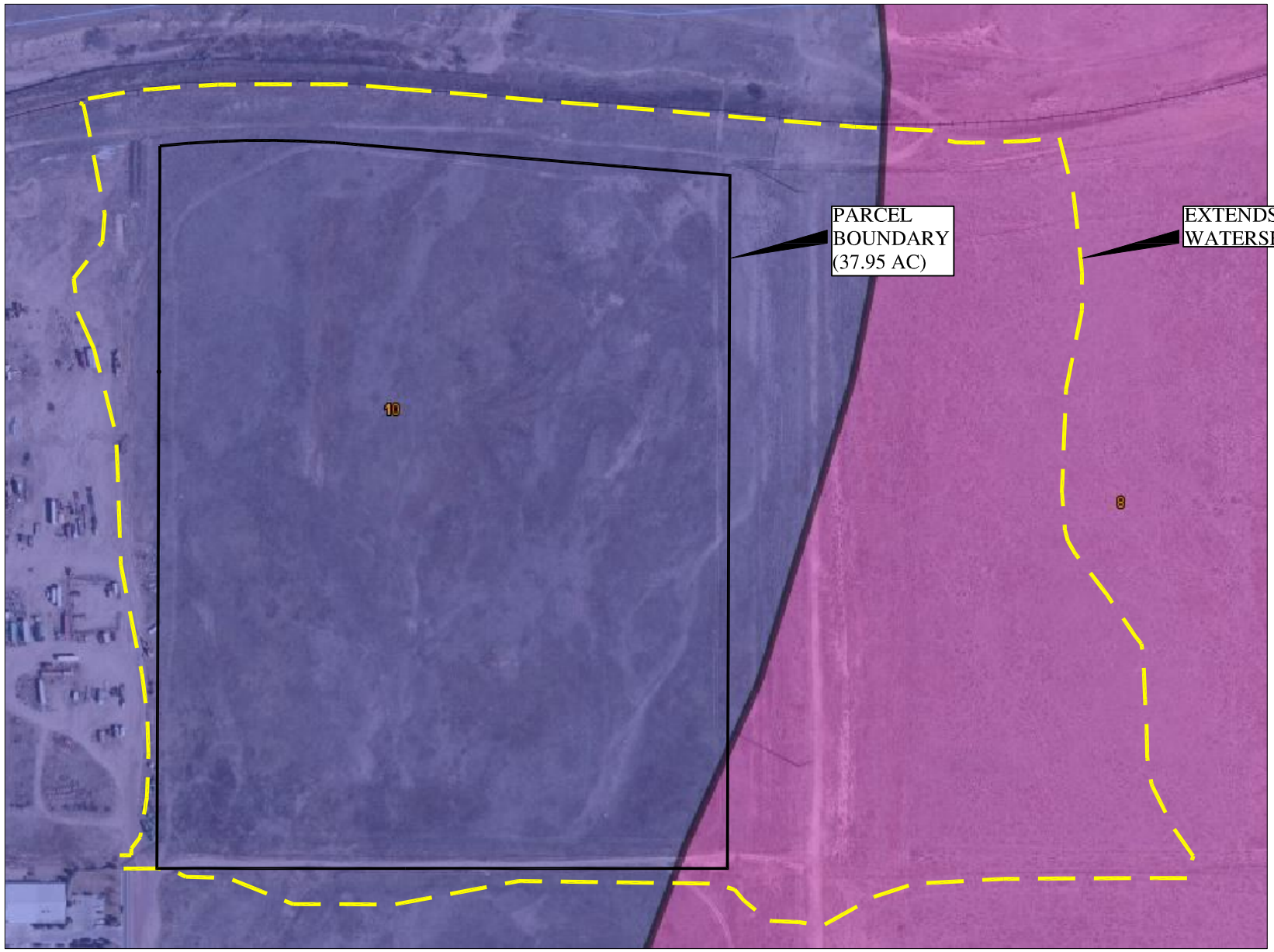


VICINITY MAP

N.T.S.

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

SOILS MAP



NOT TO SCALE

Summary by Map Unit — El Paso County Area, Colorado (CO625)		
Map unit symbol	Map unit name	Rating
8	Blakeland loamy sand, 1 to 9 percent slopes	A
10	Blendon sandy loam, 0 to 3 percent slopes	B

HYDROLOGIC TYPE A SOILS

HYDROLOGIC TYPE B SOILS

SITE BOUNDARY

ANALYZED WATERSHED BOUNDARY

TIMBERLINE STORAGE YARD

SOILS MAP

M&S CIVIL CONSULTANTS, INC.

FIRM PANEL

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 543 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

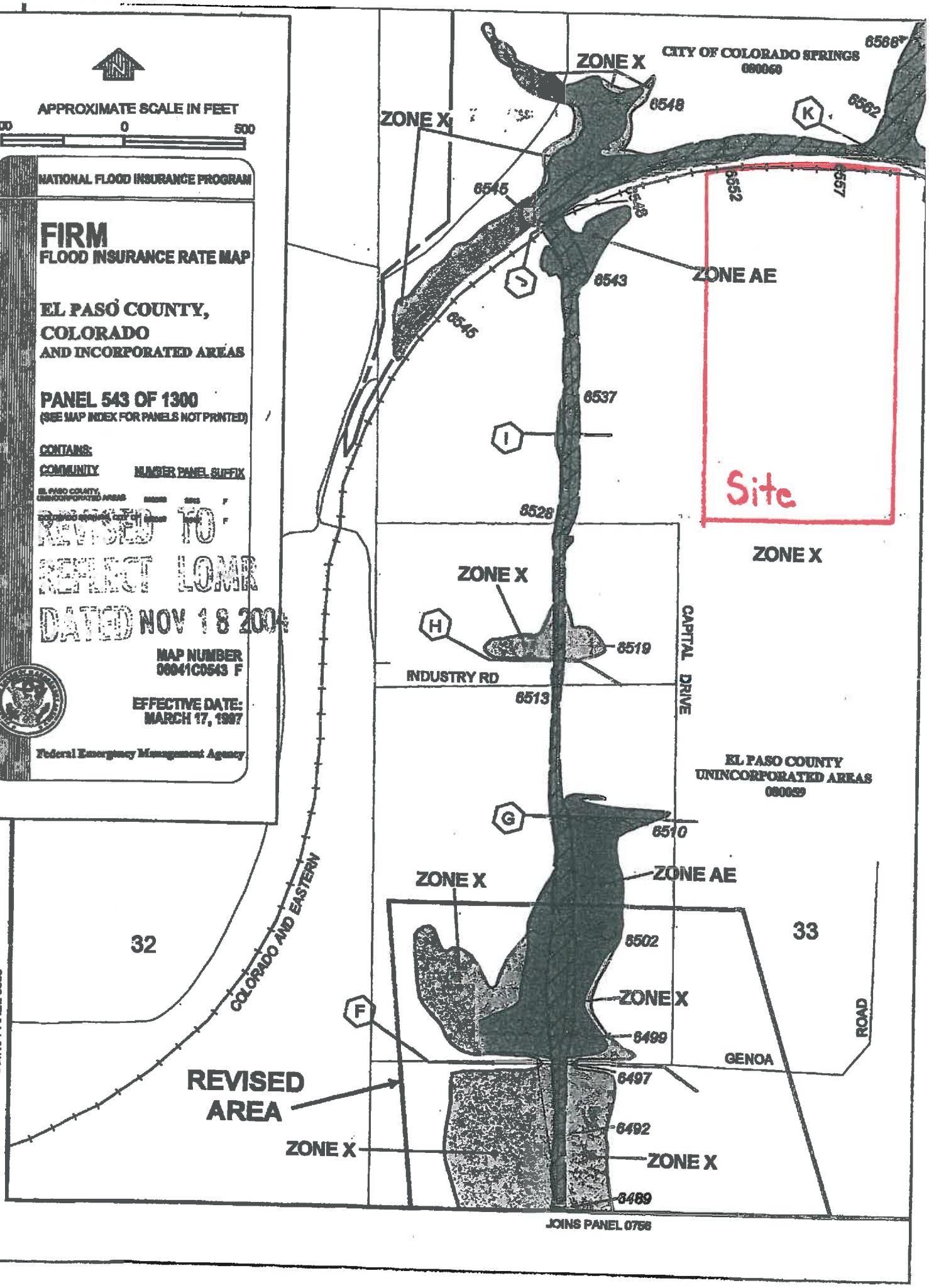
COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0543	F
COLORADO SPRINGS, CITY OF	080060	0543	F

REVISED TO REFLECT LOMR DATED NOV 18 2004

MAP NUMBER
08041C0543 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency



FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sand Creek East Fork Subtributary				REVISED DATA				
A	650	133	250	7.9	6,423.6	6,423.6	6,423.6	0.0
B	2,090	52	185	10.7	6,446.9	6,446.9	6,446.9	0.0
C	2,202	52	224	8.8	6,448.0	6,448.0	6,448.0	0.0
D	3,567	58	191	10.3	6,467.8	6,467.8	6,467.8	0.0
E	4,408	56	185	10.6	6,480.1	6,480.1	6,480.1	0.0
F	5,507	65	198	9.9	6,497.3	6,497.3	6,497.4	0.1
G	6,747	78	211	9.2	6,510.2	6,510.2	6,510.4	0.2
H	7,397	44	257	7.5	6,516.3	6,516.3	6,517.3	1.0
I	8,347	64	192	9.9	6,535.2	6,535.2	6,535.2	0.0
J	9,257	100	403	4.3	6,545.1	6,545.1	6,446.1	1.0
K	10,737	80	195	8.9	6,557.6	6,557.6	6,558.0	0.4
L	11,540	231	202	5.5	6,577.2	6,577.2	6,577.2	0.0
M	13,300	214	201	5.5	6,601.9	6,601.9	6,601.9	0.0
N	16,170	219	209	5.3	6,639.1	6,639.1	6,639.1	0.0
O	18,910	60	96	7.2	6,674.2	6,674.2	6,674.2	0.0
P	20,650	90	110	6.3	6,697.8	6,697.8	6,697.8	0.0
Q	22,900	100	112	6.1	6,729.2	6,729.2	6,729.3	0.1

[1]Feet above confluence with Sand Creek East Fork

NOV 18 2004

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK EAST FORK SUBTRIBUTARY

HYDROLOGIC CALCULATIONS

TIMBERLINE STORAGE
EXISTING DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			ASPHALT DRIVES 0.90-0.96			*GRAVEL STORAGE YARD 0.30-0.50*			*GREENBELTS/AGRI. 0.09-0.36*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	C_5	C_{100}
EX1	*998724.7*	22.93	0.00	0.90	0.96	0.00	0.30	0.50	22.93	0.09	0.36	***0.09***	***0.36***
EX2	*1029448.0*	23.63	0.00	0.90	0.96	0.00	0.30	0.50	23.63	0.09	0.36	***0.09***	***0.36***
EX3	*901993.0*	20.71	0.00	0.90	0.96	0.00	0.30	0.50	20.71	0.09	0.36	***0.09***	***0.36***
EX4	*57634.0*	1.32	0.00	0.90	0.96	0.00	0.30	0.50	1.32	0.09	0.36	***0.09***	***0.36***
OS1	*105200.0*	2.42	0.00	0.90	0.96	0.00	0.30	0.50	2.42	0.09	0.36	***0.09***	***0.36***
OS2	*24947.0*	0.57	0.00	0.90	0.96	0.00	0.30	0.50	0.57	0.09	0.36	***0.09***	***0.36***
OS3	*554118.0*	12.72	0.00	0.90	0.96	0.00	0.30	0.50	12.72	0.09	0.36	***0.09***	***0.36***
OS4	*28710.0*	0.66	0.00	0.90	0.96	0.00	0.30	0.50	0.66	0.09	0.36	***0.09***	***0.36***
OS5	*139024.0*	3.19	0.00	0.90	0.96	0.00	0.30	0.50	3.19	0.09	0.36	***0.09***	***0.36***
OS6	*15576.0*	0.36	0.00	0.90	0.96	0.00	0.30	0.50	0.36	0.09	0.36	***0.09***	***0.36***

Calculated by: GT
Date: 3/3/2020
Checked by: VAS

TIMBERLINE STORAGE
EXISTING DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
EX1	22.93	0.09	0.36	0.09	100	4.0	11.5	325	8.0%	2.8	1.9	13.5	3.7	6.2	***7.6***	***51.0***
EX2	23.63	0.09	0.36	0.09	100	4.0	11.5	1600	1.6%	1.3	21.1	32.6	2.4	4.0	***5.0***	***33.6***
EX-3	20.71	0.09	0.36	0.09	100	4.0	11.5	1750	1.6%	1.3	23.1	34.6	2.3	3.8	***4.2***	***28.4***
EX4	1.32	0.09	0.36	0.09	100	2.0	14.5	288	3.5%	1.9	2.6	17.1	3.3	5.6	***0.4***	***2.7***
OS1	2.42	0.09	0.36	0.09	100	6.0	10.1	869	1.8%	1.4	10.7	20.8	3.5	5.8	***0.8***	***5.1***
OS2	0.57	0.09	0.36	0.09	100	2.0	14.5	415	1.4%	1.2	5.8	20.3	3.8	6.3	***0.2***	***1.3***
OS3	12.72	0.09	0.36	0.09	100	8.0	9.2	1513	2.0%	1.4	17.9	27.1	3.2	5.3	***3.6***	***24.4***
OS4	0.66	0.09	0.36	0.09	100	6.0	10.1	164	10.9%	3.3	0.8	10.9	4.0	6.7	***0.2***	***1.6***
OS5	3.19	0.09	0.36	0.09	100	3.0	12.7	842	1.7%	1.3	10.9	23.6	3.5	5.9	***1.0***	***6.7***
OS6	0.36	0.09	0.36	0.09	100	2.0	14.5	343	3.5%	1.9	3.1	17.6	3.3	5.5	***0.1***	***0.7***

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

Calculated by: GT
Date: 3/3/2020
Checked by: VAS

TIMBERLINE STORAGE
EXISTING DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*	
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*
1	**EX1, EX2**	4.19	16.76	TAKEN FROM BASIN EX1			13.5	1300	1.5%	1.9	11.6	25.1	2.7	4.6	***11.5***	***77.3***
2	**OS1**	0.22	0.87	TAKEN FROM BASIN OS1								20.8	3.0	5.1	***0.7***	***4.4***
3	**DP1, DP2, EX3**	6.27	25.09	TAKEN FROM BASIN EX3								34.6	2.3	3.8	***14.2***	***95.4***
4	**EX4, OS2**	0.17	0.68	TAKEN FROM BASIN OS2								17.1	3.3	5.6	***0.6***	***3.8***
5	**OS4**	0.06	0.24	TAKEN FROM BASIN OS4								10.9	4.0	6.7	***0.2***	***1.6***
6	**OS5**	0.29	1.15	TAKEN FROM BASIN OS5								23.6	2.8	4.8	***0.8***	***5.5***
7	**OS3, OS6**	1.18	4.71	TAKEN FROM BASIN OS3								27.1	2.6	4.4	***3.1***	***20.8***

Calculated by: GT
Date: 3/3/2020
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			ROOFS 0.73-0.81 COMMERCIAL AREAS 0.81-0.88 ASPHALT DRIVES 0.90-0.96			*LANDSCAPED AREAS 0.16-0.41 GRAVEL STORAGE YARD 0.30-0.50 LIGHT INDUST AREAS 0.59-0.70*			*GRAVEL STORAGE YARD 0.30-0.50 PARKS 0.12-0.39 GREENBELTS/AGRI. 0.09-0.36*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	C_5	C_{100}
A	*255817.4*	**5.87**	0.00	0.73	0.81	4.99	0.30	0.50	0.88	0.09	0.36	***0.27***	***0.48***
B	*344618.1*	**7.91**	0.44	0.90	0.96	1.14	0.59	0.70	6.33	0.30	0.50	***0.38***	***0.55***
C	*107689.3*	**2.47**	0.00	0.73	0.81	2.10	0.30	0.50	0.37	0.09	0.36	***0.27***	***0.48***
D	*28400.0*	**0.65**	0.47	0.90	0.96	0.18	0.16	0.41	0.00	0.09	0.36	***0.70***	***0.81***
E	*15936.0*	**0.37**	0.20	0.90	0.96	0.17	0.16	0.41	0.00	0.30	0.50	***0.56***	***0.70***
F	*67446.0*	**1.55**	0.00	0.90	0.96	0.23	0.30	0.50	1.32	0.12	0.39	***0.15***	***0.41***
G	*726210.0*	**16.67**	0.00	0.90	0.96	14.17	0.30	0.50	2.50	0.09	0.36	***0.27***	***0.48***
H	*42442.0*	**0.97**	0.00	0.90	0.96	0.00	0.30	0.50	0.97	0.09	0.36	***0.09***	***0.36***
I	*65383.5*	**1.50**	0.85	0.90	0.96	0.54	0.30	0.50	0.11	0.16	0.41	***0.63***	***0.75***
OS1	*64029.9*	**1.47**	0.00	0.81	0.88	0.00	0.30	0.50	1.47	0.09	0.36	***0.09***	***0.36***
OS2	*112755.0*	**2.59**	0.00	0.81	0.88	1.90	0.30	0.50	0.69	0.09	0.36	***0.24***	***0.46***
OS3	*24414.0*	**0.56**	0.00	0.90	0.96	0.00	0.16	0.41	0.56	0.09	0.36	***0.09***	***0.36***
OS4	*134326.7*	**3.08**	0.00	0.90	0.96	0.00	0.30	0.50	3.08	0.09	0.36	***0.09***	***0.36***
OS5	*930571.9*	**21.36**	0.00	0.81	0.88	0.00	0.30	0.50	21.36	0.09	0.36	***0.09***	***0.36***
OS6	*167403.3*	**3.84**	0.00	0.81	0.88	0.00	0.30	0.50	3.84	0.09	0.36	***0.09***	***0.36***
OS7	*20171.5*	**0.46**	0.00	0.81	0.88	0.00	0.30	0.50	0.46	0.09	0.36	***0.09***	***0.36***
OS8	62767.0	**1.44**	0.23	0.90	0.96	1.21	0.30	0.50	0.00	0.09	0.36	***0.40***	***0.57***
OS9	445959.0	**10.24**	0.00	0.90	0.96	9.21	0.30	0.50	1.03	0.09	0.36	***0.28***	***0.49***
OS10	28791.0	**0.66**	0.00	0.90	0.96	0.00	0.30	0.50	0.66	0.09	0.36	***0.09***	***0.36***
OS11	139030.0	**3.19**	0.00	0.90	0.96	2.14	0.30	0.50	1.05	0.09	0.36	***0.23***	***0.45***
OS12	6174.0	**0.14**	0.00	0.90	0.96	0.00	0.30	0.50	0.14	0.09	0.36	***0.09***	***0.36***
OS13	52286.0	**1.20**	0.00	0.90	0.96	0.00	0.30	0.50	1.20	0.09	0.36	***0.09***	***0.36***
OS14	*62767.0*	**1.44**	0.00	0.90	0.96	0.00	0.30	0.50	1.44	0.09	0.36	***0.09***	***0.36***

Calculated by: GT
Date: 3/4/2020
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	5.87	0.27	0.48	0.27	90	2.0	10.9	575	1.9%	1.0	9.9	20.8	13.7	3.7	6.1	***5.8***	***17.3***
B	7.91	0.38	0.55	0.38	100	1.0	13.1	810	1.4%	1.2	11.6	24.7	15.1	3.5	5.9	***10.4***	***25.9***
C	2.47	0.27	0.48	0.27	100	2.0	11.9	850	2.5%	1.1	12.9	24.8	15.3	3.5	5.9	***2.3***	***6.9***
D	0.65	0.70	0.81	0.70	50	6.0	2.3	50	1.0%	2.0	0.4	2.7	10.6	5.2	8.7	***2.3***	***4.6***
E	0.37	0.56	0.70	0.56	100	2.0	7.8	172	0.9%	1.9	1.5	9.3	11.5	4.2	7.1	***0.9***	***1.8***
F	1.55	0.15	0.41	0.15	50	1.0	9.7	50	25.0%	5.0	0.2	9.8	10.6	4.2	7.0	***0.9***	***4.4***
G	16.67	0.27	0.48	0.27	100	2.5	11.1	1800	1.1%	0.7	41.7	52.8	20.6	3.0	5.1	***13.6***	***40.9***
H	0.97	0.09	0.36	0.09	50	4.0	6.5	518	2.8%	3.3	2.6	9.1	13.2	4.3	7.2	***0.4***	***2.5***
I	1.50	0.63	0.75	0.63	50	1.0	4.8	47	4.0%	4.0	0.2	5.0	10.5	5.2	8.7	***4.9***	***9.8***
OS1	1.47	0.09	0.36	0.09	100	4.0	11.5	315	1.1%	0.7	7.1	18.7	12.3	3.2	5.4	***0.4***	***2.8***
OS2	2.59	0.24	0.46	0.24	100	7.0	8.1	830	2.0%	1.4	9.8	17.9	15.2	3.5	5.9	***2.2***	***7.0***
OS3	0.56	0.09	0.36	0.09	50	4	6.5	800	2.5%	1.1	12.0	18.5	14.7	3.5	6.0	***0.2***	***1.2***
OS4	3.08	0.09	0.36	0.09	50	1	10.3	200	1.0%	0.7	4.8	15.0	11.4	3.5	5.9	***1.0***	***6.6***
OS5	21.36	0.09	0.36	0.09	100	4	11.5	600	5.5%	2.3	4.3	15.8	13.9	3.4	5.8	***6.6***	***44.4***
OS6	3.84	0.09	0.36	0.09	100	3	12.7	1000	3.8%	1.4	12.2	24.9	16.1	2.8	4.6	***1.0***	***6.4***
OS7	0.46	0.09	0.36	0.09	50	2	8.2	300	2.0%	2.8	1.8	9.9	11.9	4.1	7.0	***0.2***	***1.2***
OS8	1.44	0.40	0.57	0.40	100	2	10.1	440	1.1%	1.0	7.1	17.2	13.0	3.7	6.3	***2.1***	***5.2***
OS9	10.24	0.28	0.49	0.28	100	6	8.2	1286	1.9%	1.4	15.7	23.9	17.7	3.3	5.5	***9.3***	***27.3***
OS10	0.66	0.09	0.36	0.09	100	6	10.1	164	10.9%	2.3	1.2	11.3	11.5	3.9	6.6	***0.2***	***1.6***
OS11	3.19	0.23	0.45	0.23	100	3	10.9	920	1.6%	1.3	12.0	22.9	15.7	3.5	5.8	***2.5***	***8.4***
OS12	0.14	0.09	0.36	0.09	100	2	14.5	140	2.9%	1.2	2.0	16.5	11.3	3.4	5.7	***0.0***	***0.3***
OS13	1.20	0.09	0.36	0.09	30	6	3.7	469	0.5%	0.5	15.8	19.5	12.8	3.1	5.2	***0.3***	***2.3***
OS14	1.44	0.09	0.36	0.09	50	1	10.3				0.0	10.3	10.3	4.1	6.9	***0.5***	***3.6***

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

Calculated by: GT
Date: 3/4/2020
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS** *DPS AND/OR PIPES*	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**OS1, OS2, A, B, C**	5.97	10.11	TAKEN FROM BASIN A			13.7	900	1.4%	1.2	12.5	26.2	2.7	4.5	*16.0*	*45.6*	DRAINAGE SWALE INTO FSD (N Forebay)
2	**D, E**	0.66	0.79	TAKEN FROM BASIN E								9.3	4.2	7.1	*2.8*	*5.6*	2.5'W RIPRAP RUNDOWN (SW Forebay)
3	**G, OS4, OS5**	6.68	16.79	TAKEN FROM BASIN G								20.6	3.0	5.1	*20.4*	*85.9*	3.0'W RIPRAP RUNDOWN (SE Rundown)
4	**F, DP1, DP2, DP3**	13.53	28.31	TAKEN FROM BASIN A								26.2	2.7	4.5	*36.4*	*127.6*	PROPOSED FSD POND 1
5	**PR1**			TAKEN FROM UD-DETENTION SHEET DET POND 1											*0.4*	*71.5*	PROPOSED FSD POND 1 RELEASE
6	**H, OS3, OS6, OS7 PR1**	0.53	2.10	TAKEN FROM BASIN OS6			24.90	618	2.8%	3.3	3.1	28.0	2.6	4.3	*1.4*	*9.1*	HISTORIC OUTFALL
															0.4	*71.5*	POND 1 RELEASE
															1.8	*80.6*	FLOWS SUMMED
7	**BASIN I OS8**	0.96	2.08	TAKEN FROM BASIN OS8								13.0	3.7	6.3	*3.6*	*13.0*	TEMP DWIRE DETENTION POND
8	**OS10**	0.06	0.24	TAKEN FROM BASIN OS10								11.3	3.9	6.6	*0.2*	*1.6*	HISTORIC OUTFALL
9	**OS9**	2.86	4.97	TAKEN FROM BASIN OS9								17.7	3.3	5.5	*9.3*	*27.3*	TEMP DWIRE DETENTION POND
10	**OS11, OS12**	0.75	1.50	TAKEN FROM BASIN OS11								15.7	3.5	5.8	*2.6*	*8.7*	TEMP DWIRE DETENTION POND
11	**OS13, DP7, DP9, DP10**	4.68	8.98	TAKEN FROM BASIN OS9								17.7	3.3	5.5	*15.3*	*49.4*	TEMP DWIRE DETENTION POND
12	**OS14**	0.13	0.52	TAKEN FROM BASIN OS14								10.3	4.1	6.9	*0.5*	*3.6*	HISTORIC OUTFALL
13	**PR2**	1.08	1.65	TAKEN FROM UD-DETENTION SHEET DET DWIRE POND											*0.4*	*16.0*	OUTFALL INTO EAST FORK SAND CREEK SUBTRIBUTARY

Calculated by: GT
Date: 3/4/2020
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity**		*Flow*		*Pipe Size*
					I_5	*I_{100}*	*Q_5*	*Q_{100}*	
1	**POND 1 OUTLET (DP6)**		TAKEN FROM UD-DETENTION WORKSHEET				*0.4*	*71.5*	**PROP 42" RCP**
2	**OFFSITE DWIRE POND 1 OUTLET (DP13)**		TAKEN FROM UD-DETENTION WORKSHEET				*0.4*	*16.0*	**PROP 24" RCP**

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

DP - Design Point
PR - Pipe Run
FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: GT
Date: 3/5/2020
Checked by: VAS

HYDRAULIC CALCULATIONS / EDB WQCV CALCULATIONS

TIMBERLINE STORAGE
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD POND 1

Elevation	SF	CF	Storage AF	Storage Sum
6530.18	0.00	0.00	0.00	0.00
6530.51	147.00	24.25	0.00	0.00
6531.00	853.00	245.00	0.01	0.01
6532.00	7,247.00	4,050.00	0.09	0.10
6533.00	20,867.00	14,057.00	0.32	0.42
6534.00	29,321.00	25,094.00	0.58	1.00
6535.00	32,162.00	30,741.50	0.71	1.70
6536.00	35,142.00	33,652.00	0.77	2.48
6537.00	38,215.00	36,678.50	0.84	3.32
6538.00	41,392.00	39,803.50	0.91	4.23
6539.00	44,738.00	43,065.00	0.99	5.22
6540.00	48,283.00	46,510.50	1.07	6.29

Total = 273,921 CF

Total = 6.3 Ac-ft

100 Year Spillway Elevation = 6538.5

Calculated by: DLM

Date: 9/12/2017

Checked by:

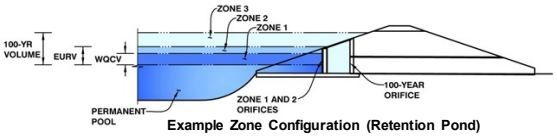
Weighted Percent Imperviousness of WQ Pond 1				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
A	5.87	0.27	34	199.67
B	7.91	0.38	53	419.30
C	2.47	0.27	34	84.06
D	0.65	0.70	84	54.77
E	0.37	0.56	78	28.54
F	1.55	0.15	11	17.03
G	16.67	0.27	34	566.83
OS1	1.47	0.09	0	0.00
OS2	2.44	0.25	30	73.29
OS4	3.08	0.09	0	0.00
OS5	21.36	0.09	0	0.00
Totals	***63.85***			***1443.48***
Imperviousness of WQ Pond 2	**22.5**			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage (Amended)

Basin ID: FSD Pond 1



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	63.84	acres		
Watershed Length =	1,880	ft		
Watershed Slope =	0.014	ft/ft		
Watershed Imperviousness =	22.50%	percent		
Percentage Hydrologic Soil Group A =	30.0%	percent		
Percentage Hydrologic Soil Group B =	70.0%	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) =	0.668	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.406	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	1.016	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.450	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.269	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.027	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.340	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.102	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.947	acre-feet		
Approximate 5-yr Detention Volume =	1.358	acre-feet		
Approximate 10-yr Detention Volume =	2.026	acre-feet		
Approximate 25-yr Detention Volume =	2.489	acre-feet		
Approximate 50-yr Detention Volume =	2.700	acre-feet		
Approximate 100-yr Detention Volume =	3.333	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.668	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.737	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.928	acre-feet
Total Detention Basin Volume =	3.333	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
30.18	**Top of Micropool**	--	0.00	--	--	--	0	0.000		
	30.51	--	0.33	--	--	--	147	0.003	23	0.001
	31	--	0.82	--	--	--	853	0.020	261	0.006
	32	--	1.82	--	--	--	7,247	0.166	4,247	0.097
	33	--	2.82	--	--	--	20,867	0.479	18,376	0.422
	34	--	3.82	--	--	--	29,321	0.673	43,470	0.998
	35	--	4.82	--	--	--	32,162	0.738	74,212	1.704
	36	--	5.82	--	--	--	35,142	0.807	107,864	2.476
	37	--	6.82	--	--	--	38,215	0.877	144,542	3.318
	38	--	7.82	--	--	--	41,392	0.950	184,346	4.232
	39	--	8.82	--	--	--	44,738	1.027	227,411	5.221
	40	--	9.82	--	--	--	48,283	1.108	273,921	6.288
	40.5	--	10.32	--	--	--	50,043	1.149	298,503	6.853
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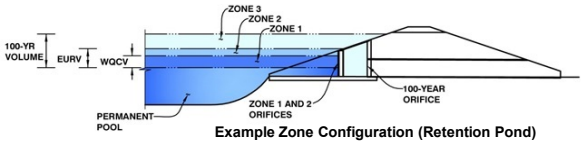
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage (Amended)

Basin ID: FSD Pond 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.29	0.668	Orifice Plate
Zone 2 (EURV)	4.41	0.737	Orifice Plate
Zone 3 (100-year)	6.84	1.928	Weir&Pipe (Restrict)
		3.333	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.41	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	19.60	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.47	2.94					
Orifice Area (sq. inches)	2.51	2.30	1.50					

	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)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.41	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	17.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.41	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.24	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	47.60	N/A	ft^2
Overflow Grate Open Area w/ Debris =	23.80	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	42.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	27.15		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	6.58	N/A	ft^2
Outlet Orifice Centroid =	1.28	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.87	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.85	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	72.50	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	0.67	feet

Calculated Parameters for Spillway

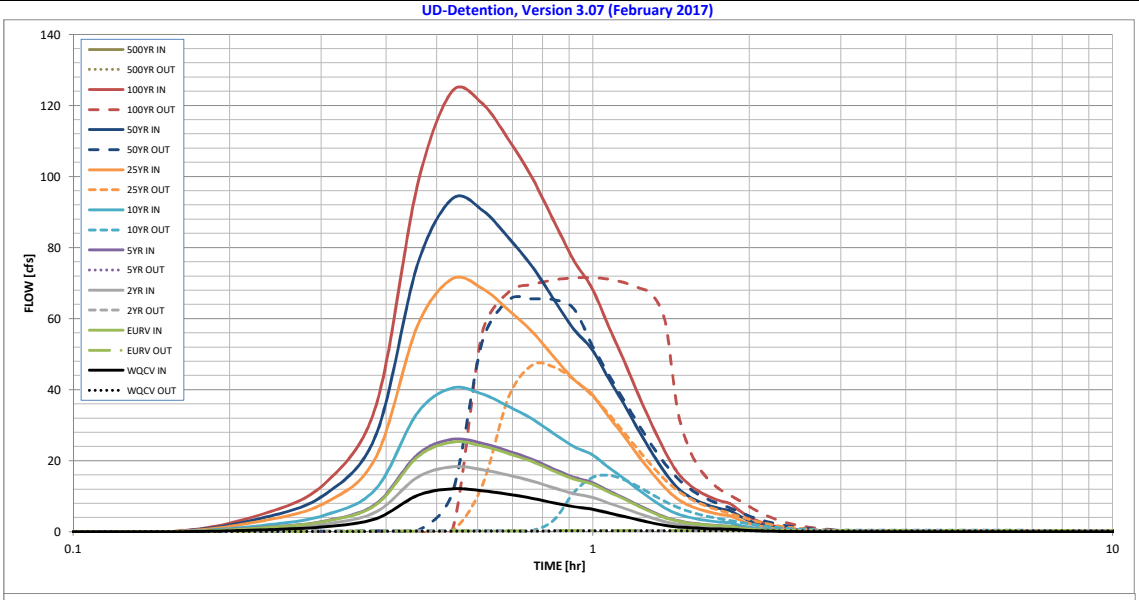
Spillway Design Flow Depth=	0.65	feet
Stage at Top of Freeboard =	8.17	feet
Basin Area at Top of Freeboard =	0.98	acres

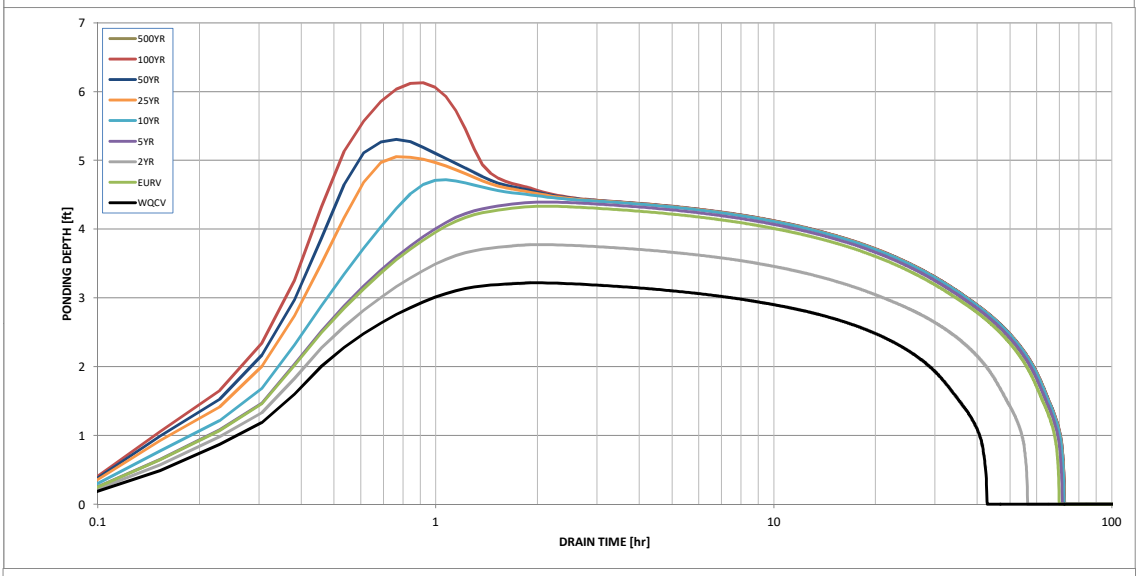
Routed Hydrograph Results

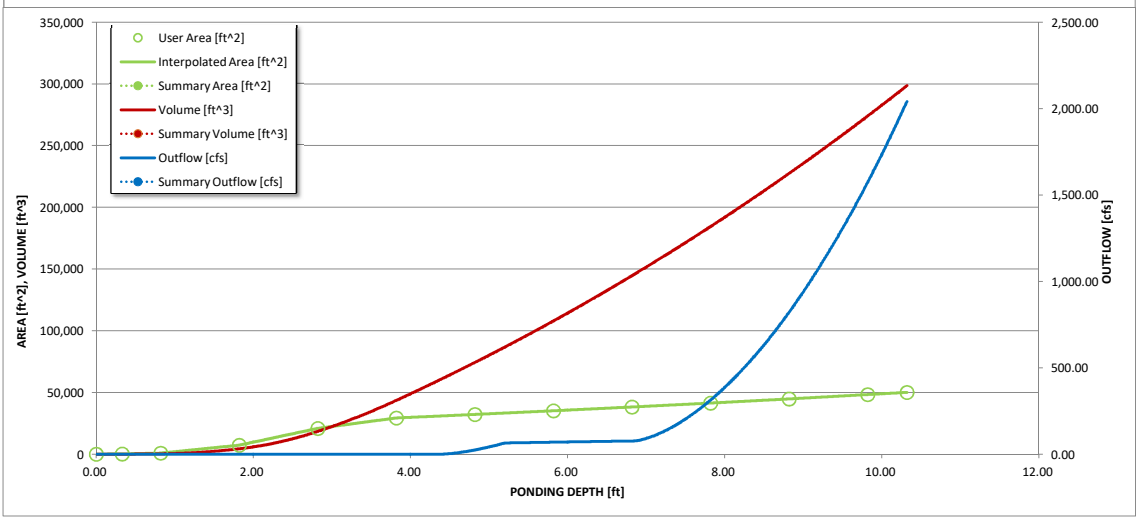
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.668	1.406	1.016	1.450	2.269	4.027	5.340	7.102	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.668	1.406	1.016	1.451	2.270	4.030	5.336	7.108	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.16	0.53	0.78	1.12	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.6	1.2	10.5	33.6	49.9	71.5	0.0
Peak Inflow Q (cfs) =	12.1	25.2	18.3	26.0	40.4	71.2	93.7	123.9	#N/A
Peak Outflow Q (cfs) =	0.3	0.4	0.3	0.4	15.9	47.0	65.5	71.5	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	1.5	1.4	1.3	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	1.0	1.4	1.5	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	40	64	52	65	64	60	57	54	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**42**	68	55	69	69	67	65	64	#N/A
Maximum Ponding Depth (ft) =	3.22	4.33	3.77	4.39	4.72	5.05	5.31	6.13	#N/A
Area at Maximum Ponding Depth (acres) =	0.55	0.71	0.66	0.71	0.73	0.75	0.77	0.83	#N/A
Maximum Volume Stored (acre-ft) =	0.623	1.350	0.965	1.392	1.623	1.875	2.066	2.721	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: O:\43095A\Tim Emick\Documents\Reports\Drainage\Excel\2019 UPDATE

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.59 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:04:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:09:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:13:46	0.53	1.09	0.80	1.13	1.73	2.96	3.79	4.83	#N/A
1.090	0:18:22	1.44	2.98	2.17	3.07	4.74	8.22	10.67	13.83	#N/A
	0:22:57	3.70	7.65	5.57	7.88	12.17	21.10	27.39	35.52	#N/A
	0:27:32	10.17	20.99	15.30	21.64	33.40	57.87	75.04	97.23	#N/A
	0:32:08	12.08	25.21	18.28	25.99	40.44	71.18	93.68	123.90	#N/A
	0:36:43	11.53	24.11	17.47	24.87	38.75	68.46	90.53	120.54	#N/A
	0:41:19	10.50	21.95	15.90	22.64	35.27	62.33	82.61	110.29	#N/A
	0:45:54	9.38	19.68	14.23	20.30	31.68	56.15	74.46	99.46	#N/A
	0:50:29	8.10	17.07	12.32	17.61	27.58	49.11	65.25	87.35	#N/A
	0:55:05	7.05	14.84	10.72	15.30	23.98	42.87	57.03	76.42	#N/A
	0:59:40	6.39	13.45	9.72	13.88	21.73	38.70	51.38	68.69	#N/A
	1:04:16	5.28	11.19	8.06	11.54	18.13	32.43	43.19	57.97	#N/A
	1:08:51	4.31	9.20	6.61	9.49	14.97	26.87	35.83	48.16	#N/A
	1:13:26	3.32	7.17	5.12	7.41	11.76	21.28	28.50	38.48	#N/A
	1:18:02	2.48	5.43	3.85	5.61	8.98	16.43	22.09	29.94	#N/A
	1:22:37	1.79	3.96	2.79	4.10	6.63	12.26	16.57	22.56	#N/A
	1:27:13	1.39	3.03	2.14	3.13	5.02	9.20	12.38	16.77	#N/A
	1:31:48	1.14	2.47	1.76	2.56	4.07	7.40	9.91	13.37	#N/A
	1:36:23	0.97	2.09	1.49	2.16	3.44	6.23	8.33	11.22	#N/A
	1:40:59	0.85	1.83	1.31	1.89	3.00	5.42	7.24	9.73	#N/A
	1:45:34	0.77	1.64	1.18	1.70	2.69	4.85	6.47	8.68	#N/A
	1:50:10	0.71	1.51	1.08	1.56	2.47	4.44	5.92	7.93	#N/A
	1:54:45	0.52	1.11	0.79	1.15	1.82	3.31	4.44	6.01	#N/A
	1:59:20	0.38	0.81	0.58	0.84	1.33	2.40	3.21	4.34	#N/A
	2:03:56	0.28	0.60	0.43	0.62	0.98	1.77	2.38	3.22	#N/A
	2:08:31	0.21	0.44	0.32	0.46	0.73	1.32	1.77	2.39	#N/A
	2:13:07	0.15	0.32	0.23	0.33	0.53	0.96	1.30	1.76	#N/A
	2:17:42	0.10	0.23	0.16	0.23	0.38	0.69	0.93	1.27	#N/A
	2:22:17	0.07	0.16	0.12	0.17	0.27	0.50	0.68	0.92	#N/A
	2:26:53	0.05	0.11	0.08	0.11	0.19	0.35	0.48	0.65	#N/A
	2:31:28	0.03	0.07	0.05	0.07	0.12	0.23	0.31	0.43	#N/A
	2:36:04	0.01	0.04	0.02	0.04	0.06	0.13	0.18	0.25	#N/A
	2:40:39	0.00	0.01	0.01	0.01	0.03	0.06	0.08	0.12	#N/A
	2:45:14	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.04	#N/A
	2:49:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:54:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:59:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:03:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:08:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:12:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:17:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:21:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:26:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:31:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:35:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:40:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:44:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:49:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:54:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:58:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:03:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:07:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:12:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:17:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:21:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:26:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:30:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:35:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:39:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:44:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:49:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:53:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:58:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:02:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:07:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:12:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:16:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:21:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:25:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:30:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Pond 1**

Facility Location & Jurisdiction: **Timberline Storage Yard, El Paso County / El Paso County**

User Input: Watershed Characteristics

Watershed Slope =	0.014	ft/ft
Watershed Length =	1880	ft
Watershed Area =	63.84	acres
Watershed Imperviousness =	22.5%	percent
Percentage Hydrologic Soil Group A =	30.0%	percent
Percentage Hydrologic Soil Group B =	70.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

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

User Input

WQCV Treatment Method = Extended Detention

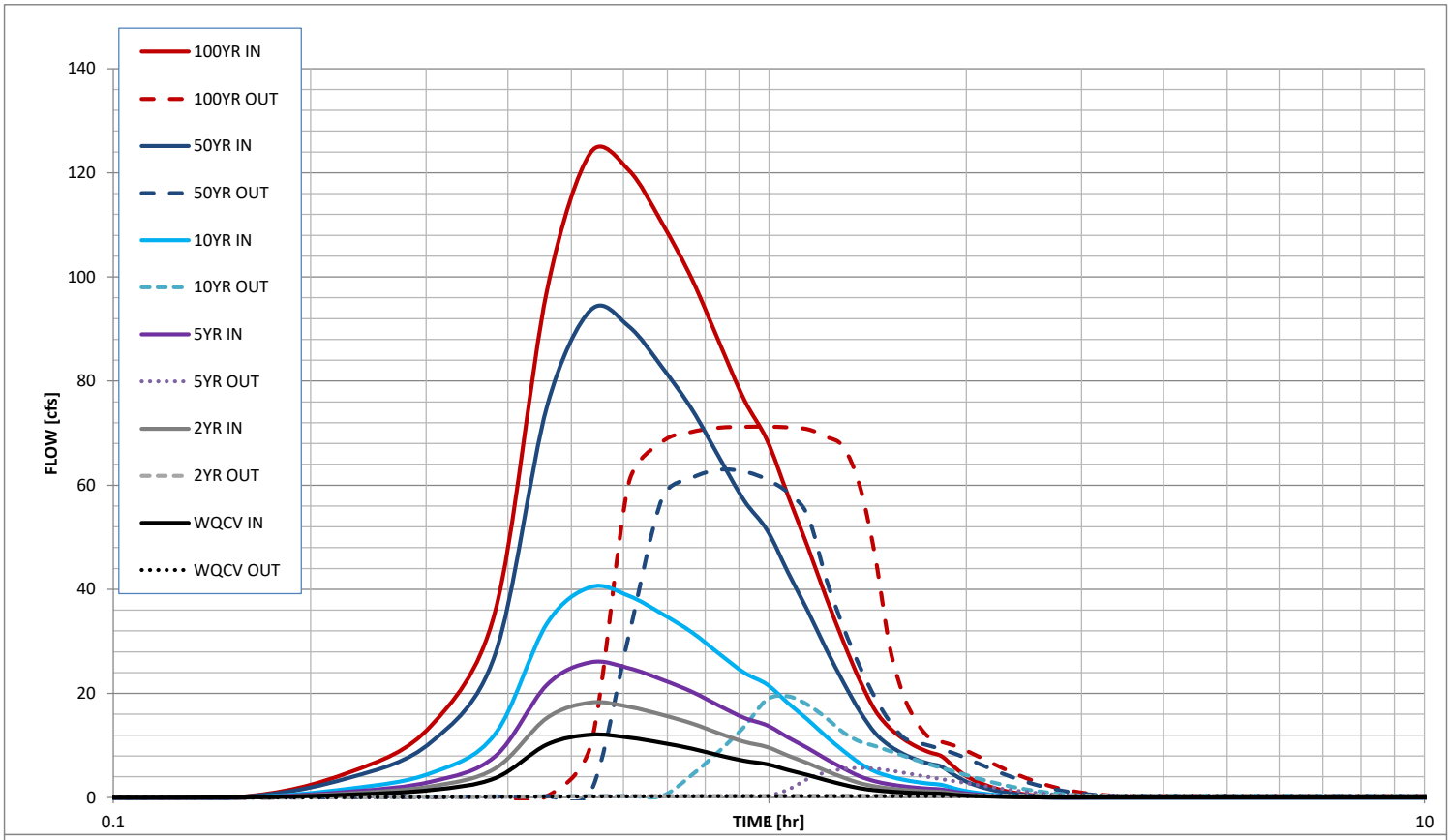
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	0	0.00	0.00
0.33	147	0.30	0.06
1.00	843	1.00	0.10
2.00	7,247	2.00	0.20
3.00	20,867	3.00	0.28
3.50	25,252	3.50	0.30
4.00	29,321	4.00	0.33
4.50	30,747	4.50	11.20
5.00	32,162	5.00	55.50
5.50	33,655	5.50	67.53
6.00	35,142	6.00	70.91
6.31	36,692	6.31	71.50

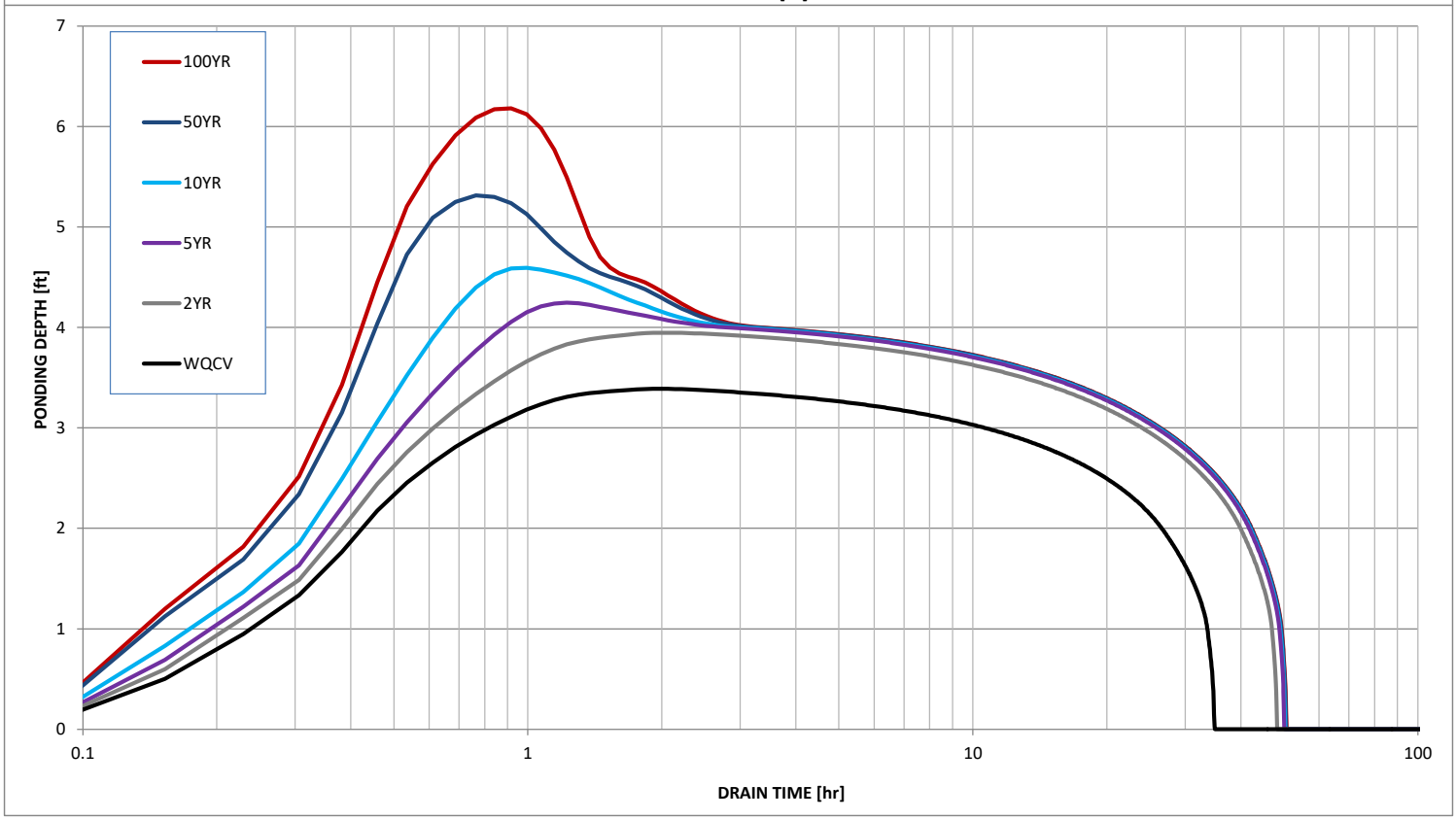
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.668	1.016	1.450	2.269	5.340	7.102	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.668	1.015	1.449	2.268	5.331	7.101	acre-ft
Time to Drain 97% of Inflow Volume =	32.5	44.9	**45.7**	44.1	38.9	36.2	hours
Time to Drain 99% of Inflow Volume =	33.9	46.9	48.1	47.6	45.4	**44.3**	hours
Maximum Ponding Depth =	3.39	3.95	4.25	4.59	5.31	6.18	ft
Maximum Ponded Area =	0.56	0.66	0.69	0.71	0.76	**0.83**	acres
Maximum Volume Stored =	0.622	0.964	1.165	1.410	1.936	2.625	acre-ft

Stormwater Detention and Infiltration Design Data Sheet



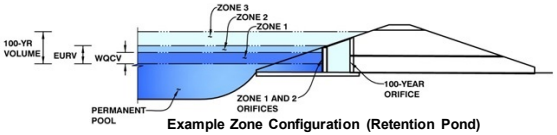


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Dwire Storage Yard

Basin ID:



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type = **EDB**
Watershed Area = 19.36 acres
Watershed Length = 1,535 ft
Watershed Slope = 0.021 ft/ft
Watershed Imperviousness = 36.90% 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) = 0.277 acre-feet
Excess Urban Runoff Volume (EURV) = 0.745 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) = 0.583 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) = 0.816 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) = 1.182 acre-feet
25-yr Runoff Volume (P1 = 2 in.) = 1.830 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) = 2.262 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) = 2.829 acre-feet
500-yr Runoff Volume (P1 = 0 in.) = 0.000 acre-feet
Approximate 2-yr Detention Volume = 0.545 acre-feet
Approximate 5-yr Detention Volume = 0.766 acre-feet
Approximate 10-yr Detention Volume = 1.071 acre-feet
Approximate 25-yr Detention Volume = 1.208 acre-feet
Approximate 50-yr Detention Volume = 1.269 acre-feet
Approximate 100-yr Detention Volume = 1.468 acre-feet

Optional User Override
1-hr Precipitation

1.19 inches
1.50 inches
1.75 inches
2.00 inches
2.25 inches
2.52 inches
inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) = 0.277 acre-feet
Zone 2 Volume (EURV - Zone 1) = 0.469 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 0.722 acre-feet
Total Detention Basin Volume = 1.468 acre-feet
Initial Surcharge Volume (ISV) = user ft^3
Initial Surcharge Depth (ISD) = user ft
Total Available Detention Depth (H_{total}) = user ft
Depth of Trickle Channel (H_{TC}) = user ft
Slope of Trickle Channel (S_{TC}) = user ft/ft
Slopes of Main Basin Sides (S_{main}) = user H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = user

Depth Increment = ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6528.17	**Top of Micropool**	--	0.00	--	--	--	48	0.001		
INV Trickle = 6528.5		--	0.33	--	--	--	48	0.001	15	0.000
6529.0		--	0.83	--	--	--	464	0.011	139	0.003
6530.0		--	1.83	--	--	--	5,862	0.135	3,248	0.075
6531.0		--	2.83	--	--	--	18,645	0.428	15,560	0.357
6532.0		--	3.83	--	--	--	30,236	0.694	40,000	0.918
6533.0		--	4.83	--	--	--	35,073	0.805	72,655	1.668
6534.0		--	5.83	--	--	--	39,532	0.908	109,957	2.524
6535.0		--	6.83	--	--	--	44,111	1.013	151,779	3.484
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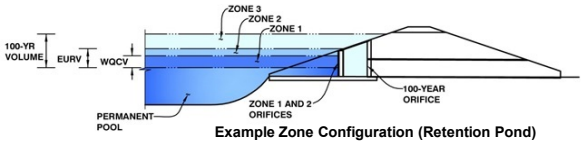
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Dwire Storage Yard

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.63	0.277	Orifice Plate
Zone 2 (EURV)	3.57	0.469	Orifice Plate
Zone 3 (100-year)	4.58	0.722	Weir&Pipe (Restrict)
		1.468	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.57	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.60	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.19	2.38					
Orifice Area (sq. inches)	1.12	1.12	1.40					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.70	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.90	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.00	N/A	feet
Over Flow Weir Slope Length =	2.90	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.35	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	11.57	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.79	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	15.60		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.16	N/A	ft^2
Outlet Orifice Centroid =	0.73	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.88	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	14.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

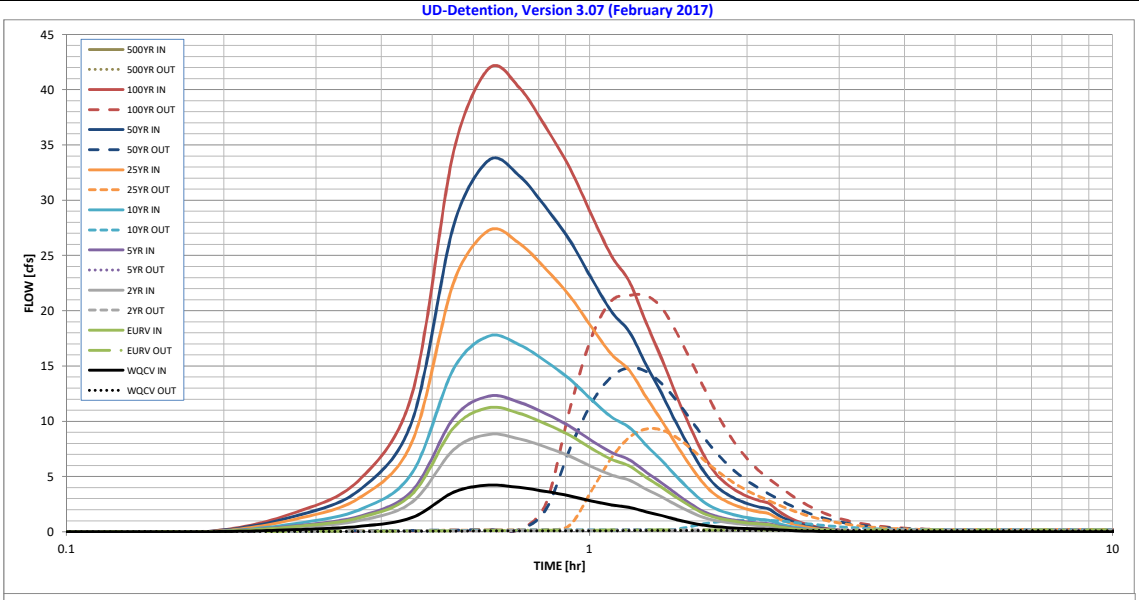
Spillway Design Flow Depth=	0.88	feet
Stage at Top of Freeboard =	6.68	feet
Basin Area at Top of Freeboard =	1.00	acres

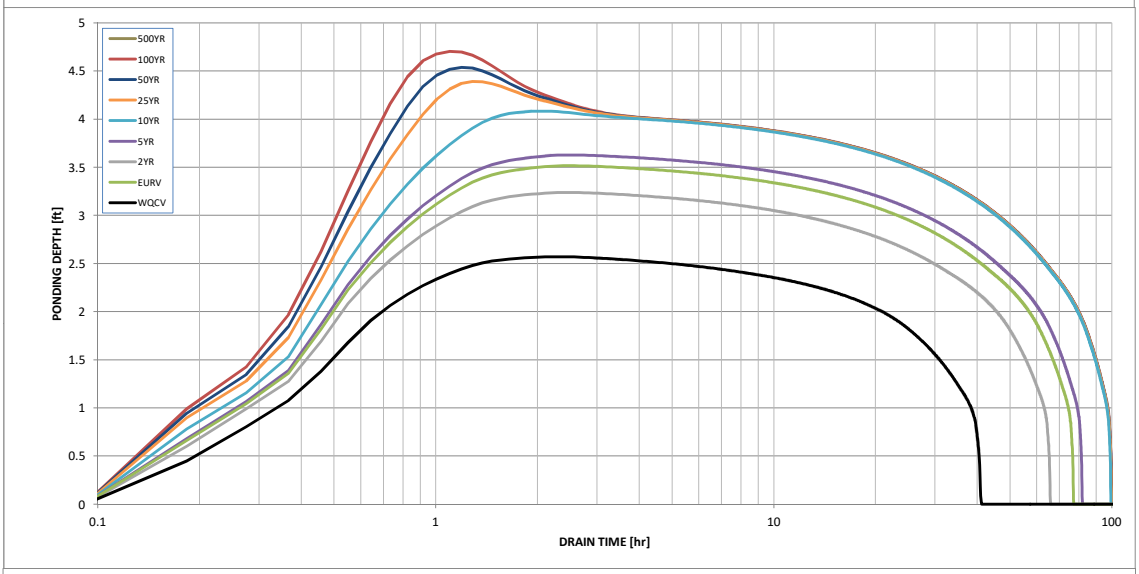
Routed Hydrograph Results

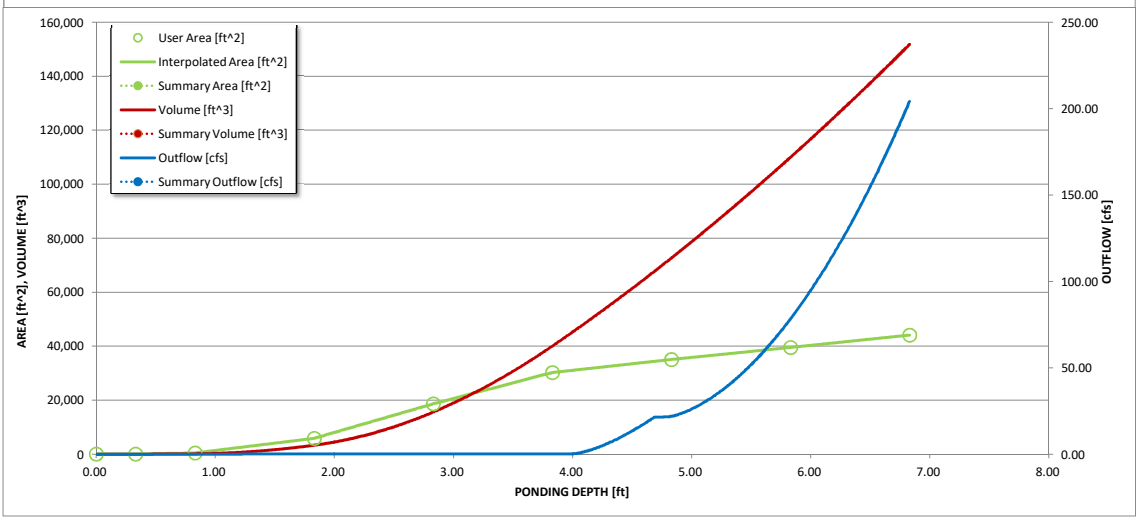
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.277	0.745	0.583	0.816	1.182	1.830	2.262	2.829	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.276	0.745	0.583	0.816	1.181	1.829	2.261	2.827	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.59	0.82	1.11	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.4	3.4	11.5	15.9	21.4	0.0
Peak Inflow Q (cfs) =	4.2	11.2	8.8	12.3	17.7	27.3	33.6	41.9	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.2	1.1	9.3	14.9	21.4	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.3	0.8	0.9	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.8	1.3	1.8	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	70	60	74	90	87	85	83	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	64	79	95	94	93	92	#N/A
Maximum Ponding Depth (ft) =	2.57	3.52	3.24	3.63	4.08	4.39	4.54	4.70	#N/A
Area at Maximum Ponding Depth (acres) =	0.35	0.61	0.53	0.64	0.72	0.76	0.77	0.79	#N/A
Maximum Volume Stored (acre-ft) =	0.256	0.710	0.550	0.778	1.095	1.324	1.431	1.564	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Dwire Storage Yard**

Facility Location & Jurisdiction: **38.88423 Latitude, -104.67879 Longitude, El Paso County**

User Input: Watershed Characteristics

Watershed Slope =	0.021	ft/ft
Watershed Length =	1535	ft
Watershed Area =	19.36	acres
Watershed Imperviousness =	36.9%	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

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

User Input

WQCV Treatment Method = Extended Detention

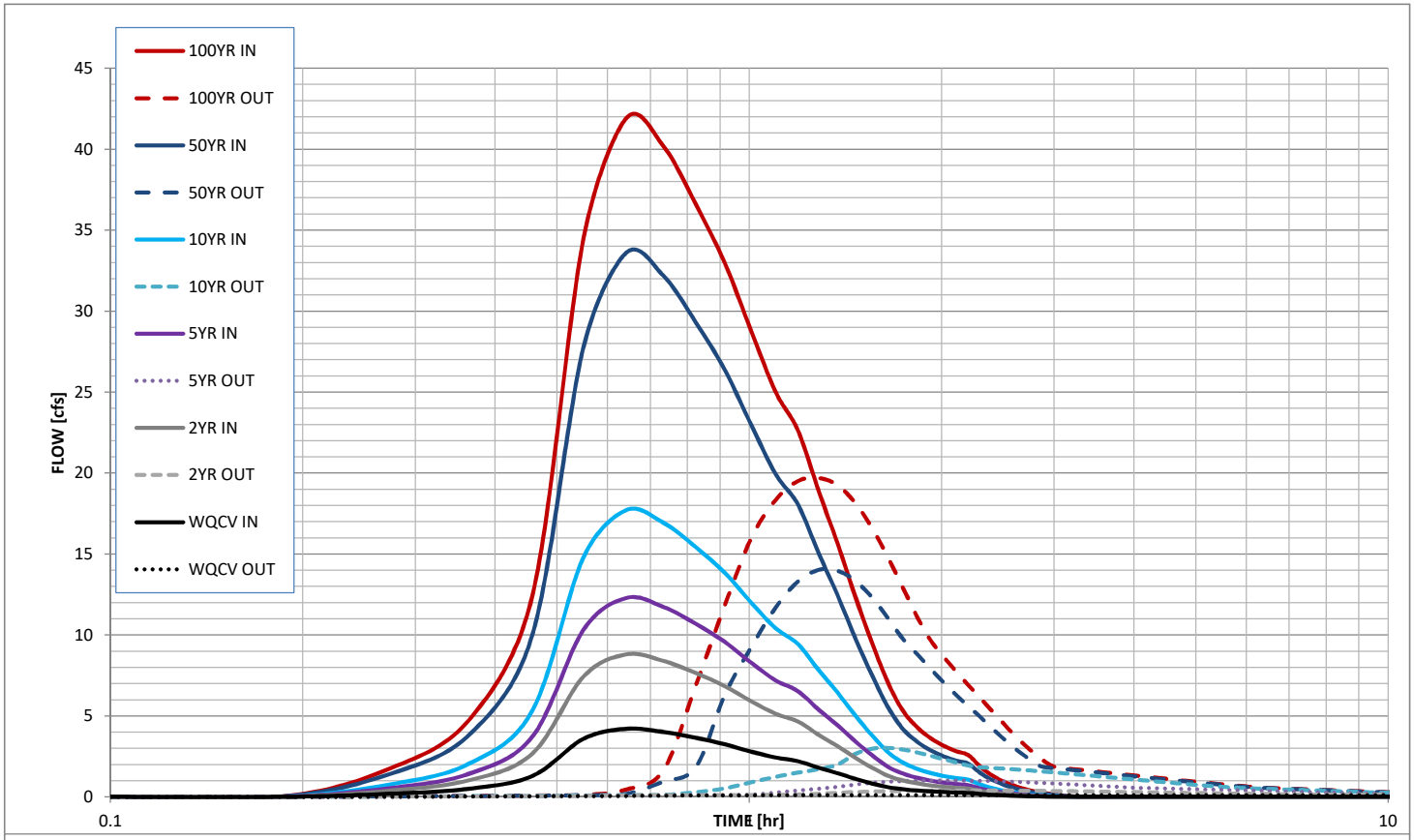
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	48	0.00	0.00
0.33	48	0.33	0.01
0.50	189	0.50	0.02
0.83	464	0.83	0.03
1.00	1,382	1.00	0.04
1.40	3,541	1.40	0.05
1.83	5,862	1.83	0.07
2.00	8,035	2.00	0.09
2.40	13,148	2.40	0.11
2.83	18,645	2.83	0.12
3.00	20,616	3.00	0.15
3.35	24,672	3.35	0.57
3.83	30,236	3.83	1.84
4.00	31,058	4.00	4.90
4.30	32,509	4.30	9.97
4.70	34,444	4.70	19.70

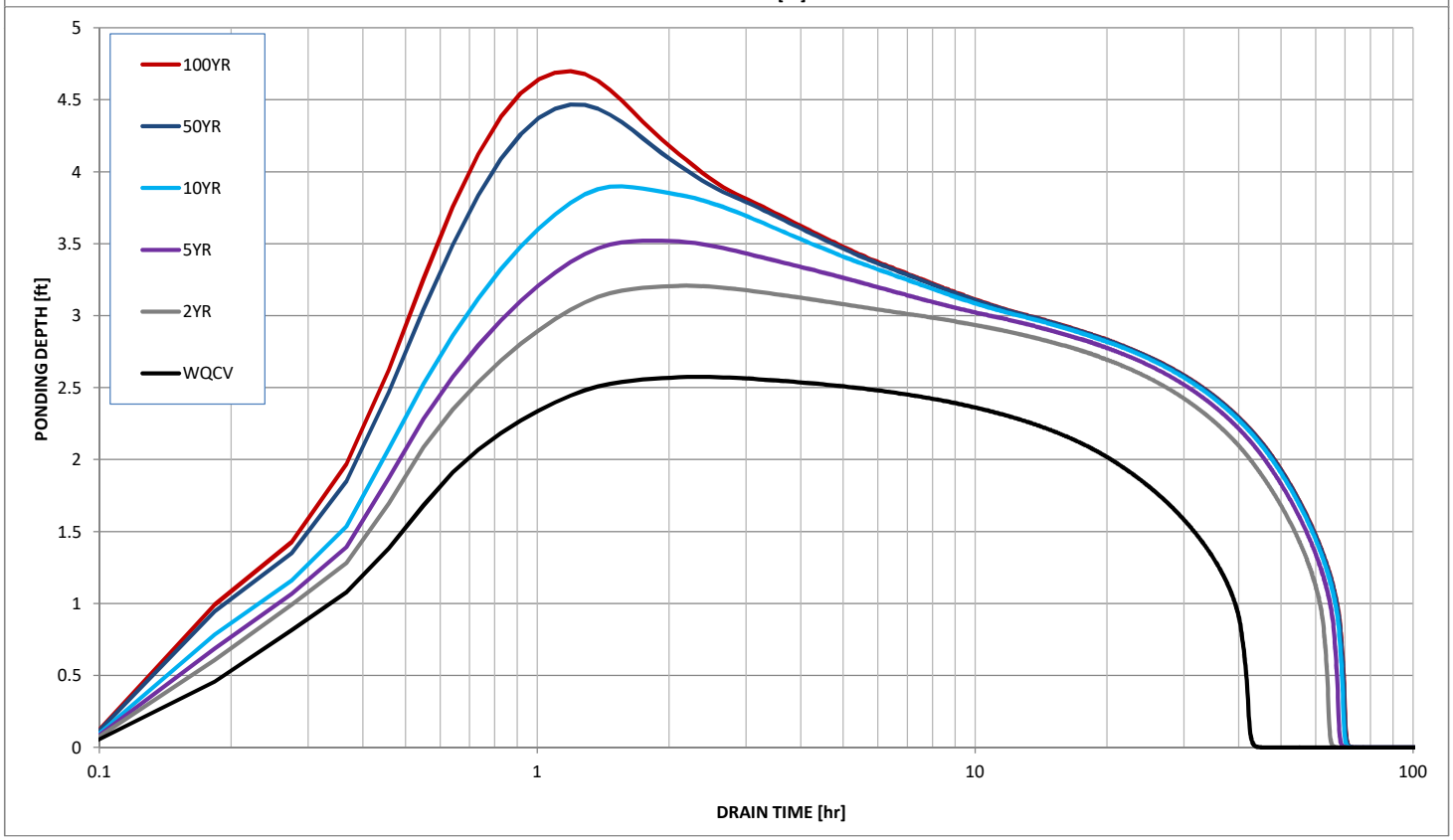
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.277	0.583	0.816	1.182	2.262	2.828	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.276	0.583	0.816	1.182	2.261	2.828	acre-ft
Time to Drain 97% of Inflow Volume =	38.9	58.4	**60.1**	59.4	53.6	50.9	hours
Time to Drain 99% of Inflow Volume =	40.7	61.7	64.3	65.1	62.8	**61.6**	hours
Maximum Ponding Depth =	2.57	3.21	3.52	3.90	4.47	4.70	ft
Maximum Ponded Area =	0.35	0.53	0.61	0.70	0.76	**0.79**	acres
Maximum Volume Stored =	0.255	0.537	0.715	0.964	1.378	1.556	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





MS CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: Timberline Storage Yard

DATE:

Forebay Volumes Req'd

Size of Contributing Area = 69.22 ac.

Min. Forebays = 3% of WQCV (UDFCD T5-EDB-12)

WQCV Pond 1 = .740 (UD-Det V. 3.07)

Total Volume Req'd = 0.03 x 0.740 = 0.022 ac

x $\frac{43560 \text{ sq-ft}}{1 \text{ ac}}$ = 967.03 cf

Total # of Forebays = 3

Divide Volume based upon Contributing area flows

Q100 @ Pond = 45.7 + 4.5 + 9.6 + 58.3 = 118.1 cfs

N = 45.7 / 118.1 = 0.387 = 38.7%

SW = 4.5 / 118.1 = 0.038 = 3.8%

~~SE = 100% - 38.7 - 3.8 = 57.5%~~

Req'd Forebay Volumes

N = 0.387 x 967.0 = 374 cf / 1.5 ft = 249.3 sf (min)

SW = 0.038 / x 967.0 37 cf / 1.0 ft = 37.0 sq ft

~~SE = 0.575 x 967.0 = 556 cf / 1.5 ft = 370.7 sf (min)~~

MS CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: Timberline Storage Yard

DATE:

Size notch for N Forebay

2% of undetained 100-yr Flow Reaching Forebay

$Q_{100} = 45.3$ cfs

$Q_{LF} = 45.3$ cfs $\times 0.02 = 0.906$ cfs

Size notch using weir eqn (Rect Weir)

$$Q = \frac{3.247\, L \cdot H^{1.48} - 0.566\, L^{1.9}}{1 + 2L^{1.87}} \cdot H^{1.9} \qquad H = 1.5'$$

$L = 1.9''$

Size notch for SE Forebay

2% of undetained 100-yr Flow Reaching Forebay

$Q_{100} = 65.2$ cfs

$Q_{LF} = 65.2 \times 0.02 = 1.304$ cfs

Size notch using weir eqn (Rect Weir)

$$Q = \frac{3.247\, L \cdot H^{1.48} - 0.566\, L^{1.9}}{1 + 2L^{1.87}} \cdot H^{1.9} \qquad H = 1.5'$$

$L = 2.8''$

CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: _____

DATE: _____

Size notch for SW forebay

2% of unattained 100-yr Flow Remaining Forebay

$Q_{100} = 4.5 cfs$

$Q_{2\%} = 4.5 \times 0.02 = 0.09 cfs$

$$Q = \frac{3.247\, L \cdot H^{1.4} - 0.5066\, L^{1.9}}{1 + 2L^{1.8}} H^{1.9} \qquad H = 10$$

$L = 0.33''$ use a min of 3/8" wide

TIMBERLINE STORAGE

EMERGENCY SPILLWAY CALCULATIONS FSD POND 1

Horizontal Broad-Crested Weir (Eqn 12-20 UDFCD)						
Variable				*Solve For*		
C	3.00			L (ft)	H (ft)	Q (cfs)
L	72.50	ft		0.0	0.0	119.3
H	0.67	ft				
Q		cfs				

Total Q	128.10

Equation 12-20

$$Q = C_{BCW} L H^{1.5}$$

Sloping Broad-Crested Weir (Eqn 12-21 UDFCD)						
Variable				*Solve For*		
C	3.00			Z (ft)	H (ft)	Q (cfs)
Z	10.00	ft		0.0	0.0	4.4
H	0.67	ft				
Q		cfs				

Equation 12-21

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

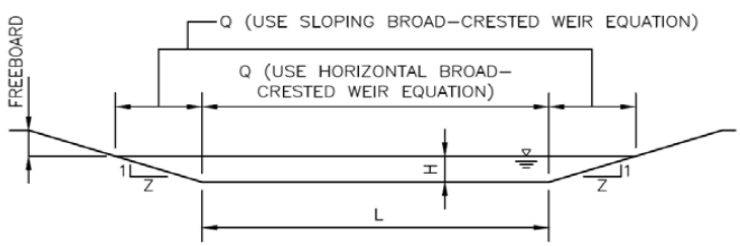


Figure 12-20. Sloping broad-crest weir

MS CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: TIMBERLINE STORAGE YARD

DATE: 11-14-19

RIPRAP APRON

FROM 3.2.1 UDFCD EQ. 9-11 $L_p = \left[\frac{1}{2\tan\theta}\right]\left[\frac{A_t}{y_t} - w\right]$

$A_t = \frac{Q}{V} = \frac{100}{5} = \underline{20\ ft^2}$ ASSUMED 0.4 FOR y_t/D $Q/D^{2.5} = 100/3.5^{2.5} = 4.36$

FROM FIGURE 9-35 EXPANSION FACTOR = 4.2

$L_p = (4.2)\left(\frac{20\ ft^2}{3.5ft} - 3.5ft\right) = 9.3'$ check $3 \times 3.5 = 10.5' > 9.3'$ USE $\underline{10.5'}$

EQ 9-13

$\theta = \tan^{-1}\left(\frac{1}{2[\text{EXPANSION FACTOR}]}\right) = \tan^{-1}\left[\frac{1}{2(4.2)}\right] = 6.79$

EQ 9-14

$T = 2(L_p \tan\theta) + w = 2(10.5 \tan 6.79) + 3.5 = \underline{6.0}$

ROCK SIZING

ASSUME $y_t/D = 0.4$ $Q/D^{1.5} = \frac{100}{3.5^{1.5}} = 15.27$

FROM FIG 9-38 USE TYPE H RIPRAP $D_{50} = 18''$

DEPTH $= 2D_{50} = 3'$ DEPTH

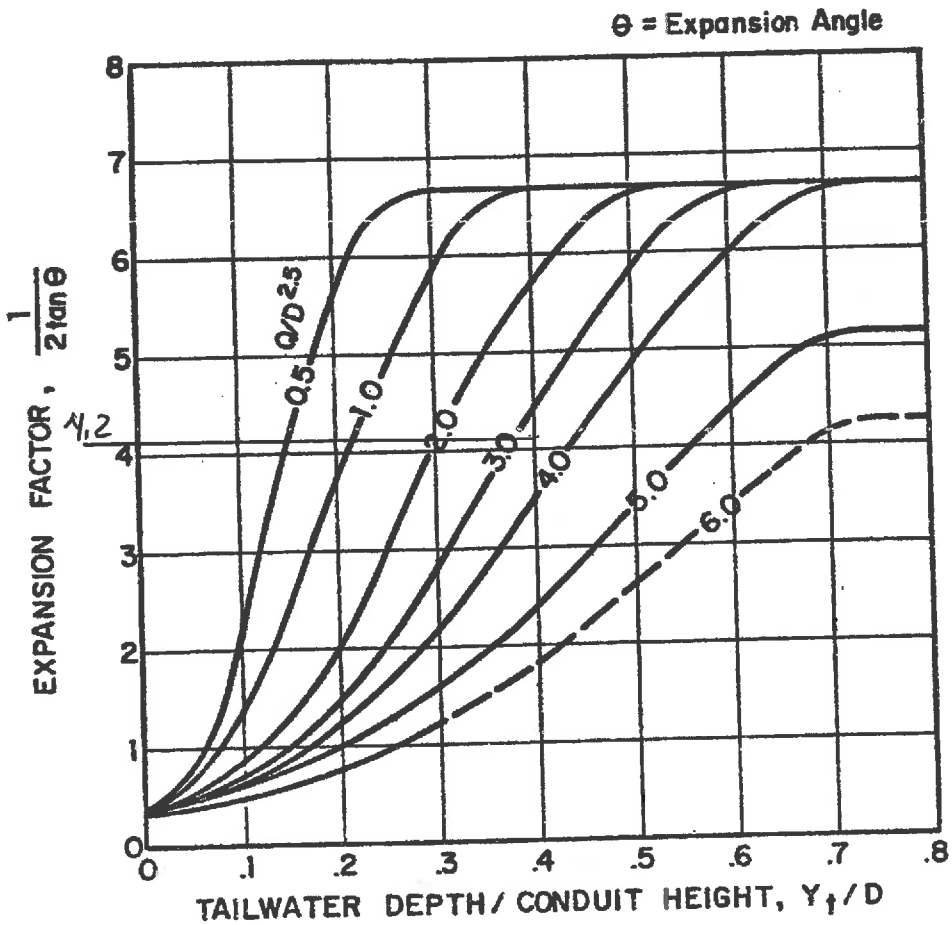


Figure 9-35. Expansion factor for circular conduits

$$H_a = \frac{(H + Y_n)}{2}$$ Equation 9-19

Where the maximum value of H_a shall not exceed H, and:

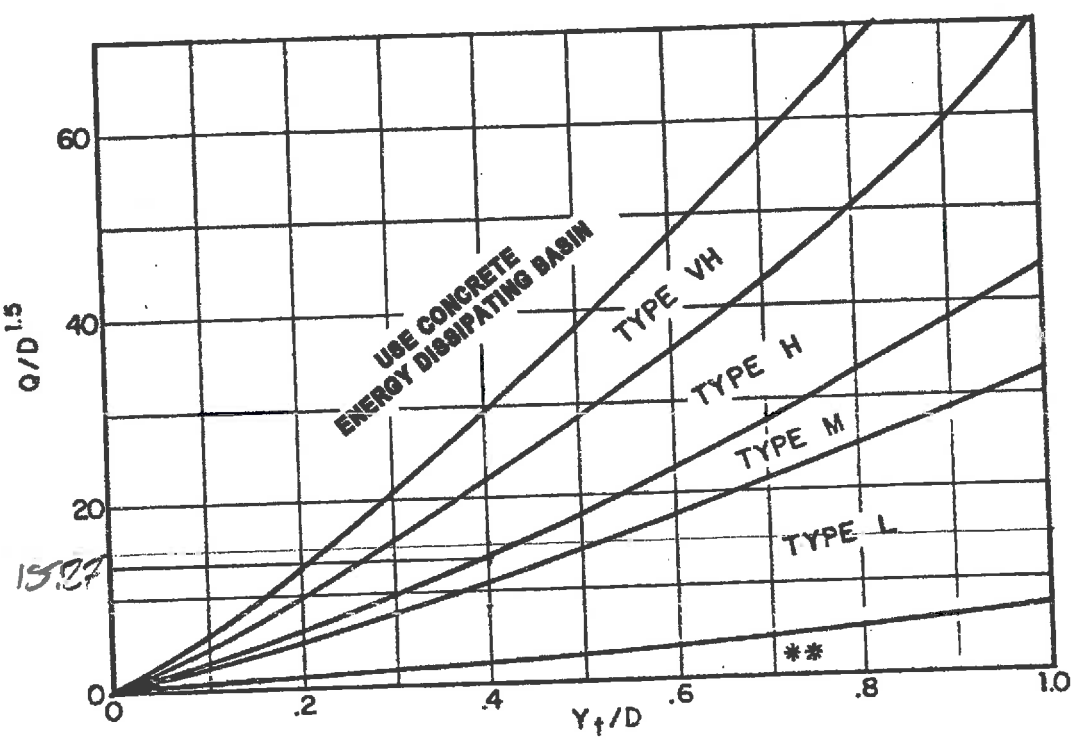
D_a = parameter to use in place of D in Figure 9-38 when flow is supercritical (ft)

D_c = diameter of circular culvert (ft)

H_a = parameter to use in place of H in Figure 9-39 when flow is supercritical (ft)

H = height of rectangular culvert (ft)

Y_n = normal depth of supercritical flow in the culvert (ft)

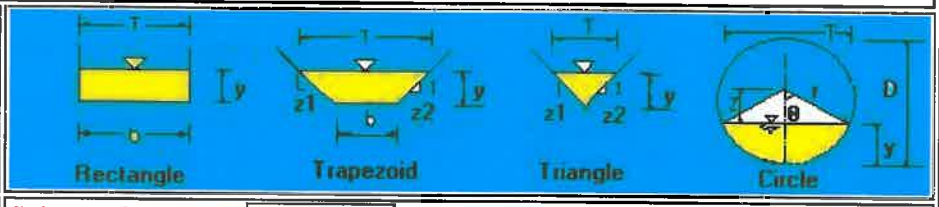


Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

The open channel flow calculator

Select Channel Type: Trapezoid



Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: .018 ft/ft	Water depth(y): 0.4 ft	Bottom width(b) 72.5 ft
Flow velocity 4.1833 ft/s	LeftSlope (Z1): 10 to 1 (H:V	RightSlope (Z2): 10 to 1 (H:V
Flow discharge 128.0098 ft^3/s	Input n value 0.025 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 80.54 ft	Flow area 30.6 ft^2	Top width(T) 80.5 ft
Specific energy 0.67 ft	Froude number 1.2	Flow status Supercritical flow
Critical depth 0.45 ft	Critical slope 0.012 ft/ft	Velocity head 0.27 ft

RUNDOWN BELOW SPILLWAY V= 4.18 ft/s

USE NORTH AMERICAN GREEN SC150 PERMISSIBL SHEAR STRESS 8 ft/s

Material and Performance Specification Sheet

North American Green
14649 Highway 41 North
Evansville, IN 47725
800-772-2040
FAX: 812-867-0247
www.nagreen.com

NORTH AMERICAN GREEN®

A tensar. Company

SC150 Erosion Control Blanket

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 24 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 (1.59 x 1.59 cm) mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 x 0.50 in (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread.

The SC150 shall meet requirements established by the Erosion Control Technology Council (ECTC) Specification and the US Department of Transportation, Federal Highway Administration's (FHWA) *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-03 Section 713.17 as a type 3.B Extended-term Erosion Control Blanket.*

The SC150 is also available with the DOT System™, which consists of installation staple patterns clearly marked on the erosion control blanket with environmentally safe paint. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

Material Content		
Matrix	70% Straw Fiber	0.35 lbs/yd² (0.19 kg/m²)
	30% Coconut Fiber	0.15 lbs/yd² (0.08 kg/m²)
Nettings	Top – Heavyweight photodegradable with UV additives	3.0 lb/1000 ft² (1.47 kg/100 m²)
	Bottom – Lightweight Photodegradable	1.5 lb/1000 ft² (0.73 kg/100 m²)
Thread	Degradable	

SC150 is available in the following standard roll sizes:

Width	6.67 ft (2.03 m)	16 ft (4.87 m)
Length	108 ft (32.92 m)	108 ft (32.92 m)
Weight ± 10%	44 lbs (19.95 kg)	105.6 lbs (47.9 kg)
Area	80.0 yd² (66.9 m²)	192 yd² (165.5 m²)

Index Value Properties:

Property	Test Method	Typical
Thickness	ASTM D6525	0.39 in (9.91 mm)
Resiliency	ECTC Guidelines	75%
Water Absorbency	ASTM D1117	285%
Mass/Unit Area	ASTM 6475	11.44 oz/yd² (388 g/m²)
Swell	ECTC Guidelines	30%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	1.11 oz-in
Light Penetration	ECTC Guidelines	8.7%
Tensile Strength –MD	ASTM D6818	146.6 lbs/ft (2.17 kN/m)
Elongation – MD	ASTM D6818	26.9%
Tensile Strength – TD	ASTM D6818	147.6 lbs/ft (2.19 kN/m)
Elongation – TD	ASTM D6818	25.2%

Performance Design Values:

Maximum Permissible Shear Stress	
Unvegetated Shear Stress	2.00 lbs/ft² (96 Pa)
Unvegetated Velocity	8.00 ft/s (2.44 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.048	0.100
20-50 ft	0.051	0.079	0.145
≥ 50 ft (15.2 m)	0.10	0.110	0.190

Bench Scale Testing* (NTPEP):

Test Method	Parameters	Results
ECTC Method 2 Rainfall	50 mm (2 in)/hr for 30 min	SLR** = 5.47
	100mm (4 in)/hr for 30 min	SLR** = 5.67
	150 mm (6 in)/hr for 30 min	SLR** = 5.88
ECTC Method 3 Shear Resistance	**Shear at 0.50 inch soil loss**	**2.72 lbs/ft²**
ECTC Method 4 Germination	Top Soil, Fescue, 21 day incubation	538% improvement of biomass

* Bench Scale tests should not be used for design purposes

** Soil Loss Ratio = Soil loss with Bare Soil/Soil Loss with RECP (soil loss is based on regression analysis)

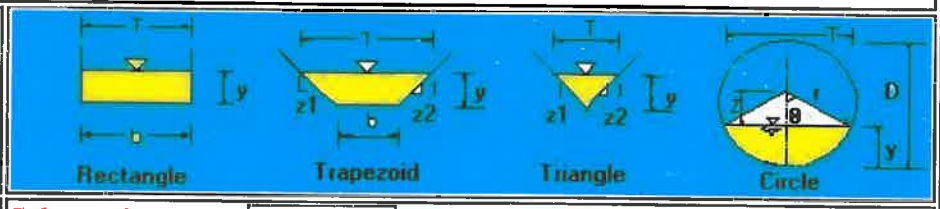
Roughness Coefficients- Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 – 2.0 ft	0.050 – 0.018
≥ 2.0 ft (0.60 m)	0.018

Product Participant of: QDOR

Updated 3/09

The open channel flow calculator

Select Channel Type: Trapezoid



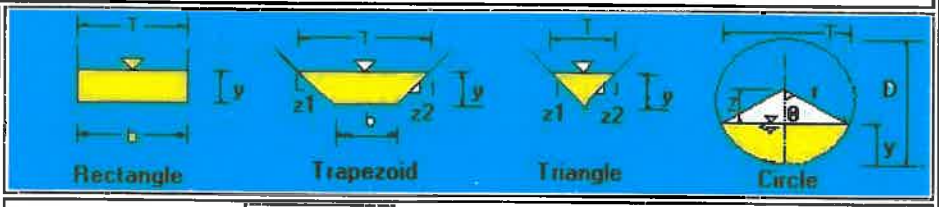
Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 0.25 ft/ft	Water depth(y): 0.25 ft	Bottom width(b) 2.5 ft
Flow velocity 7.3353 ft/s	LeftSlope (Z1): 2.5 to 1 (H:V	RightSlope (Z2): 2.5 to 1 (H:V
Flow discharge 5.7307 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 3.85 ft	Flow area 0.78 ft^2	Top width(T) 3.75 ft
Specific energy 1.09 ft	Froude number 2.83	Flow status Supercritical flow
Critical depth 0.46 ft	Critical slope 0.0265 ft/ft	Velocity head 0.84 ft

SW RIPRAP RUN DOWN

The open channel flow calculator

Select Channel Type: Trapezoid



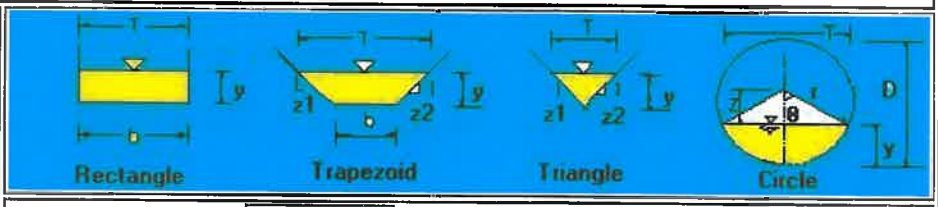
Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 0.25 ft/ft	Water depth(y): 0.99 ft	Bottom width(b) 3 ft
Flow velocity 15.9389 ft/s	LeftSlope (Z1): 2.5 to 1 (H:V	RightSlope (Z2): 2.5 to 1 (H:V
Flow discharge 86.3928 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 8.33 ft	Flow area 5.42 ft^2	Top width(T) 7.95 ft
Specific energy 4.93 ft	Froude number 3.4	Flow status Supercritical flow
Critical depth 1.86 ft	Critical slope 0.0182 ft/ft	Velocity head 3.94 ft

SE RIPRAP RUNDOWN

The open channel flow calculator

Select Channel Type: Triangle

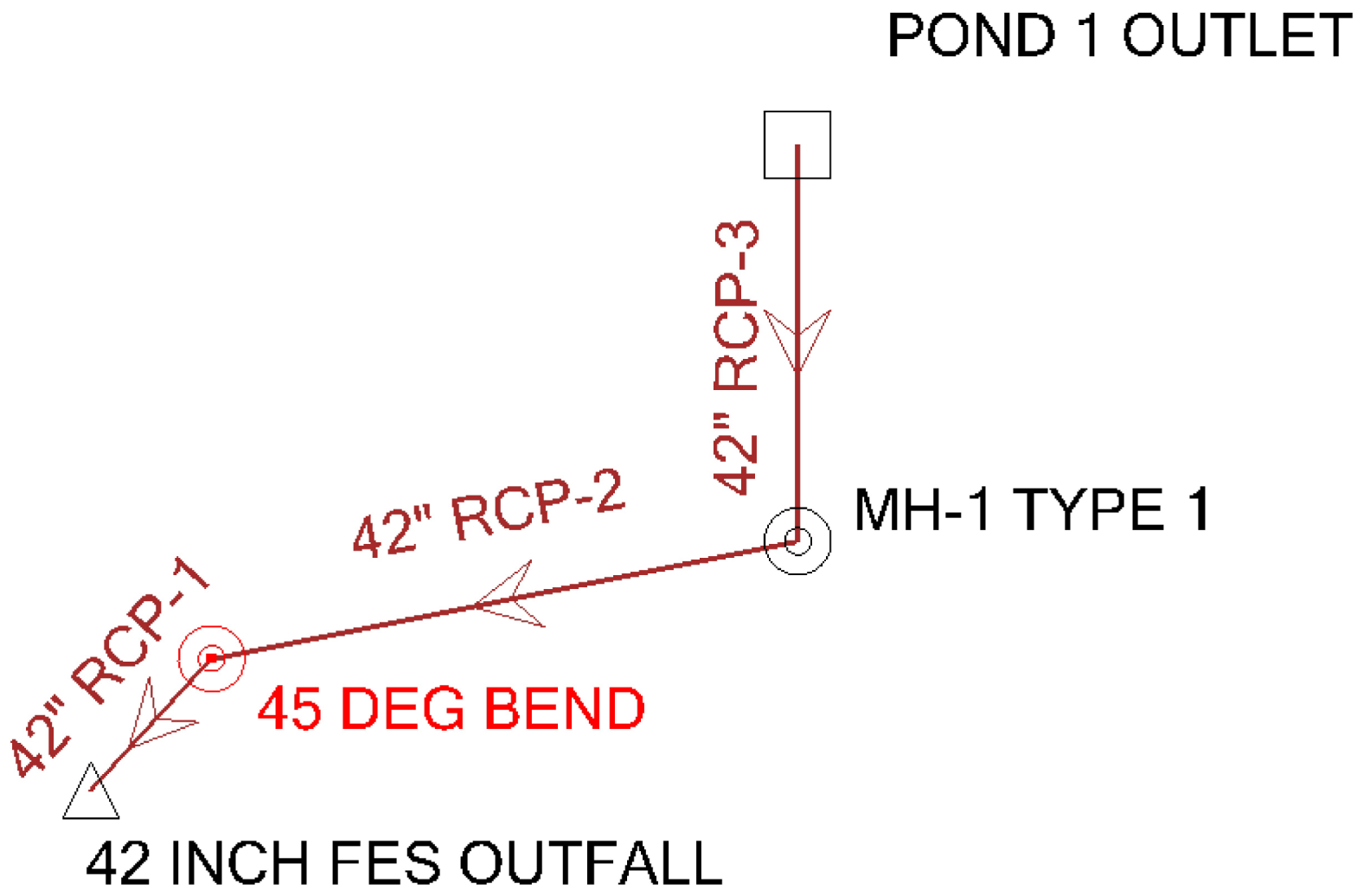


Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 0.005 ft/ft	Water depth(y): 0.58 ft	Bottom W(b) 0 ft
Flow velocity 3.4704 ft/s	LeftSlope (Z1): 4 to 1 (H:V	RightSlope (Z2): 4 to 1 (H:V
Flow discharge 4.6698 ft^3/s	Input n value 0.013 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 4.78 ft	Flow area 1.35 ft^2	Top width(T) 4.64 ft
Specific energy 0.77 ft	Froude number 1.14	Flow status Supercritical flow
Critical depth 0.61 ft	Critical slope 0.0037 ft/ft	Velocity head 0.19 ft

6' CONCRETE SWALE

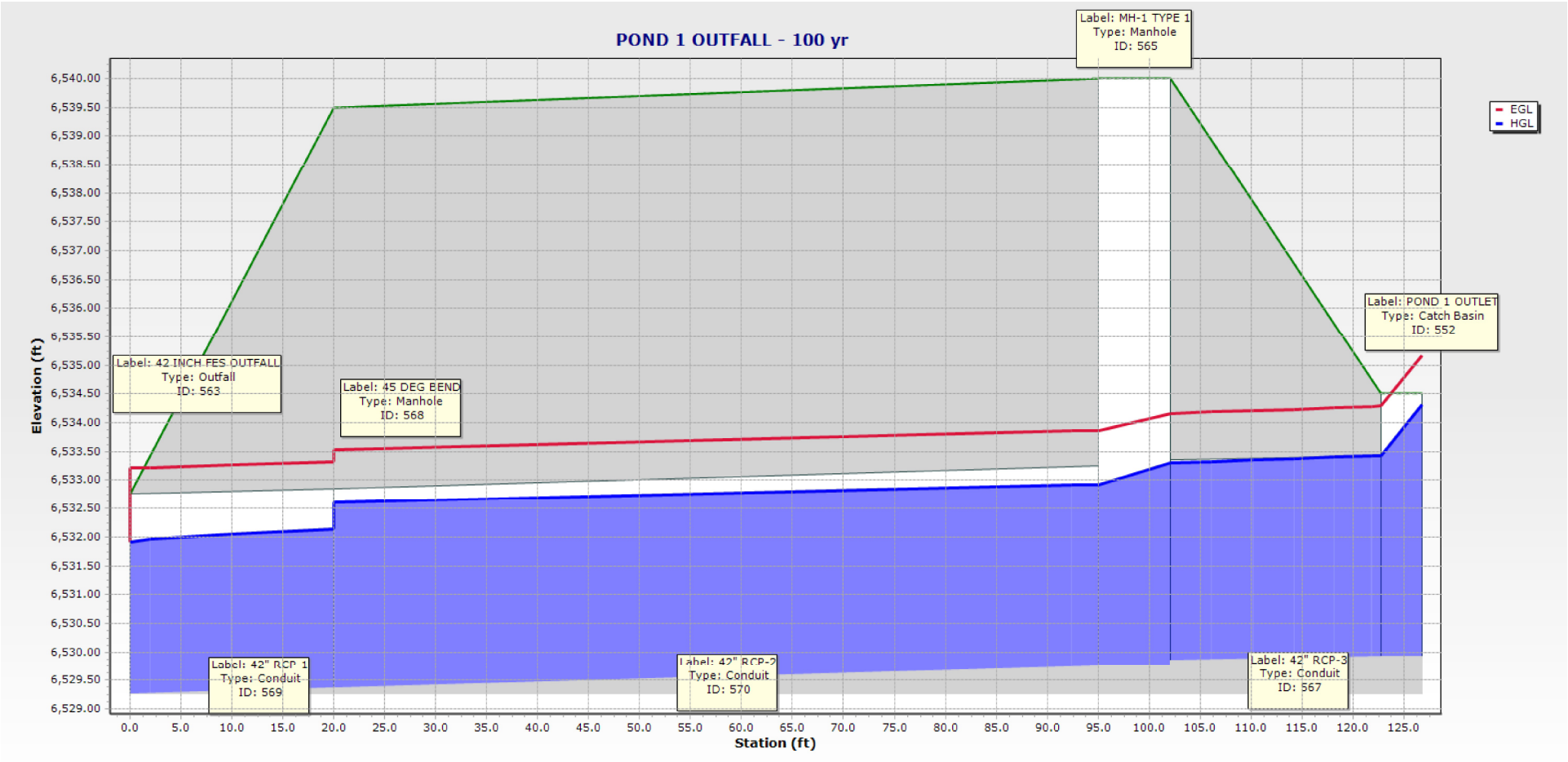
STRM 1- POND 1 OUTFALL INDEX MAP



Conduit FlexTable: POND 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)
42" RCP-3	567	POND 1 OUTLET	71.50	128.6	26.2	7.43	0.700	(N/A)	2.65	6,534.29	6,534.17	6,533.43	6,533.30	0.13	6,534.31
42" RCP-1	569	45 DEG BEND	71.50	100.5	20.0	8.43	0.833	2.88	2.65	6,533.32	6,533.21	6,532.13	6,531.91	0.22	6,532.61
42" RCP-2	570	MH-1 TYPE 1	71.50	100.9	78.6	8.40	0.824	2.90	2.65	6,533.87	6,533.52	6,532.93	6,532.61	0.32	6,533.30

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
7.43	1.020	0.88	6,540.00	6,534.51	6,529.85	6,529.93	Circle - 42.0 in
7.68	0.400	0.48	6,532.76	6,539.50	6,529.26	6,529.36	Circle - 42.0 in
7.45	0.400	0.38	6,539.50	6,540.00	6,529.36	6,529.75	Circle - 42.0 in


POND 1 OUTFALL - 100 yr
Label: MH-1 TYPE 1
Type: Manhole
ID: 565
Label: POND 1 OUTLET
Type: Catch Basin
ID: 552
Label: 42 INCH FES OUTFALL
Type: Outfall
ID: 563
Label: 45 DEG BEND
Type: Manhole
ID: 568
Label: 42" RCP-1
Type: Conduit
ID: 569
Label: 42" RCP-2
Type: Conduit
ID: 570
Label: 42" RCP-3
Type: Conduit
ID: 567
EGL
HGL
Elevation (ft)
Station (ft)
6,540.00
6,539.50
6,539.00
6,538.50
6,538.00
6,537.50
6,537.00
6,536.50
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6,535.50
6,535.00
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6,529.00
0.0
5.0
10.0
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50.0
55.0
60.0
65.0
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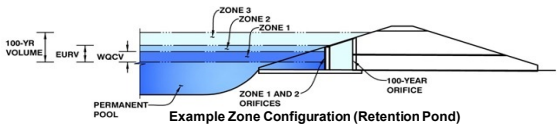
85.0
90.0
95.0
100.0
105.0
110.0
115.0
120.0
125.0

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Dwire Storage Yard

Basin ID: Temporary Pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	19.36	acres		
Watershed Length =	1,535	ft		
Watershed Slope =	0.021	ft/ft		
Watershed Imperviousness =	36.90%	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) =	0.277	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.745	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.583	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.816	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.182	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.830	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.262	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.829	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.545	acre-feet		
Approximate 5-yr Detention Volume =	0.766	acre-feet		
Approximate 10-yr Detention Volume =	1.071	acre-feet		
Approximate 25-yr Detention Volume =	1.208	acre-feet		
Approximate 50-yr Detention Volume =	1.269	acre-feet		
Approximate 100-yr Detention Volume =	1.468	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.277	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.469	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.722	acre-feet
Total Detention Basin Volume =	1.468	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

INV Trickle = 6528.5

Depth Increment = ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6528.17	**Top of Micropool**	--	0.00	--	--	--	48	0.001		
		--	0.33	--	--	--	48	0.001	15	0.000
6529.0		--	0.83	--	--	--	464	0.011	139	0.003
6530.0		--	1.83	--	--	--	5,862	0.135	3,248	0.075
6531.0		--	2.83	--	--	--	18,645	0.428	15,560	0.357
6532.0		--	3.83	--	--	--	30,236	0.694	40,000	0.918
6533.0		--	4.83	--	--	--	35,073	0.805	72,655	1.668
6534.0		--	5.83	--	--	--	39,532	0.908	109,957	2.524
6535.0		--	6.83	--	--	--	44,111	1.013	151,779	3.484
		--		--	--	--				
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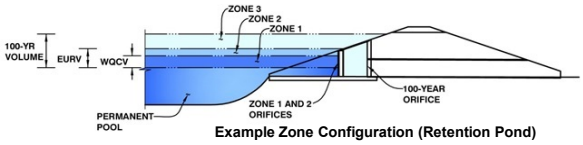
		--		--	--	--				
		--		--	--	--				

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Dwire Storage Yard

Basin ID: Temp structure



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.63	0.277	Orifice Plate
Zone 2 (EURV)	3.57	0.469	Orifice Plate
Zone 3 (100-year)	4.58	0.722	Weir&Pipe (Restrict)
		1.468	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.57	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.30	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.19	2.38					
Orifice Area (sq. inches)	1.12	1.12	1.40					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.57	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.67	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.67	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.57	N/A	feet
Over Flow Weir Slope Length =	2.67	N/A	feet
Grate Open Area / 100-yr Orifice Area =	1.59	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	4.99	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.50	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.14	N/A	ft^2
Outlet Orifice Centroid =	1.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.83	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	14.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

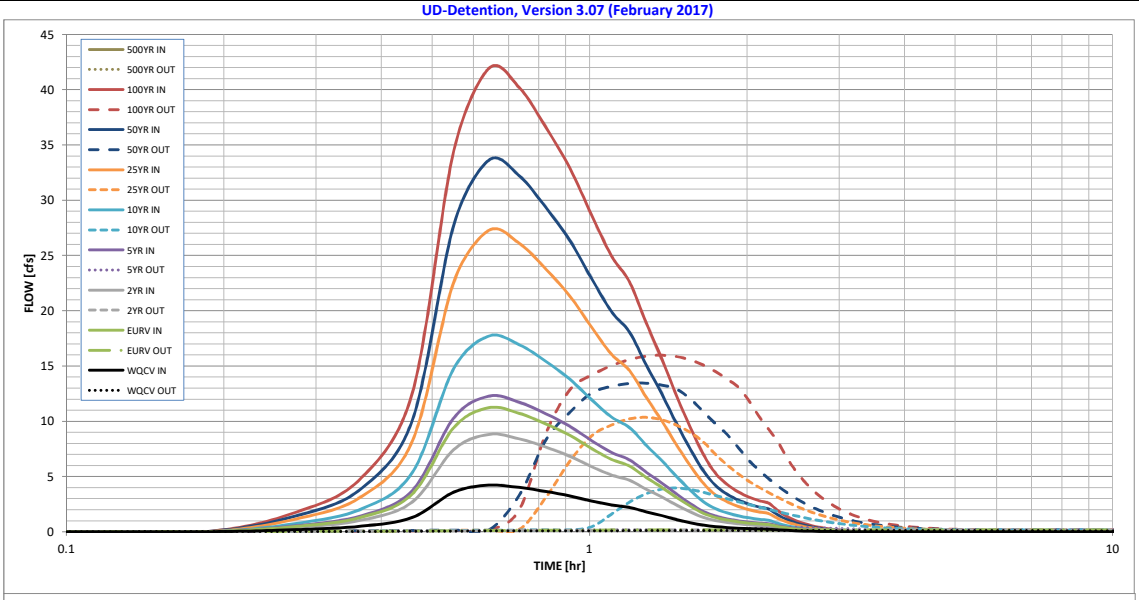
Spillway Design Flow Depth=	0.88	feet
Stage at Top of Freeboard =	6.71	feet
Basin Area at Top of Freeboard =	1.00	acres

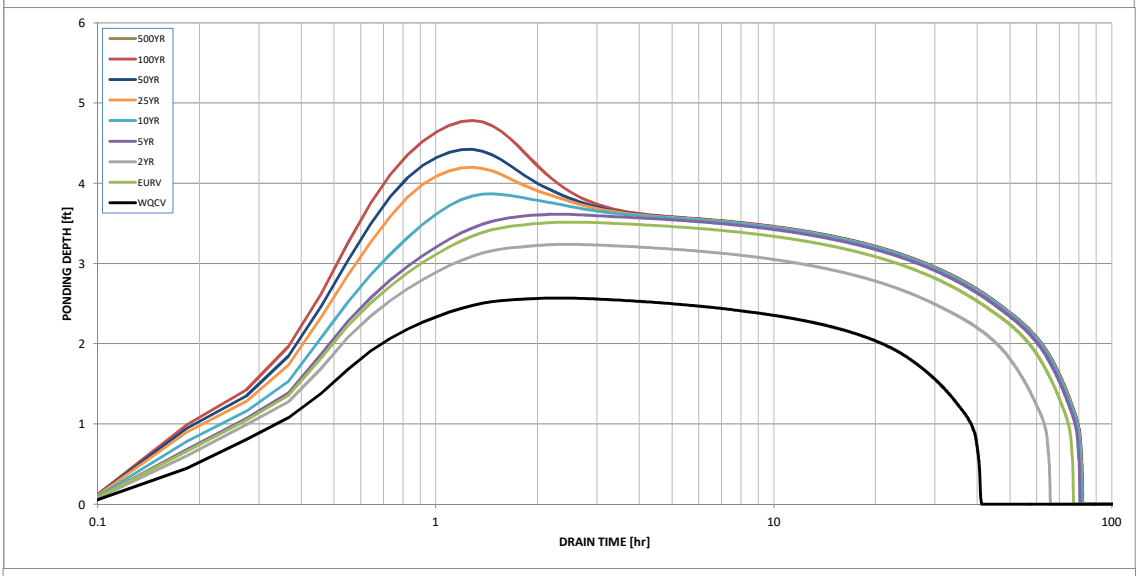
Routed Hydrograph Results

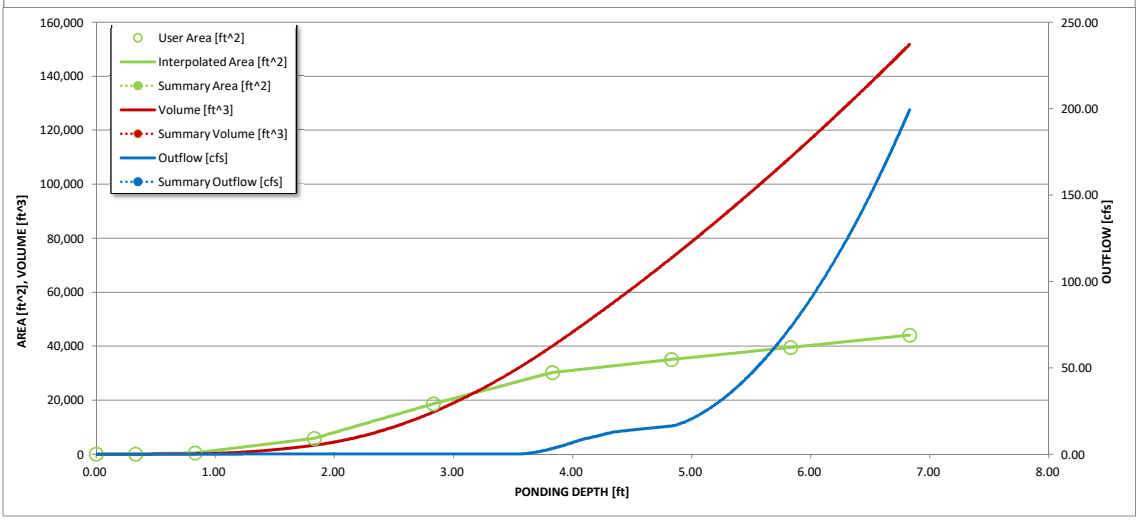
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.277	0.745	0.583	0.816	1.182	1.830	2.262	2.829	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.276	0.745	0.583	0.816	1.181	1.829	2.261	2.827	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.59	0.82	1.11	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.4	3.4	11.5	15.9	21.4	0.0
Peak Inflow Q (cfs) =	4.2	11.2	8.8	12.3	17.7	27.3	33.6	41.9	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.4	4.0	10.4	13.4	16.0	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.2	0.9	0.8	0.7	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.8	2.0	2.6	3.2	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	70	60	73	72	69	67	65	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	64	78	77	76	75	74	#N/A
Maximum Ponding Depth (ft) =	2.57	3.52	3.24	3.61	3.87	4.20	4.42	4.78	#N/A
Area at Maximum Ponding Depth (acres) =	0.35	0.61	0.53	0.64	0.70	0.73	0.76	0.80	#N/A
Maximum Volume Stored (acre-ft) =	0.256	0.710	0.550	0.772	0.939	1.175	1.347	1.628	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Dwire Storage Yard**

Facility Location & Jurisdiction: **38.88423 Latitude, -104.67879 Longitude, El Paso County**

User Input: Watershed Characteristics

Watershed Slope =	0.021	ft/ft
Watershed Length =	1535	ft
Watershed Area =	19.36	acres
Watershed Imperviousness =	36.9%	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

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

User Input

WQCV Treatment Method = Extended Detention

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	48	0.00	0.00
0.33	48	0.33	0.01
0.50	189	0.50	0.02
0.83	464	0.83	0.03
1.00	1,382	1.00	0.04
1.40	3,541	1.40	0.05
1.83	5,862	1.83	0.07
2.00	8,035	2.00	0.09
2.40	13,148	2.40	0.11
2.83	18,645	2.83	0.12
3.00	20,616	3.00	0.15
3.35	24,672	3.35	0.57
3.83	30,236	3.83	1.84
4.00	31,058	4.00	4.90
4.30	32,509	4.30	9.97
4.70	34,444	4.70	19.70

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

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.277	0.583	0.816	1.182	2.262	2.828	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.276	0.583	0.816	1.182	2.261	2.828	acre-ft
Time to Drain 97% of Inflow Volume =	38.9	58.4	**60.1**	59.4	53.6	50.9	hours
Time to Drain 99% of Inflow Volume =	40.7	61.7	64.3	65.1	62.8	**61.6**	hours
Maximum Ponding Depth =	2.57	3.21	3.52	3.90	4.47	4.70	ft
Maximum Ponded Area =	0.35	0.53	0.61	0.70	0.76	**0.79**	acres
Maximum Volume Stored =	0.255	0.537	0.715	0.964	1.378	1.556	acre-ft

DWIRE YARD

EMERGENCY SPILLWAY CALCULATIONS FSD POND

Horizontal Broad-Crested Weir (Eqn 12-20 UDFCD)						
Variable				*Solve For*		
C	3.00			L (ft)	H (ft)	Q (cfs)
L	14.00	ft		0.0	0.0	42.0
H	1.00	ft				
Q		cfs				

Sloping Broad-Crested Weir (Eqn 12-21 UDFCD)						
Variable				*Solve For*		
C	3.00			Z (ft)	H (ft)	Q (cfs)
Z	4.00	ft		0.0	0.0	4.8
H	1.00	ft				
Q		cfs				

Total Q	51.60

Equation 12-20

$$Q = C_{BCW} L H^{1.5}$$

Equation 12-21

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

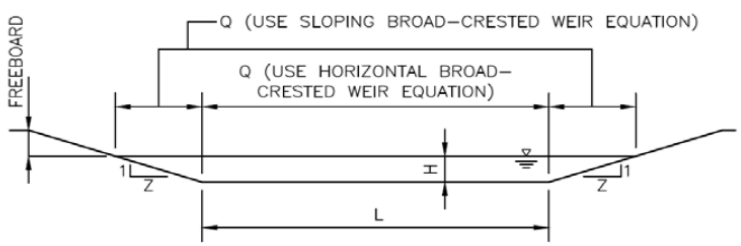


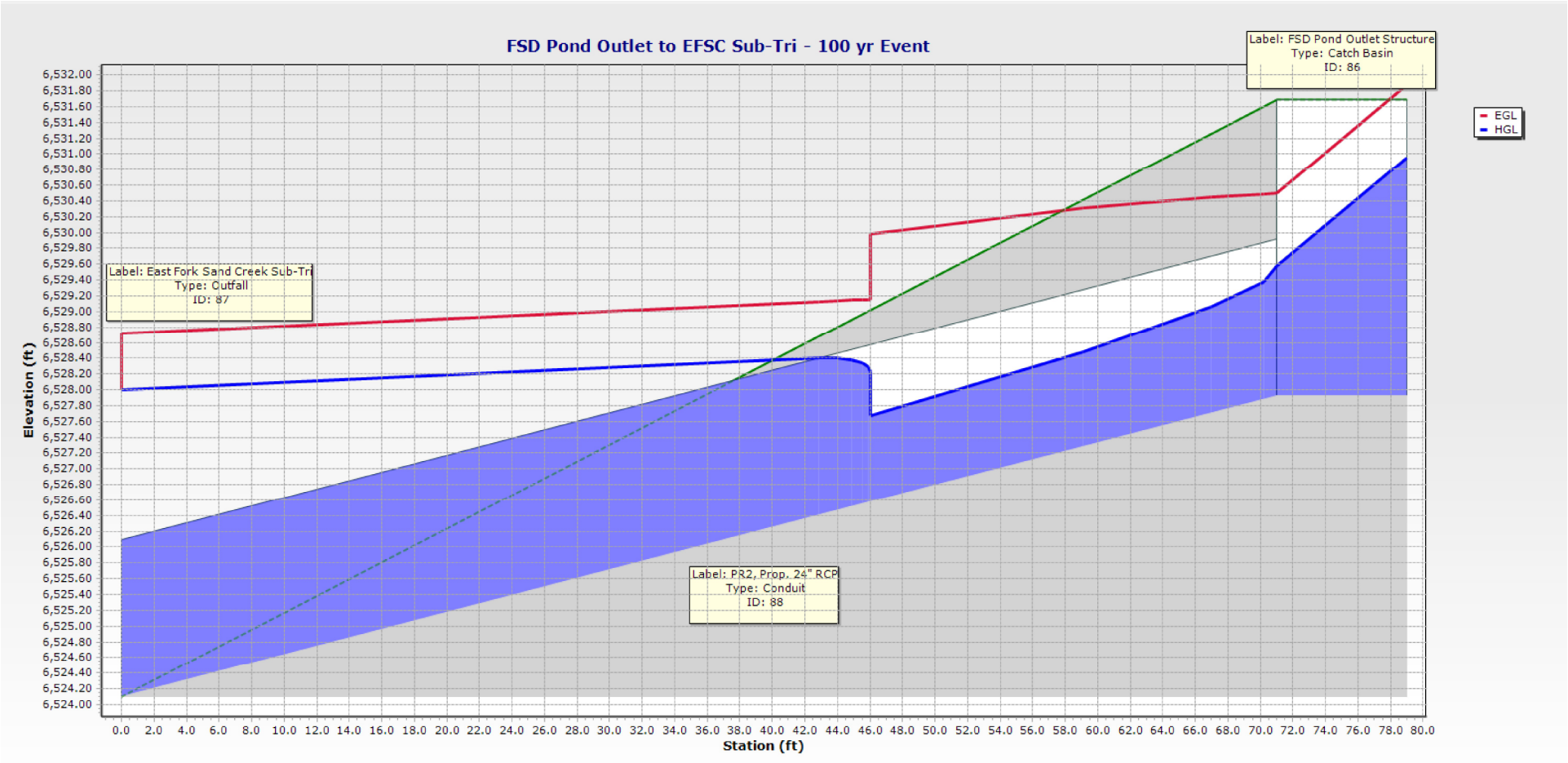
Figure 12-20. Sloping broad-crest weir

EFSCST INDEX MAP

Conduit FlexTable: EFSCST 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)
PR2, Prop. 24" RCP	88	FSD Pond Outlet Structure	21.40	41.9	75.0	15.53	3.292	0.90	1.66	6,530.50	6,528.72	6,529.58	6,528.00	1.58	6,530.96

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
7.70	1.500	1.38	6,531.69	6,524.10	6,527.92	6,524.10	Circle - 24.0 in


FSD Pond Outlet to EFSC Sub-Tri - 100 yr Event
Label: FSD Pond Outlet Structure
Type: Catch Basin
ID: 86
Label: East Fork Sand Creek Sub-Tri
Type: Outfall
ID: 87
Label: PR2, Prop. 24" RCP
Type: Conduit
ID: 88
EGL
HGL
Elevation (ft)
Station (ft)

```
                    HEC-RAS HEC-RAS 5.0.3 September 2016
                      U.S. Army Corps of Engineers
                     Hydrologic Engineering Center
                           609 Second Street
                           Davis, California


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

PROJECT DATA
Project Title: existingswale
Project File : existingswale.prj
Run Date and Time: 12/4/2017 3:05:07 PM

Project in English units

PLAN DATA

Plan Title: swale analysis
Plan File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.p01

Geometry Title: existingswale
Geometry File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.g01

Flow Title : ex flow w timberline
Flow File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.f01

Plan Summary Information:

Number of:	Cross Sections	= 7	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: ex flow w timberline
Flow File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.f01

Flow Data (cfs)

River	Reach	RS	5YR	100YR
existing swale	existing swale	1074.48	5.2	84.2
existing swale	existing swale	620.87	11.6	126.9
existing swale	existing swale	400	12.1	130.6
existing swale	existing swale	175.88	13.5	139.7

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
existing swale	existing swale	5YR	Normal S = 0.022	Normal S = 0.02

GEOMETRY DATA

Geometry Title: existingswale
Geometry File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.g01

```
CROSS SECTION


RIVER: existing swale
REACH: existing swale     RS: 1074.48

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6530.367.099998 6530.27   15.57 6530.18    39.4 6530.13   43.03 6529.97
   51.38 6526.41   52.96 6526.23      60 6526.81   61.75 6526.94   62.19 6526.94
   65.05 6527.42   69.31  6528.1   92.52 6528.97   97.37 6529.07  108.59 6529.46
     120 6529.84

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03     120    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     120           171.67  171.67  171.67             .1       .3

CROSS SECTION


RIVER: existing swale
REACH: existing swale     RS: 902.81

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6527.85   13.59 6527.47   16.76 6527.42   41.75 6526.87   46.77 6526.29
      60  6525.4    61.9 6525.27    68.4 6525.78    74.5 6525.91    81.3 6526.18
   88.72 6527.19   94.11 6528.08  112.71 6528.74  119.25 6529.01     120 6529.03

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03     120    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     120           113.78  113.78  113.78             .1       .3

CROSS SECTION


RIVER: existing swale
REACH: existing swale     RS: 789.03

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6527.76   23.05 6526.62   32.69 6526.3162.39999 6524.94   75.97 6524.47
   80.31 6524.36   80.54 6524.36   89.43  6524.3   98.67 6525.33  108.83 6526.49
  138.32 6527.86  155.36 6528.39  165.31 6529.02

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03  165.31    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  165.31           168.16  168.16  168.16             .1       .3

CROSS SECTION


RIVER: existing swale
REACH: existing swale     RS: 620.87

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6527.58.9100037 6527.56   29.14 6526.6337.42999 6526.2761.32001 6523.27
62.03999 6523.1362.46001 6523.1367.78999 6523.29      80 6523.59   92.41 6523.94
    94.9 6523.98   99.08 6524.02  135.86 6524.35  139.15 6524.37  146.21 6524.49
  196.17 6525.18     220 6525.61

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03     220    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     220           220.87  220.87  220.87             .1       .3

CROSS SECTION
```

```
RIVER: existing swale
REACH: existing swale     RS: 400

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6522.564.610001 6522.47   22.67 6522.23   33.53 6521.75   52.72 6521.63
      60 6521.57    64.2 6521.54   82.04 6521.4492.49001 6521.58  141.05 6521.75
  142.01 6521.75  142.24 6521.82     145 6522.82

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03     145    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     145           224.12  224.12  224.12             .1       .3

CROSS SECTION


RIVER: existing swale
REACH: existing swale     RS: 175.88

INPUT
Description:
Station Elevation Data    num=      22
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6521.1930.50999 6520.75   32.22 6520.7132.78999 6520.7134.03999 6520.69
   35.09 6520.67  102.35 6519.63  112.29 6519.49     130 6519.57   137.9 6519.62
  140.38 6519.68  167.91 6519.68  168.26 6519.65   168.7 6519.66     170 6519.67
   172.6 6519.69  199.67 6519.87  210.95 6519.98  228.11 6520.84  235.11 6522.39
  243.44 6522.22     245 6522.17

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03     245    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     245           147.52  147.52  147.52             .1       .3

CROSS SECTION


RIVER: existing swale
REACH: existing swale     RS: 28.36

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 6521.5232.07001 6521.08   36.97 6521.01   45.59 6520.75   61.39 6520.37
   86.45 6519.71   95.58 6519.39  102.08 6519.42  106.63    6519  119.68  6518.2
  124.79 6518.04  125.48 6518.02  136.36 6518.56  140.39 6518.81  149.97 6518.72

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0     .03  149.97    .035

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0  149.97             .1       .3



SUMMARY OF MANNING'S N VALUES

River:existing swale

      Reach          River Sta.       n1        n2        n3

 existing swale       1074.48          .035       .03       .035
 existing swale       902.81           .035       .03       .035
 existing swale       789.03           .035       .03       .035
 existing swale       620.87           .035       .03       .035
 existing swale       400              .035       .03       .035
 existing swale       175.88           .035       .03       .035
 existing swale       28.36            .035       .03       .035



SUMMARY OF REACH LENGTHS

River: existing swale

      Reach          River Sta.      Left     Channel    Right
```

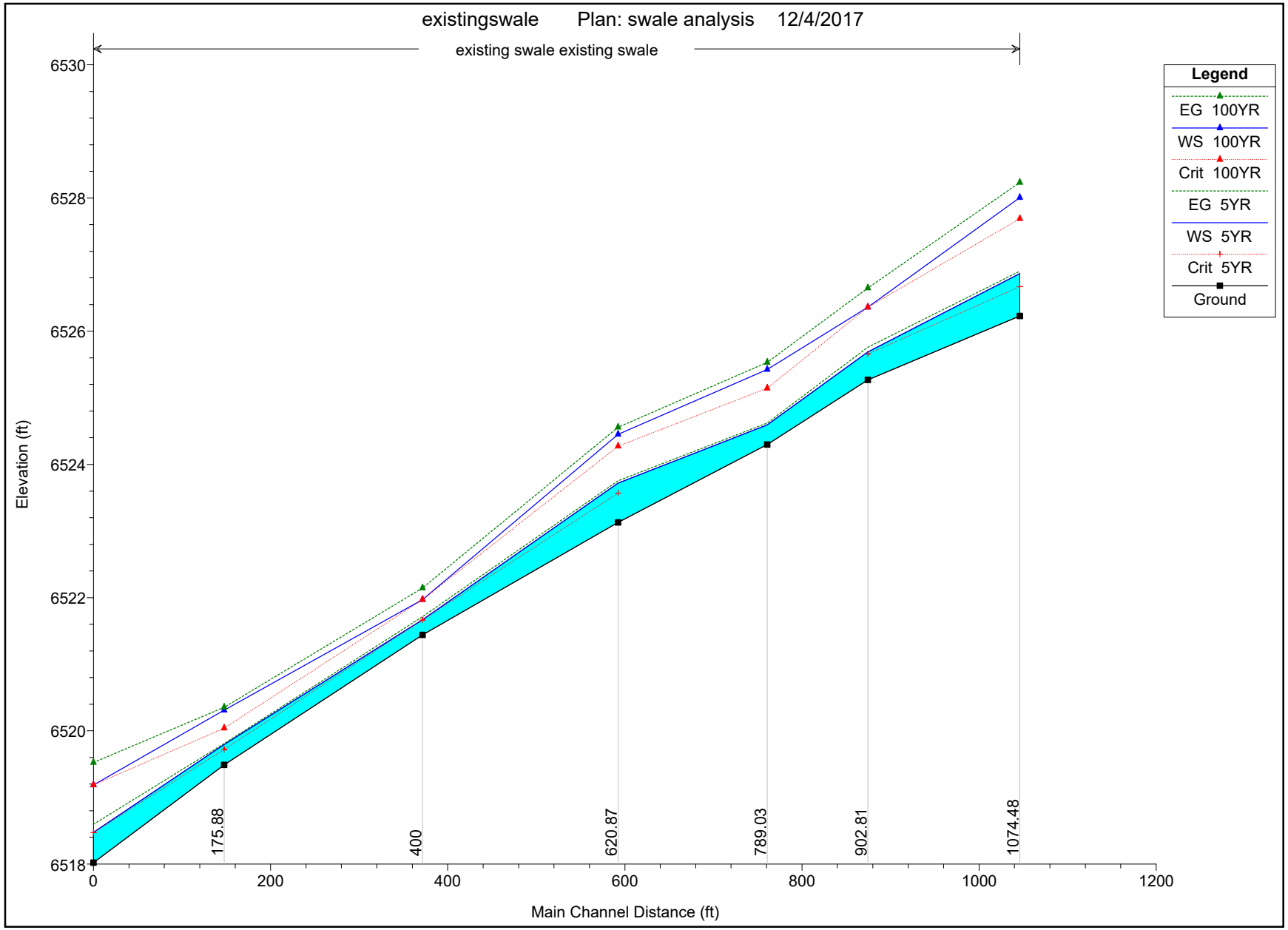
existing swale	1074.48	171.67	171.67	171.67
existing swale	902.81	113.78	113.78	113.78
existing swale	789.03	168.16	168.16	168.16
existing swale	620.87	220.87	220.87	220.87
existing swale	400	224.12	224.12	224.12
existing swale	175.88	147.52	147.52	147.52
existing swale	28.36			

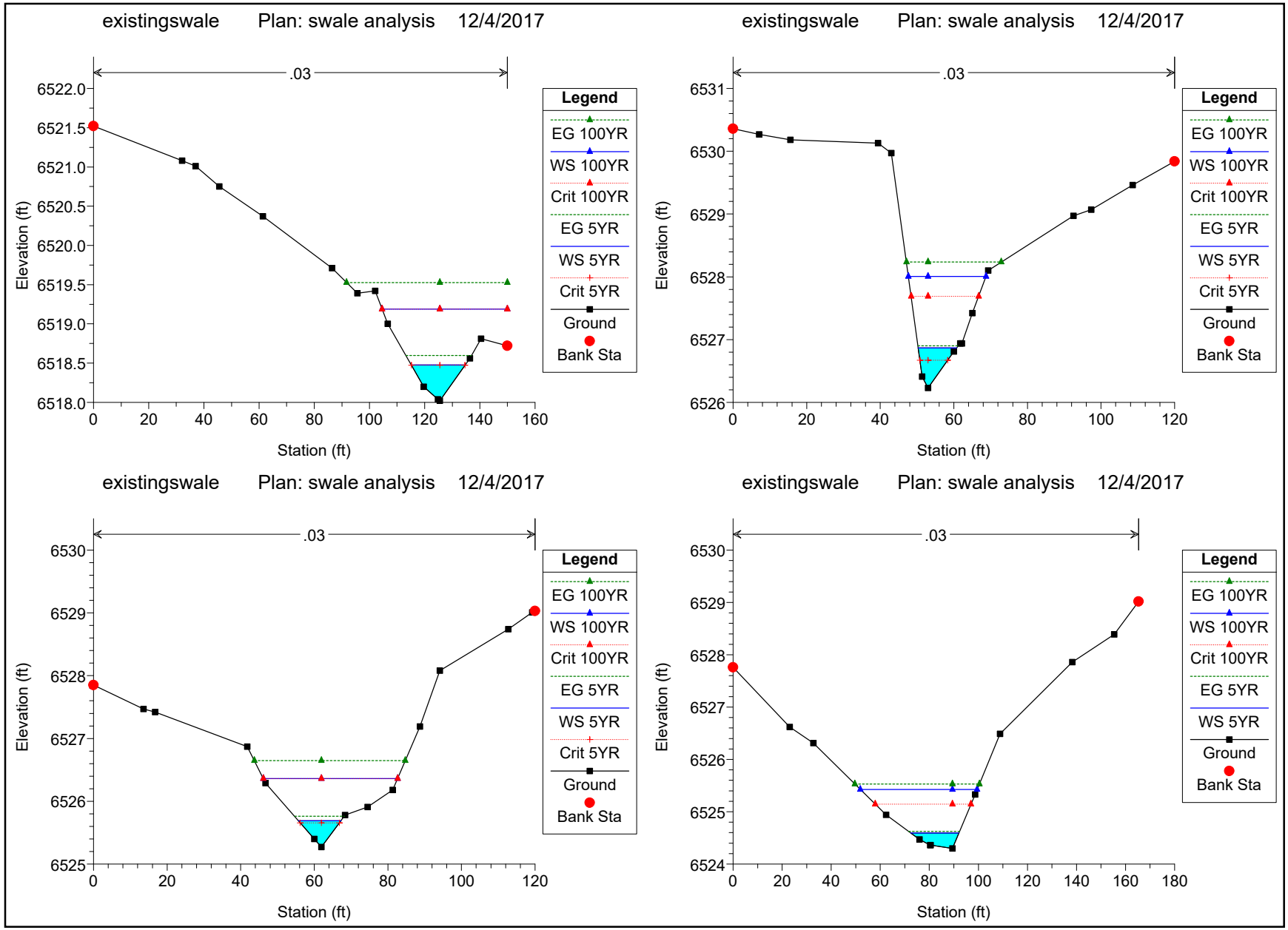
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: existing swale

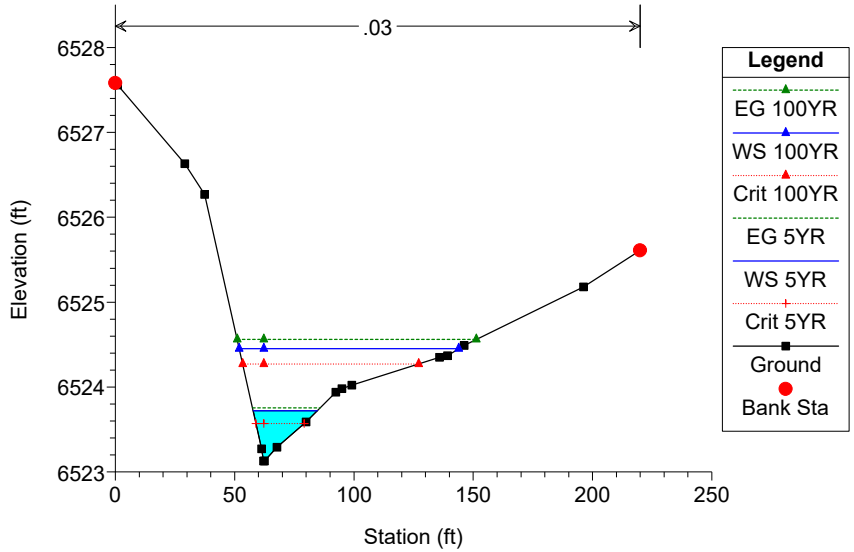
Reach	River Sta.	Contr.	Expan.
existing swale	1074.48	.1	.3
existing swale	902.81	.1	.3
existing swale	789.03	.1	.3
existing swale	620.87	.1	.3
existing swale	400	.1	.3
existing swale	175.88	.1	.3
existing swale	28.36	.1	.3

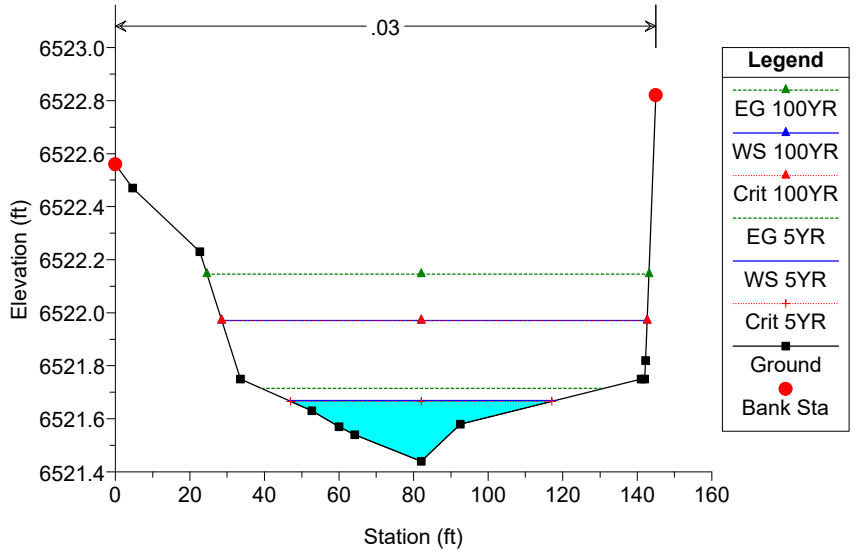
HEC-RAS Plan: exsw River: existing swale Reach: existing swale

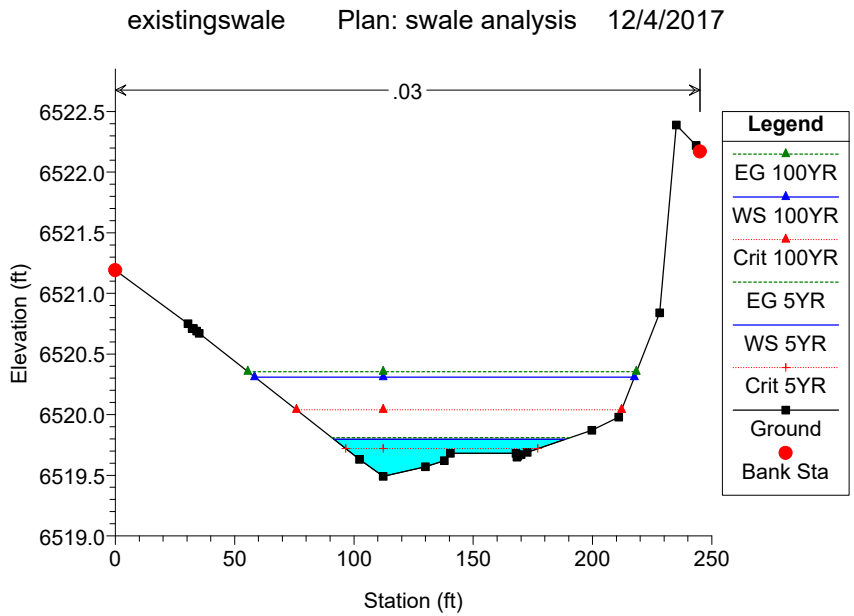
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Shear Chan	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(lb/sq ft)	
existing swale	1074.48	5YR	5.20	6526.23	6526.87	0.64	6526.67	6526.90	0.003696	1.46	3.57	10.45	0.08	0.44
existing swale	1074.48	100YR	84.20	6526.23	6528.01	1.78	6527.69	6528.23	0.005784	3.82	22.03	21.10	0.37	0.66
existing swale	902.81	5YR	5.20	6525.27	6525.69	0.42	6525.66	6525.76	0.015218	2.15	2.42	11.55	0.20	0.83
existing swale	902.81	100YR	84.20	6525.27	6526.36	1.09	6526.36	6526.65	0.017093	4.28	19.66	36.48	0.57	1.03
existing swale	789.03	5YR	5.20	6524.30	6524.59	0.29		6524.62	0.006992	1.38	3.77	19.65	0.08	0.55
existing swale	789.03	100YR	84.20	6524.30	6525.43	1.13	6525.14	6525.53	0.004633	2.60	32.35	47.61	0.20	0.56
existing swale	620.87	5YR	11.60	6523.13	6523.72	0.59	6523.57	6523.75	0.004583	1.48	7.86	26.87	0.08	0.48
existing swale	620.87	100YR	126.90	6523.13	6524.45	1.32	6524.27	6524.56	0.006887	2.66	47.79	91.93	0.22	0.65
existing swale	400	5YR	12.10	6521.44	6521.67	0.23	6521.67	6521.71	0.025559	1.70	7.12	71.62	0.16	0.95
existing swale	400	100YR	130.60	6521.44	6521.97	0.53	6521.97	6522.15	0.019209	3.35	38.96	114.13	0.41	1.01
existing swale	175.88	5YR	13.50	6519.49	6519.80	0.31	6519.72	6519.81	0.004447	0.93	14.50	96.91	0.04	0.42
existing swale	175.88	100YR	139.70	6519.49	6520.31	0.82	6520.04	6520.35	0.002691	1.67	83.55	159.13	0.09	0.41
existing swale	28.36	5YR	13.50	6518.02	6518.48	0.46	6518.47	6518.60	0.019987	2.77	4.87	19.54	0.31	0.98
existing swale	28.36	100YR	139.70	6518.02	6519.19	1.17	6519.19	6519.53	0.015570	4.65	30.01	45.39	0.64	1.01


existingswale Plan: swale analysis 12/4/2017
existing swale existing swale
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Elevation (ft)
6530
6528
6526
6524
6522
6520
6518
0
200
400
600
800
1000
1200
Main Channel Distance (ft)
175.88
400
620.87
789.03
902.81
1074.48

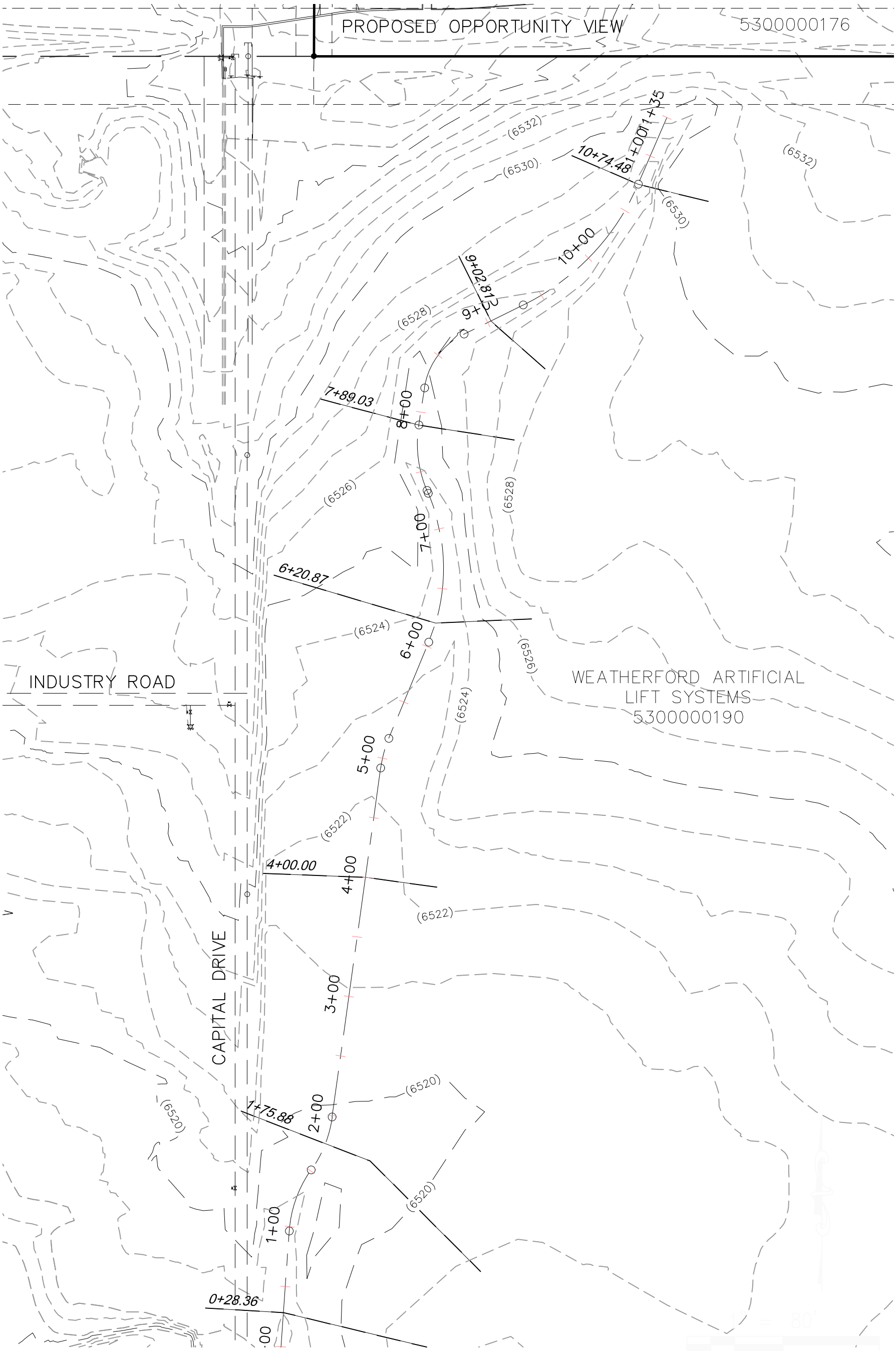

existingswale Plan: swale analysis 12/4/2017
.03
Elevation (ft)
Station (ft)
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Bank Sta
existingswale Plan: swale analysis 12/4/2017
.03
Elevation (ft)
Station (ft)
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Bank Sta
existingswale Plan: swale analysis 12/4/2017
.03
Elevation (ft)
Station (ft)
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Bank Sta
existingswale Plan: swale analysis 12/4/2017
.03
Elevation (ft)
Station (ft)
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Ground
Bank Sta


existingswale Plan: swale analysis 12/4/2017
.03
Elevation (ft)
Station (ft)
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Bank Sta


existingswale Plan: swale analysis 12/4/2017
.03
Elevation (ft)
Station (ft)
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Bank Sta


existingswale Plan: swale analysis 12/4/2017
.03
Elevation (ft)
Station (ft)
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Bank Sta

OFF-SITE SWALE HEC-RAS WORK MAP



5YR EVENT / 100YR EVENT

CROSS SECTION ID	FLOW CFS	DEPTH FT	VELOCITY FT/S	SHEAR LB/SF		FLOW CFS	DEPTH FT	VELOCITY FT/S	SHEAR LB/SF
10+74.48	5.2	0.6	1.5	0.1		84.2	1.8	3.8	0.4
9+02.81	5.2	0.4	2.2	0.2		84.2	1.1	4.3	0.6
7+89.03	5.2	0.3	1.4	<0.1		84.2	1.1	2.6	0.2
6+20.87	11.6	0.6	1.5	<0.1		126.9	1.3	2.7	0.2
4+00.00	12.1	0.2	1.7	0.2		130.6	0.5	3.4	0.4
1+75.88	13.5	0.3	0.9	<0.1		139.7	0.8	1.7	0.1
0+28.36	13.5	0.4	2.8	0.3		139.7	1.2	4.7	0.6

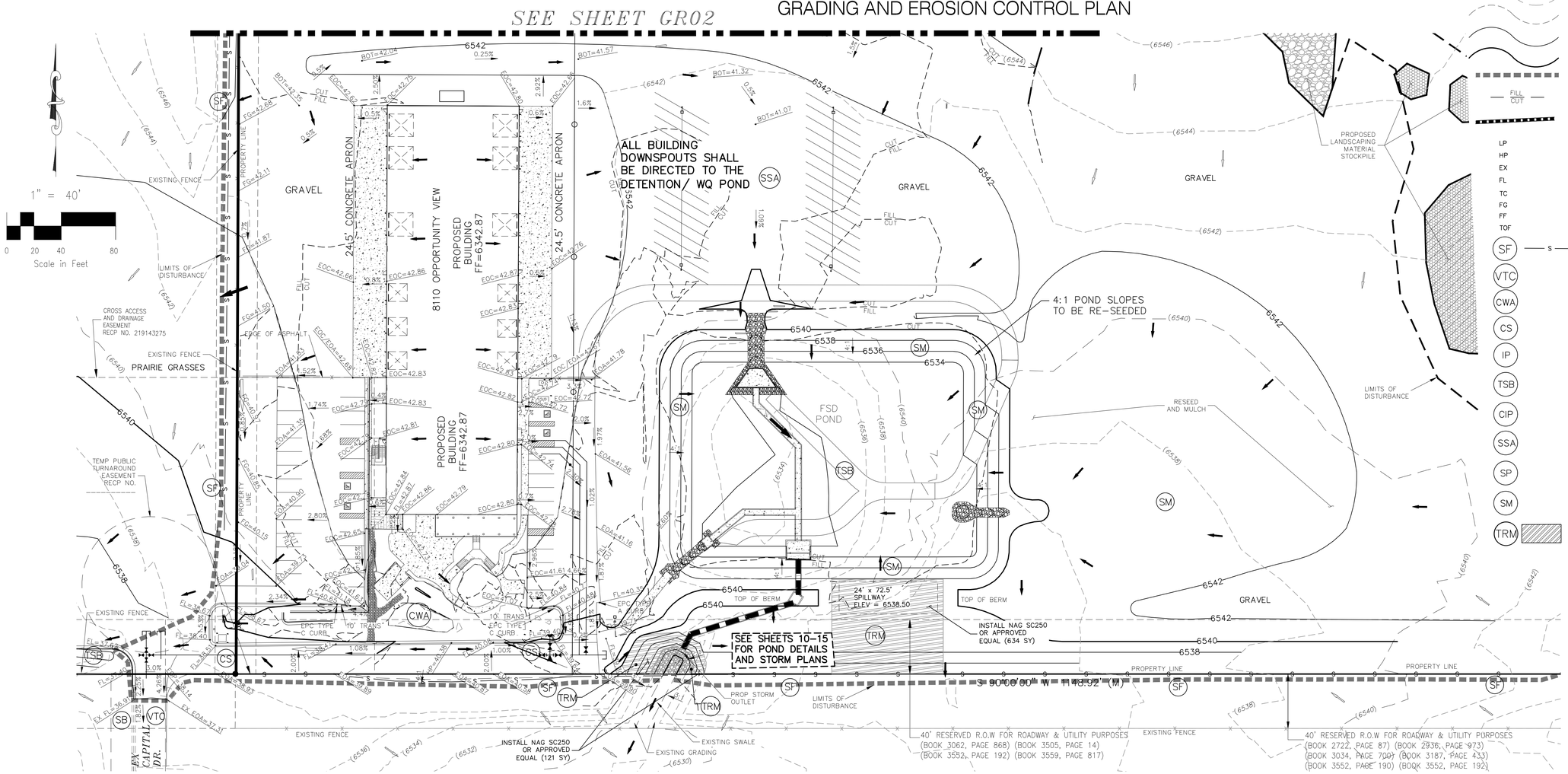
M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

File: O:\43095A\Tim Emick\dwg\Eng Exhibits\RAS model XS.dwg Plotstamp: 12/5/2017 8:28 AM

GRADING AND EROSION CONTROL PLAN

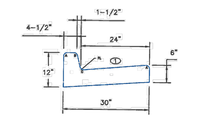
TIMBERLINE STORAGE YARD

GRADING AND EROSION CONTROL PLAN

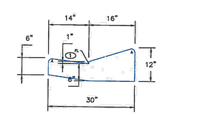


LEGEND

	EX MAJ CONT
	EX MIN CONT
	PROP MAJ CONT
	PROP MIN CONT
	LIMITS OF DISTURBANCE
FILL / CUT	CUT FILL LINE
	PROPOSED STORM SEWER INLET WITH PIPE
LP	LOW POINT
HP	HIGH POINT
EX	EXISTING
FL	FLOWLINE
TC	TOP OF CURB
FG	FINISH GRADE
FF	FINISH FLOOR
TOF	TOP OF FOOTING
SF — S —	SILT FENCE – INITIAL
VTC	VEHICLE TRACKING CONTROL – INITIAL
CWA	CONCRETE WASH-OUT BASIN – INITIAL
CS	CURB SOCKS – INITIAL/INTERIM
IP	INLET PROTECTION – INITIAL
TSB	TEMPORARY SEDIMENT BASIN – INTERIM
CIP	CULVERT INLET PROTECTION – INITIAL
SSA	STABILIZED STAGING & STORAGE AREA – INITIAL
SP	TEMPORARY STOCK PILE AREA – INITIAL
SM	SEEDING & MULCHING – PERM
TRM	NORTH AMERICAN GREEN SC250 PERMANENT EROSION CONTROL BLANKET (OR APPROVED EQUAL) – PERM



EPC TYPE A
(REVERSE SLOPE OF PAN FOR SPILL CURB)



EPC TYPE C
(REVERSE SLOPE OF PAN FOR SPILL CURB)

STANDARD CONSTRUCTION NOTES:

1. ALL DRAINAGE AND ROADWAY CONSTRUCTION SHALL MEET THE STANDARDS AND SPECIFICATIONS OF THE CITY OF COLORADO SPRINGS/EL PASO COUNTY DRAINAGE CRITERIA MANUAL VOLUMES 1 AND 2, AND THE EL PASO COUNTY ENGINEERING CRITERIA MANUAL.

2. CONTRACTOR SHALL BE RESPONSIBLE FOR THE NOTIFICATION AND FIELD LOCATION OF ALL EXISTING UTILITIES, WHETHER SHOWN ON THE PLANS OR NOT, BEFORE BEGINNING CONSTRUCTION. LOCATION OF EXISTING UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. CALL 811 TO CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO SPRINGS.

3. CONTRACTOR SHALL KEEP A COPY OF THESE APPROVED PLANS, THE GRADING AND EROSION CONTROL PLAN, THE STORMWATER MANAGEMENT PLAN (SWMP), THE SOILS AND GEOTECHNICAL REPORT AND THE APPROPRIATE DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATIONS AT THE JOB SITE AT ALL TIME INCLUDING THE FOLLOWING:
   3.1 EL PASO COUNTY ENGINEERING CRITERIA MANUAL (ECM)
   3.2 CITY OF COLORADO SPRINGS/EL PASO COUNTY ENGINEERING CRITERIA MANUAL VOLUMES 1 AND 2.
   3.3 COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) STANDARDS SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION.
   3.4 CDOT M&S STANDARDS.

4. IT IS THE DESIGN ENGINEERS RESPONSIBILITY TO ACCURACY SHOW EXISTING CONDITION BOTH ONSITE AND OFFSITE ON THE CONSTRUCTION PLANS. ANY MODIFICATION NECESSARY DUE TO CONFLICT OMISSIONS OR CHANGED CONDITIONS WILL BE ENTIRELY THE DEVELOPERS RESPONSIBILITY TO RECTIFY.

5. ONCE THE ESQCP HAS BEEN ISSUED, THE CONTRACTOR MAY INSTALL THE INITIAL STAGE EROSION AND SEDIMENT CONTROL BMPS AS INDICATED ON THE GEC. A PRECONSTRUCTION MEETING BETWEEN THE CONTRACTOR, ENGINEER, AND EL PASO COUNTY WILL BE HELD PRIOR TO ANY CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE APPLICANT TO COORDINATE THE MEETING TIME AND PLACE WITH COUNTY PCD INSPECTIONS STAFF.

6. IT IS THE CONTRACTORS RESPONSIBILITY TO UNDERSTAND THE REQUIREMENTS OF ALL JURISDICTIONAL AGENCIES AND TO OBTAIN ALL REQUIRED PERMITS, INCLUDING BUT NOT LIMITED TO EL PASO COUNTY EROSION AND STORM WATER QUALITY CONTROL PERMIT (ESQCP), US ARMY CORPS OF ENGINEER ISSUED 401 AND/OR 404 PERMITS AND COUNTY AND STATE FUGITIVE DUST PERMITS.

7. ALL CONSTRUCTION TRAFFIC MUST ENTER/EXIT THE CONSTRUCTION SITE AT APPROVED CONSTRUCTION ACCESS POINTS.

8. ANY TEMPORARY SIGNAGE AND STRIPING SHALL COMPLY WITH EL PASO COUNTY DPW AND MUTCD CRITERIA.

9. CONTRACTOR SHALL OBTAIN ANY PERMITS REQUIRE BY EL PASO COUNTY DPW INCLUDING WORK WITHIN THE RIGHT-OF-WAY AND SPECIAL TRANSPORT PERMITS.

10. THE LIMITS OF CONSTRUCTION SHALL REMAIN WITHIN THE PROPERTY LINE UNLESS OTHERWISE NOTED. THE OWNER/DEVELOPER SHALL OBTAIN WRITTEN PERMISSION AND EASEMENTS, WHERE REQUIRED, FROM ADJOINING PROPERTY OWNER(S) PRIOR TO ANY OFFSITE DISTURBANCE GRADING, OR CONSTRUCTION.

11. THE COUNTY THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT, NOR DOES IT AFFIRM THAT SUFFICIENT EASEMENTS OR OTHER PERMISSIONS EXIST FOR ANY OFFSITE WORK.

GRADING AND EROSION CONTROL NOTES:

1. STORMWATER DISCHARGES FROM CONSTRUCTION SITES SHALL NOT CAUSE OR THREATEN TO CAUSE POLLUTION, CONTAMINATION, OR DEGRADATION OF STATE WATERS. ALL WORK AND EARTH DISTURBANCE SHALL BE DONE IN A MANNER THAT MINIMIZES POLLUTION OF ANY ON-SITE OR OFF-SITE WATERS, INCLUDING WETLANDS.

2. NOTWITHSTANDING ANYTHING DEPICTED IN THESE PLANS IN WORDS OR GRAPHIC REPRESENTATION, ALL DESIGN AND CONSTRUCTION RELATED TO ROADS, STORM DRAINAGE AND EROSION CONTROL SHALL CONFORM TO THE STANDARDS AND REQUIREMENTS OF THE MOST RECENT VERSION OF THE RELEVANT ADOPTED EL PASO COUNTY STANDARDS, INCLUDING THE LAND DEVELOPMENT CODE, THE ENGINEERING CRITERIA MANUAL, THE DRAINAGE CRITERIA MANUAL, AND THE DRAINAGE CRITERIA MANUAL VOLUME 2. ANY DEVIATIONS FROM REGULATIONS AND STANDARDS MUST BE REQUESTED, AND APPROVED, IN WRITING.

3. A SEPARATE STORMWATER MANAGEMENT PLAN (SMWP) FOR THIS PROJECT SHALL BE COMPLETED AND AN EROSION AND STORMWATER QUALITY CONTROL PERMIT (ESQCP) ISSUED PRIOR TO COMMENCING CONSTRUCTION. MANAGEMENT OF THE SWMP DURING CONSTRUCTION IS THE RESPONSIBILITY OF THE DESIGNATED QUALIFIED STORMWATER MANAGER OR CERTIFIED EROSION CONTROL INSPECTOR. THE SWMP SHALL BE LOCATED ON SITE AT ALL TIMES DURING CONSTRUCTION AND SHALL BE KEPT UP TO DATE WITH WORK PROGRESS AND CHANGES IN THE FIELD.

4. ONCE THE ESQCP IS APPROVED AND A "NOTICE TO PROCEED" HAS BEEN ISSUED, THE CONTRACTOR MAY INSTALL THE INITIAL STAGE EROSION AND SEDIMENT CONTROL MEASURES AS INDICATED ON THE APPROVED GEC. A PRECONSTRUCTION MEETING BETWEEN THE CONTRACTOR, ENGINEER, AND EL PASO COUNTY WILL BE HELD PRIOR TO ANY CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE APPLICANT TO COORDINATE THE MEETING TIME AND PLACE WITH COUNTY STAFF.

5. CONTROL MEASURES MUST BE INSTALLED PRIOR TO COMMENCEMENT OF ACTIVITIES THAT COULD CONTRIBUTE POLLUTANTS TO STORMWATER. CONTROL MEASURES FOR ALL SLOPES, CHANNELS, DITCHES, AND DISTURBED LAND AREAS SHALL BE INSTALLED IMMEDIATELY UPON COMPLETION OF THE DISTURBANCE.

6. ALL TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE MAINTAINED AND REMAIN IN EFFECTIVE OPERATING CONDITION UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IMPLEMENTED AND FINAL STABILIZATION IS ESTABLISHED. ALL PERSONS ENGAGED IN LAND DISTURBANCE ACTIVITIES SHALL ASSESS THE ADEQUACY OF CONTROL MEASURES AT THE SITE AND IDENTIFY IF CHANGES TO THOSE CONTROL MEASURES ARE NEEDED TO ENSURE THE CONTINUED EFFECTIVE PERFORMANCE OF THE CONTROL MEASURES. ALL CHANGES TO TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES MUST BE INCORPORATED INTO THE STORMWATER MANAGEMENT PLAN.

7. TEMPORARY STABILIZATION SHALL BE IMPLEMENTED ON DISTURBED AREAS AND STOCKPILES WHERE GROUND DISTURBING CONSTRUCTION ACTIVITY HAS PERMANENTLY CEASED OR TEMPORARILY CEASED FOR LONGER THAN 14 DAYS.

8. FINAL STABILIZATION MUST BE IMPLEMENTED AT ALL APPLICABLE CONSTRUCTION SITES. FINAL STABILIZATION IS ACHIEVED WHEN ALL GROUND DISTURBING ACTIVITIES ARE COMPLETE AND ALL DISTURBED AREAS EITHER HAVE A UNIFORM VEGETATIVE COVER WITH INDIVIDUAL PLANT DENSITY OF 70 PERCENT OF PRE-DISTURBANCE LEVELS ESTABLISHED OR EQUIVALENT PERMANENT ALTERNATIVE STABILIZATION METHOD IS IMPLEMENTED. ALL TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE REMOVED UPON FINAL STABILIZATION AND BEFORE PERMIT CLOSURE.

9. ALL PERMANENT STORMWATER MANAGEMENT FACILITIES SHALL BE INSTALLED AS DESIGNED IN THE APPROVED PLANS. ANY PROPOSED CHANGES THAT EFFECT THE DESIGN OR FUNCTION OF PERMANENT STORMWATER MANAGEMENT STRUCTURES MUST BE APPROVED BY THE ECM ADMINISTRATOR PRIOR TO IMPLEMENTATION.

10. EARTH DISTURBANCES SHALL BE CONDUCTED IN SUCH A MANNER SO AS TO EFFECTIVELY MINIMIZE ACCELERATED SOIL EROSION AND RESULTING SEDIMENTATION. ALL DISTURBANCES SHALL BE DESIGNED, CONSTRUCTED, AND COMPLETED SO THAT THE EXPOSED AREA OF ANY DISTURBED LAND SHALL BE LIMITED TO THE SHORTEST PRACTICAL PERIOD OF TIME. PRE-EXISTING VEGETATION SHALL BE PROTECTED AND MAINTAINED WITHIN 50 HORIZONTAL FEET OF A WATERS OF THE STATE UNLESS SHOWN TO BE INFEASIBLE AND SPECIFICALLY REQUESTED AND APPROVED.

11. COMPACTION OF SOIL MUST BE PREVENTED IN AREAS DESIGNATED FOR INFILTRATION CONTROL MEASURES OR WHERE FINAL STABILIZATION WILL BE ACHIEVED BY VEGETATIVE COVER. AREAS DESIGNATED FOR INFILTRATION CONTROL MEASURES SHALL ALSO BE PROTECTED FROM SEDIMENTATION DURING CONSTRUCTION UNTIL FINAL STABILIZATION IS ACHIEVED. IF COMPACTION PREVENTION IS NOT FEASIBLE DUE TO SITE CONSTRAINTS, ALL AREAS DESIGNATED FOR INFILTRATION AND VEGETATION CONTROL MEASURES MUST BE LOOSENED PRIOR TO INSTALLATION OF THE CONTROL MEASURE(S).

12. ANY TEMPORARY OR PERMANENT FACILITY DESIGNED AND CONSTRUCTED FOR THE CONVEYANCE OF STORMWATER AROUND, THROUGH, OR FROM THE EARTH DISTURBANCE AREA SHALL BE A STABILIZED CONVEYANCE DESIGNED TO MINIMIZE EROSION AND THE DISCHARGE OF SEDIMENT OFF SITE.

13. CONCRETE WASH WATER SHALL BE CONTAINED AND DISPOSED OF IN ACCORDANCE WITH THE SWMP. NO WASH WATER SHALL BE DISCHARGED TO OR ALLOWED TO ENTER STATE WATERS, INCLUDING ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR FACILITIES. CONCRETE WASHOUTS SHALL NOT BE LOCATED IN AN AREA WHERE SHALLOW GROUNDWATER MAY BE PRESENT, OR WITHIN 50 FEET OF A SURFACE WATER BODY, CREEK OR STREAM.

14. DURING DEWATERING OPERATIONS OF UNCONTAMINATED GROUND WATER MAY BE DISCHARGED ON SITE, BUT SHALL NOT LEAVE THE SITE IN THE FORM OF SURFACE RUNOFF UNLESS AN APPROVED STATE DEWATERING PERMIT IS IN PLACE.

15. EROSION CONTROL BLANKETING OR OTHER PROTECTIVE COVERING SHALL BE USED ON SLOPES STEEPER THAN 3:1.

16. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL WASTES FROM THE CONSTRUCTION SITE FOR DISPOSAL IN ACCORDANCE WITH LOCAL AND STATE REGULATORY REQUIREMENTS. NO CONSTRUCTION DEBRIS, TREE SLASH, BUILDING MATERIAL WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURIED, DUMPED, OR DISCHARGED AT THE SITE.

17. WASTE MATERIALS SHALL NOT BE TEMPORARILY PLACED OR STORED IN THE STREET, ALLEY, OR OTHER PUBLIC WAY, UNLESS IN ACCORDANCE WITH AN APPROVED TRAFFIC CONTROL PLAN. CONTROL MEASURES MAY BE REQUIRED BY EL PASO COUNTY ENGINEERING IF DEEMED NECESSARY, BASED ON SPECIFIC CONDITIONS AND CIRCUMSTANCES.

18. TRACKING OF SOILS AND CONSTRUCTION DEBRIS OFF-SITE SHALL BE MINIMIZED. MATERIALS TRACKED OFF-SITE SHALL BE CLEANED UP AND PROPERLY DISPOSED OF IMMEDIATELY.

19. THE OWNER/DEVELOPER SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL CONSTRUCTION DEBRIS, DIRT, TRASH, ROCK, SEDIMENT, SOIL, AND SAND THAT MAY ACCUMULATE IN ROADS, STORM DRAINS AND OTHER DRAINAGE CONVEYANCE SYSTEMS AND STORMWATER APPURTENANCES AS A RESULT OF SITE DEVELOPMENT.

20. THE QUANTITY OF MATERIALS STORED ON THE PROJECT SITE SHALL BE LIMITED, AS MUCH AS PRACTICAL, TO THAT QUANTITY REQUIRED TO PERFORM THE WORK IN AN ORDERLY SEQUENCE. ALL MATERIALS STORED ON-SITE SHALL BE STORED IN A NEAT, ORDERLY MANNER, IN THEIR ORIGINAL CONTAINERS, WITH ORIGINAL MANUFACTURER'S LABELS.

21. NO CHEMICAL(S) HAVING THE POTENTIAL TO BE RELEASED IN STORMWATER ARE TO BE STORED OR USED ONSITE UNLESS PERMISSION FOR THE USE OF SUCH CHEMICAL(S) IS GRANTED IN WRITING BY THE ECM ADMINISTRATOR. IN GRANTING APPROVAL FOR THE USE OF SUCH CHEMICAL(S), SPECIAL CONDITIONS AND MONITORING MAY BE REQUIRED.

22. BULK STORAGE OF ALLOWED PETROLEUM PRODUCTS OR OTHER ALLOWED LIQUID CHEMICALS IN EXCESS OF 55 GALLONS SHALL REQUIRE ADEQUATE SECONDARY CONTAINMENT PROTECTION TO CONTAIN ALL SPILLS ONSITE AND TO PREVENT ANY SPILLED MATERIALS FROM ENTERING STATE WATERS, ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR OTHER FACILITIES.

23. NO PERSON SHALL CAUSE THE IMPEDIMENT OF STORMWATER FLOW IN THE CURB AND GUTTER OR DITCH EXCEPT WITH APPROVED SEDIMENT CONTROL MEASURES.

24. OWNER/DEVELOPER AND THEIR AGENTS SHALL COMPLY WITH THE "COLORADO WATER QUALITY CONTROL ACT" (TITLE 25, ARTICLE 8, CRS), AND THE "CLEAN WATER ACT" (33 USC 1344). IN ADDITION TO THE REQUIREMENTS OF THE LAND DEVELOPMENT CODE, DCM VOLUME II AND THE ECM APPENDIX I. ALL APPROPRIATE PERMITS MUST BE OBTAINED BY THE CONTRACTOR PRIOR TO CONSTRUCTION (1041, NPDES, FLOODPLAIN, 404, FUGITIVE DUST, ETC.). IN THE EVENT OF CONFLICTS BETWEEN THESE REQUIREMENTS AND OTHER LAWS, RULES, OR REGULATIONS OF OTHER FEDERAL, STATE, LOCAL, OR COUNTY AGENCIES, THE MOST RESTRICTIVE LAWS, RULES, OR REGULATIONS SHALL APPLY.

25. ALL CONSTRUCTION TRAFFIC MUST ENTER/EXIT THE SITE ONLY AT APPROVED CONSTRUCTION ACCESS POINTS.

26. PRIOR TO CONSTRUCTION THE PERMITTEE SHALL VERIFY THE LOCATION OF EXISTING UTILITIES.

27. A WATER SOURCE SHALL BE AVAILABLE ON SITE DURING EARTHWORK OPERATIONS AND SHALL BE UTILIZED AS REQUIRED TO MINIMIZE DUST FROM EARTHWORK EQUIPMENT AND WIND.

28. THE SOILS REPORT FOR THIS SITE HAS BEEN PREPARED BY CTL THOMPSON, INC., ENTITLED GEOTECHNICAL INVESTIGATION TIMBERLINE LANDSCAPING OFFICE AND WAREHOUSE, DATED MAY 5, 2017, AND SHALL BE CONSIDERED A PART OF THESE PLANS.

29. AT LEAST TEN (10) DAYS PRIOR TO THE ANTICIPATED START OF CONSTRUCTION, FOR PROJECTS THAT WILL DISTURB ONE (1) ACRE OR MORE, THE OWNER OR OPERATOR OF CONSTRUCTION ACTIVITY SHALL SUBMIT A PERMIT APPLICATION FOR STORMWATER DISCHARGE TO THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, WATER QUALITY DIVISION. THE APPLICATION CONTAINS CERTIFICATION OF COMPLETION OF A STORMWATER MANAGEMENT PLAN (SWMP), OF WHICH THIS GRADING AND EROSION CONTROL PLAN MAY BE A PART. FOR INFORMATION OR APPLICATION MATERIALS CONTACT:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
WATER QUALITY CONTROL DIVISION
WQCD - PERMITS
4300 CHERRY CREEK DRIVE SOUTH
DENVER, CO 80246-1530
ATTN: PERMITS UNIT

ADDITIONAL NOTES:

STAGING AREA TO BE DETERMINED BY CONTRACTOR IN THE FIELD. THE LOCATIONS SHALL BE DELINEATED ON THIS PLAN BY THE CONTRACTOR.

THE EROSION CONTROL DELINEATED ON THIS PLAN SHALL BE REGULARLY UPDATED BY THE CONTRACTOR.

NO PORTION OF THIS PROPERTY IS LOCATED WITHIN A DESIGNATED FEMA FLOODPLAIN IN ACCORDANCE WITH FLOOD INSURANCE RATE MAPS (FIRM) 08041C0543G, EFFECTIVE DATE DECEMBER 7, 2018.

EL PASO COUNTY FILE NO. PPR 19-042

TIMBERLINE STORAGE YARD
GRADING AND EROSION CONTROL PLAN

PROJECT NO. 43-095 | DATE: 03/05/2020 | SHEET 3 OF 18 | GR01

DESIGNED BY: GW | DRAWN BY: GW | CHECKED BY: VAS | SCALE: HORIZONTAL: 1"=40' VERTICAL: N/A

102 E. PIKES PEAK AVE. 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF MATRIX DESIGN CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS: NO. | DATE: | BY: | DESCRIPTION: | APRV'D. 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 LAND USES BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

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TIMBERLINE STORAGE YARD

GRADING AND EROSION CONTROL PLAN

1" = 40'

0 20 40 80
Scale in Feet

LEGEND

EX MAJ CONT	LP	LOW POINT	IP	INLET PROTECTION – INITIAL
EX MIN CONT	HP	HIGH POINT	TSB	TEMPORARY SEDIMENT BASIN – INTERIM
PROP MAJ CONT	EX	EXISTING	CIP	CULVERT INLET PROTECTION – INITIAL
PROP MIN CONT	FL	FLOWLINE	SSA	STABILIZED STAGING & STORAGE AREA – INITIAL
LIMITS OF DISTURBANCE	TC	TOP OF CURB	SP	TEMPORARY STOCK PILE AREA – INITIAL
CUT FILL LINE	FG	FINISH GRADE	TRM	NORTH AMERICAN GREEN SC250 PERMANENT EROSION CONTROL BLANKET (OR APPROVED EQUAL) – PERM
PROPOSED STORM SEWER INLET WITH PIPE	FF	FINISH FLOOR		
	TOF	TOP OF FOOTING		
	SF — S —	SILT FENCE – INITIAL		
	VTC	VEHICLE TRACKING CONTROL – INITIAL		
	CWA	CONCRETE WASH-OUT BASIN – INITIAL		
	SB	STRAW BALE – INITIAL		

EL PASO COUNTY FILE NO. PPR 19-042

TIMBERLINE STORAGE YARD
GRADING AND EROSION CONTROL PLAN

PROJECT NO. 43-095	SCALE: HORIZONTAL: 1"=40' VERTICAL: N/A	DATE: 03/05/2020	SHEET 4 OF 18 GR02
DESIGNED BY: GW DRAWN BY: GW CHECKED BY: VAS			

102 E. PIKES PEAK AVE. 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF MARK DIXON CONSULTANTS, INC.

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

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APRV'D. BY:	DATE:

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TIMBERLINE STORAGE YARD

OVERALL GRADING AND EROSION CONTROL PLAN

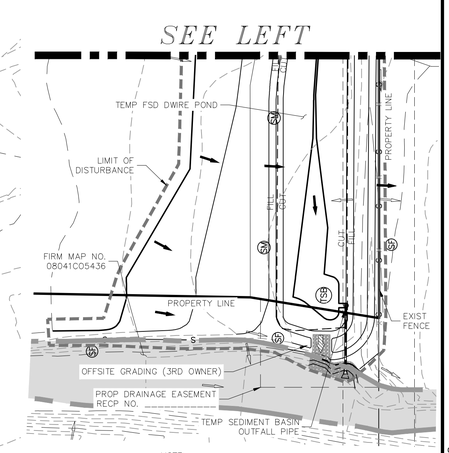
1" = 80

0 20 80 160

Scale in Feet

LEGEND

	EX MAJ CONT
	EX MIN CONT
	PROP MAJ CONT
	PROP MIN CONT
	LIMITS OF DISTURBANCE
FILL / CUT	CUT FILL LINE
	PROPOSED STORM SEWER INLET WITH PIPE
LP	LOW POINT
HP	HIGH POINT
EX	EXISTING
FL	FLOWLINE
TC	TOP OF CURB
FG	FINISH GRADE
FF	FINISH FLOOR
TOF	TOP OF FOOTING
SF — S —	SILT FENCE – INITIAL
VTC	VEHICLE TRACKING CONTROL – INITIAL
CWA	CONCRETE WASH-OUT BASIN – INITIAL
CS	CURB SOCK – INITIAL/INTERIM
IP	INLET PROTECTION – INITIAL
TSB	TEMPORARY SEDIMENT BASIN – INTERIM
CIP	CULVERT INLET PROTECTION – INITIAL
SSA	STABILIZED STAGING & STORAGE AREA – INITIAL
SP	TEMPORARY STOCK PILE AREA – INITIAL
SM	SEEDING & MULCHING – PERM
TRM	NORTH AMERICAN GREEN SC250 PERMANENT EROSION CONTROL BLANKET (OR APPROVED EQUAL) – PERM



NOTE:
ALL DISTURBED AREAS TO BE RE-SEEDED.

EL PASO COUNTY FILE NO. PPR 19-042

TIMBERLINE STORAGE YARD
OVERALL GRADING AND EROSION CONTROL PLAN

PROJECT NO. 43-095 | DATE: 03/05/2020 | SHEET 5 OF 18 | GR03

DESIGNED BY: GW | DRAWN BY: GW | CHECKED BY: VAS

SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A

102 E. PIKES PEAK AVE. 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS: NO. | DATE: | BY: | DESCRIPTION: | APRV'D. 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

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soil amendments and rototill them into the soil to a depth of 6 inches or more.

Topsoil should be salvaged during grading operations for use and spread on areas to be revegetated later. Topsoil should be viewed as an important resource to be utilized for vegetation establishment, due to its water-holding capacity, structure, texture, organic matter content, biological activity, and nutrient content. The rooting depth of most native grasses in the semi-arid Denver metropolitan area is 6 to 18 inches. At a minimum, the upper 6 inches of topsoil should be stripped, stockpiled, and ultimately respread across areas that will be revegetated.

Where topsoil is not available, subsoils should be amended to provide an appropriate plant-growth medium. Organic matter, such as well digested compost, can be added to improve soil characteristics conducive to plant growth. Other treatments can be used to adjust soil pH conditions when needed. Soil testing, which is typically inexpensive, should be completed to determine and optimize the types and amounts of amendments that are required.

If the disturbed ground surface is compacted, rip or rototill the surface prior to placing topsoil. If adding compost to the existing soil surface, rototilling is necessary. Surface roughening will assist in placement of a stable topsoil layer on steeper slopes, and allow infiltration and root penetration to greater depth.

Prior to seeding, the soil surface should be rough and the seedbed should be firm, but neither too loose nor compacted. The upper layer of soil should be in a condition suitable for seeding at the proper depth and conducive to plant growth. Seed-to-soil contact is the key to good germination.

Seed Mix for Temporary Vegetation

To provide temporary vegetative cover on disturbed areas which will not be paved, built upon, or fully landscaped or worked for an extended period (typically 30 days or more), plant an annual grass appropriate for the time of planting and mulch the planted areas. Annual grasses suitable for the Denver metropolitan area are listed in Table TS/PS-1. These are to be considered only as general recommendations when specific design guidance for a particular site is not available. Local governments typically specify seed mixes appropriate for their jurisdiction.

Seed Mix for Permanent Revegetation

To provide vegetative cover on disturbed areas that have reached final grade, a perennial grass mix should be established. Permanent seeding should be performed promptly (typically within 14 days) after reaching final grade. Each site will have different characteristics and a landscape professional or the local jurisdiction should be contacted to determine the most suitable seed mix for a specific site. In lieu of a specific recommendation, one of the perennial grass mixes appropriate for site conditions and growth season listed in Table TS/PS-2 can be used. The pure live seed (PLS) rates of application recommended in these tables are considered to be absolute minimum rates for seed applied using proper drill-seeding equipment.

If desired for wildlife habitat or landscape diversity, shrubs such as rubber rabbitbrush (*Chrysothamnus nauseosus*), fourwing saltbush (*Atriplex canescens*) and skunkbrush sumac (*Rhus trilobata*) could be added to the upland seedmixes at 0.25, 0.5 and 1 pound PLS/acre, respectively. In riparian zones, planting root stock of such species as American plum (*Prunus americana*), woods rose (*Rosa woodsii*), plains cottonwood (*Populus sargentii*), and willow (*Populus spp.*) may be considered. On non-topsoiled upland sites, a legume such as Ladak alfalfa at 1 pound PLS/acre can be included as a source of nitrogen for perennial grasses.

Seeding dates for the highest success probability of perennial species along the Front Range are generally in the spring from April through early May and in the fall after the first of September until the ground freezes. If the area is irrigated, seeding may occur in summer months, as well. See Table TS/PS-3 for appropriate seeding dates.

Table TS/PS-1. Minimum Drill Seeding Rates for Various Temporary Annual Grasses

Species[a] (Common name)	Growth Season[b]	Pounds of Pure Live Seed (PLS)/acre[c]	Planting Depth (inches)
1. Oats	Cool	35 - 50	1 - 2
2. Spring wheat	Cool	25 - 35	1 - 2
3. Spring barley	Cool	25 - 35	1 - 2
4. Annual ryegrass	Cool	10 - 15	½
5. Millet	Warm	3 - 15	½ - ¾
6. Sudangrass	Warm	5–10	½ - ¾
7. Sorghum	Warm	5–10	½ - ¾
8. Winter wheat	Cool	20–35	1 - 2
9. Winter barley	Cool	20–35	1 - 2
10. Winter rye	Cool	20–35	1 - 2
11. Triticale	Cool	25–40	1 - 2

[a] Successful seeding of annual grass resulting in adequate plant growth will usually produce enough dead-plant residue to provide protection from wind and water erosion for an additional year. This assumes that the cover is not disturbed or mowed closer than 8 inches.

Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1 or where access limitations exist. When hydraulic seeding is used, hydraulic mulching should be applied as a separate operation, when practical, to prevent the seeds from being encapsulated in the mulch.

[b] See Table TS/PS-3 for seeding dates. Irrigation, if consistently applied, may extend the use of cool season species during the summer months.

[c] Seeding rates should be doubled if seed is broadcast, or increased by 50 percent if done using a Brillion Drill or by hydraulic seeding.

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses

Common[a] Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Alakali Soil Seed Mix					
Alkali sacaton	*Sporobolus airoides*	Cool	Bunch	1,750,000	0.25
Basin wildrye	*Elymus cinereus*	Cool	Bunch	165,000	2.5
Sodar streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Jose tall wheatgrass	*Agropyron elongatum 'Jose'*	Cool	Bunch	79,000	7.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.75**
Fertile Loamy Soil Seed Mix					
Ephriam crested wheatgrass	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	2.0
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Sodar streambank wheatgrass	*Agropyron riparium 'Sodar'*	Cool	Sod	170,000	2.5
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	7.0
Total					**15.5**
High Water Table Soil Seed Mix					
Meadow foxtail	*Alopecurus pratensis*	Cool	Sod	900,000	0.5
Redtop	*Agrostis alba*	Warm	Open sod	5,000,000	0.25
Reed canarygrass	*Phalaris arundinacea*	Cool	Sod	68,000	0.5
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Pathfinder switchgrass	*Panicum virgatum 'Pathfinder'*	Warm	Sod	389,000	1.0
Alkar tall wheatgrass	*Agropyron elongatum 'Alkar'*	Cool	Bunch	79,000	5.5
Total					**10.75**
Transition Turf Seed Mix[c]					
Ruebens Canadian bluegrass	*Poa compressa 'Ruebens'*	Cool	Sod	2,500,000	0.5
Dural hard fescue	*Festuca ovina 'duriuscula'*	Cool	Bunch	565,000	1.0
Citation perennial ryegrass	*Lolium perenne 'Citation'*	Cool	Sod	247,000	3.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Total					**7.5**

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses (cont.)

Common Name	Botanical Name	Growth Season[b]	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Sandy Soil Seed Mix					
Blue grama	*Bouteloua gracilis*	Warm	Sod-forming bunchgrass	825,000	0.5
Camper little bluestem	*Schizachyrium scoparium 'Camper'*	Warm	Bunch	240,000	1.0
Prairie sandreed	*Calamovilfa longifolia*	Warm	Open sod	274,000	1.0
Sand dropseed	*Sporobolus cryptandrus*	Cool	Bunch	5,298,000	0.25
Vaughn sideoats grama	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**10.25**
Heavy Clay, Rocky Foothill Seed Mix					
Ephriam crested wheatgrass[d]	*Agropyron cristatum 'Ephriam'*	Cool	Sod	175,000	1.5
Oahe Intermediate wheatgrass	*Agropyron intermedium 'Oahe'*	Cool	Sod	115,000	5.5
Vaughn sideoats grama[e]	*Bouteloua curtipendula 'Vaughn'*	Warm	Sod	191,000	2.0
Lincoln smooth brome	*Bromus inermis leyss 'Lincoln'*	Cool	Sod	130,000	3.0
Arriba western wheatgrass	*Agropyron smithii 'Arriba'*	Cool	Sod	110,000	5.5
Total					**17.5**

[a] All of the above seeding mixes and rates are based on drill seeding followed by crimped straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching should be done as a separate operation.

[b] See Table TS/PS-3 for seeding dates.

[c] If site is to be irrigated, the transition turf seed rates should be doubled.

[d] Crested wheatgrass should not be used on slopes steeper than 6H to 1V.

[e] Can substitute 0.5 lbs PLS of blue grama for the 2.0 lbs PLS of Vaughn sideoats grama.

Table TS/PS-3. Seeding Dates for Annual and Perennial Grasses

	Annual Grasses (Numbers in table reference species in Table TS/PS-1)		Perennial Grasses	
Seeding Dates	**Warm**	**Cool**	**Warm**	**Cool**
January 1–March 15			✓	✓
March 16–April 30	4	1,2,3	✓	✓
May 1–May 15	4		✓	
May 16–June 30	4,5,6,7			
July 1–July 15	5,6,7			
July 16–August 31				
September 1–September 30		8,9,10,11		
October 1–December 31			✓	✓

Mulch

Cover seeded areas with mulch or an appropriate rolled erosion control product to promote establishment of vegetation. Anchor mulch by crimping, netting or use of a non-toxic tackifier. See the Mulching BMP Fact Sheet for additional guidance.

Maintenance and Removal

Monitor and observe seeded areas to identify areas of poor growth or areas that fail to germinate. Reseed and mulch these areas, as needed.

An area that has been permanently seeded should have a good stand of vegetation within one growing season if irrigated and within three growing seasons without irrigation in Colorado. Reseed portions of the site that fail to germinate or remain bare after the first growing season.

Seeded areas may require irrigation, particularly during extended dry periods. Targeted weed control may also be necessary.

Protect seeded areas from construction equipment and vehicle access.

- Clean, weed-free and seed-free cereal grain straw should be applied evenly at a rate of 2 tons per acre and must be tacked or fastened by a method suitable for the condition of the site. Straw mulch must be anchored (and not merely placed) on the surface. This can be accomplished mechanically by crimping or with the aid of tackifiers or nets. Anchoring with a crimping implement is preferred, and is the recommended method for areas flatter than 3:1. Mechanical crimpers must be capable of tucking the long mulch fibers into the soil to a depth of 3 inches without cutting them. An agricultural disk, while not an ideal substitute, may work if the disk blades are dull or blunted and set vertically; however, the frame may have to be weighted to afford proper soil penetration.
- Grass hay may be used in place of straw; however, because hay is comprised of the entire plant including seed, mulching with hay may seed the site with non-native grass species which might in turn out-compete the native seed. Alternatively, native species of grass hay may be purchased, but can be difficult to find and are more expensive than straw. Purchasing and utilizing a certified weed-free straw is an easier and less costly mulching method. When using grass hay, follow the same guidelines as for straw (provided above).
- On small areas sheltered from the wind and heavy runoff, spraying a tackifier on the mulch is satisfactory for holding it in place. For steep slopes and special situations where greater control is needed, erosion control blankets anchored with stakes should be used instead of mulch.
- Hydraulic mulching consists of wood cellulose fibers mixed with water and a tackifying agent and should be applied at a rate of no less than 1,500 pounds per acre (1,425 lbs of fibers mixed with at least 75 lbs of tackifier) with a hydraulic mulcher. For steeper slopes, up to 2000 pounds per acre may be required for effective hydroseeding. Hydromulch typically requires up to 24 hours to dry; therefore, it should not be applied immediately prior to inclement weather. Application to roads, waterways and existing vegetation should be avoided.
- Erosion control mats, blankets, or nets are recommended to help stabilize steep slopes (generally 3:1 and steeper) and waterways. Depending on the product, these may be used alone or in conjunction with grass or straw mulch. Normally, use of these products will be restricted to relatively small areas. Biodegradable mats made of straw and jute, straw-coconut, coconut fiber, or excelsior can be used instead of mulch. (See the ECM/TRM BMP for more information.)
- Some tackifiers or binders may be used to anchor mulch. Check with the local jurisdiction for allowed tackifiers. Manufacturer's recommendations should be followed at all times. (See the Soil Binder BMP for more information on general types of tackifiers.)
- Rock can also be used as mulch. It provides protection of exposed soils to wind and water erosion and allows infiltration of precipitation. An aggregate base course can be spread on disturbed areas for temporary or permanent stabilization. The rock mulch layer should be thick enough to provide full coverage of exposed soil on the area it is applied.

Maintenance and Removal

After mulching, the bare ground surface should not be more than 10 percent exposed. Reapply mulch, as needed, to cover bare areas.

EROSION CONTROL CRITERIA:

EROSION CONTROL MEASURES SHALL BE IMPLEMENTED IN A MANNER THAT WILL PROTECT PROPERTIES AND PUBLIC FACILITIES FROM THE ADVERSE EFFECTS OF EROSION AND SEDIMENTATION AS A RESULT OF CONSTRUCTION AND EARTHWORK ACTIVITIES WITHIN THE PROJECT SITE.

1. PRIOR TO START OF GRADING OPERATIONS, LOCATE AND SET THE SEDIMENT BERM AND VEHICLE TRACKING CONTROL AS SHOWN ON THE EROSION CONTROL PLAN.
2. THE SILT FENCE SHALL BE KEPT IN PLACE AND MAINTAINED UNTIL EROSION AND SEDIMENTATION POTENTIAL IS MITIGATED. REMOVAL OF SILT AND SEDIMENT COLLECTED BY THE SILT FENCE IS REQUIRED ONCE IT REACHES HALF THE HEIGHT OF THE SILT FENCE.
3. EROSION CONTROL DEVICES SHOULD BE CHECKED AFTER EVERY STORM OR NOT MORE THAN EVERY 14 DAYS. REPAIRS OR REPLACEMENT SHOULD BE MADE AS NECESSARY TO MAINTAIN PROPER PROTECTION.

SOIL EROSION CONTROL MEASURES FOR ALL SLOPES, CHANNELS, DITCHES, OR ANY DISTURBED LAND AREA SHALL BE COMPLETED WITHIN TWENTY-ONE (21) CALENDAR DAYS AFTER FINAL GRADING, OR FINAL EARTH DISTURBANCE HAS BEEN COMPLETED. DISTURBED AREAS AND STOCKPILES WHICH ARE NOT AT THE FINAL GRADE BUT WILL REMAIN DORMANT FOR LONGER THAN 30 DAYS SHALL ALSO BE MULCHED WITHIN 21 DAYS AFTER INTERIM GRADING. AN AREA THAT IS GOING TO REMAIN IN AN INTERIM STATE FOR MORE THAN 60 DAYS SHALL ALSO BE SEEDED. ALL TEMPORARY SOIL EROSION CONTROL MEASURES AND BMP'S SHALL BE MAINTAINED UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IMPLEMENTED.

TIMBERLINE STORAGE YARD
GRADING AND EROSION CONTROL DETAILS

PROJECT NO. 43-095 | DATE: 03/05/2020 | SCALE: HORIZONTAL: N/A VERTICAL: N/A | SHEET 6 OF 18 | GR04

DESIGNED BY: GW
DRAWN BY: GW
CHECKED BY: VAS

102 E. PIKES PEAK AVE., 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

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

FOR AND ON BEHALF OF MACS CIVIL CONSULTANTS, INC.

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APRV'D.	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

EL PASO COUNTY FILE NO. PPR 19-042

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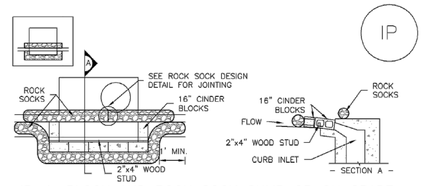


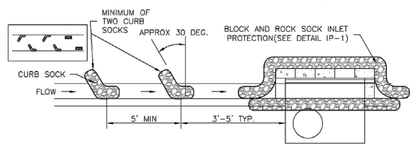
IP–1. BLOCK AND ROCK SOCK SUMP OR ON GRADE INLET PROTECTION

BLOCK AND CURB SOCK INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. CONCRETE "CINDER" BLOCKS SHALL BE LAID ON THEIR SIDES AROUND THE INLET IN A SINGLE ROW, ABUTTING ONE ANOTHER WITH THE OPEN END FACING AWAY FROM THE CURB.

3. GRAVEL BAGS SHALL BE PLACED AROUND CONCRETE BLOCKS, CLOSELY ABUTTING ONE ANOTHER AND JOINTED TOGETHER IN ACCORDANCE WITH ROCK SOCK DESIGN DETAIL.



IP–2. CURB ROCK SOCKS UPSTREAM OF INLET PROTECTION

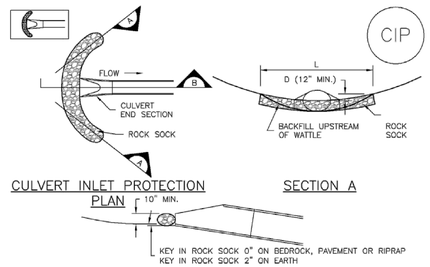
CURB ROCK SOCK INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL INSTALLATION REQUIREMENTS.

2. PLACEMENT OF THE SOCK SHALL BE APPROXIMATELY 30 DEGREES FROM PERPENDICULAR IN THE OPPOSITE DIRECTION OF FLOW.

3. SOCKS ARE TO BE FLUSH WITH THE CURB AND SPACED A MINIMUM OF 5 FEET APART.

4. AT LEAST TWO CURB SOCKS IN SERIES ARE REQUIRED UPSTREAM OF ON–GRADE INLETS.



CIP–1. CULVERT INLET PROTECTION

CULVERT INLET PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR
–LOCATION OF CULVERT INLET PROTECTION.

2. SEE ROCK SOCK DESIGN DETAIL FOR ROCK GRADATION REQUIREMENTS AND JOINTING DETAIL.

CULVERT INLET PROTECTION MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF THE CULVERT SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS ½ THE HEIGHT OF THE ROCK SOCK.

5. CULVERT INLET PROTECTION SHALL REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS PERMANENTLY STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

GENERAL INLET PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
–LOCATION OF INLET PROTECTION.
–TYPE OF INLET PROTECTION (IP.1, IP.2, IP.3, IP.4, IP.5, IP.6)

2. INLET PROTECTION SHALL BE INSTALLED PROMPTLY AFTER INLET CONSTRUCTION OR PAVING IS COMPLETE (TYPICALLY WITHIN 48 HOURS). IF A RAINFALL/RUNOFF EVENT IS FORECAST, INSTALL INLET PROTECTION PRIOR TO ONSET OF EVENT.

3. MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICITIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

INLET PROTECTION MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF INLET PROTECTION SHALL BE REMOVED AS NECESSARY TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN STORAGE VOLUME REACHES 50% OF CAPACITY, A DEPTH OF 6" WHEN SILT FENCE IS USED, OR ¾ OF THE HEIGHT FOR STRAW BALES.

5. INLET PROTECTION IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS PERMANENTLY STABILIZED, UNLESS THE LOCAL JURISDICTION APPROVES EARLIER REMOVAL OF INLET PROTECTION IN STREETS.

6. WHEN INLET PROTECTION AT AREA INLETS IS REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOP SOIL, SEEDED AND MULCHED, OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICITIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

NOTE: THE DETAILS INCLUDED WITH THIS FACT SHEET SHOW COMMONLY USED, CONVENTIONAL METHODS OF INLET PROTECTION IN THE DENVER METROPOLITAN AREA. THERE ARE MANY PROPRIETARY INLET PROTECTION METHODS ON THE MARKET. UDFCD NEITHER ENDORSES NOR DISCOURAGES USE OF PROPRIETARY INLET PROTECTION; HOWEVER, IN THE EVENT PROPRIETARY METHODS ARE USED, THE APPROPRIATE DETAIL FROM THE MANUFACTURER MUST BE INCLUDED IN THE SWMP AND THE BMP MUST BE INSTALLED AND MAINTAINED AS SHOWN IN THE MANUFACTURER'S DETAILS.

NOTE: SOME MUNICIPALITIES DISCOURAGE OR PROHIBIT THE USE OF STRAW BALES FOR INLET PROTECTION. CHECK WITH LOCAL JURISDICTION TO DETERMINE IF STRAW BALE INLET PROTECTION IS ACCEPTABLE.

IP-3. Rock Sock Inlet Protection for Sump/Area Inlet

IP-4. Silt Fence Inlet Protection for Sump/Area Inlet

IP-5. Over-excavation Inlet Protection

IP-6. Straw Bale Inlet Protection for Sump/Area Inlet

CIP-1. Culvert Inlet Protection

Propriety inlet protection devices should be installed in accordance with manufacturer specifications.

More information is provided below on selecting inlet protection for sump and on-grade locations.

Inlets Located in a Sump

When applying inlet protection in sump conditions, it is important that the inlet continue to function during larger runoff events. For curb inlets, the maximum height of the protective barrier should be lower than the top of the curb opening to allow overflow into the inlet during larger storms without excessive localized flooding. If the inlet protection height is greater than the curb elevation, particularly if the filter becomes clogged with sediment, runoff will not enter the inlet and may bypass it, possibly causing localized flooding, public safety issues, and downstream erosion and damage from bypassed flows.

Area inlets located in a sump setting can be protected through the use of silt fence, concrete block and rock socks (on paved surfaces), sediment control logs/straw wattles embedded in the adjacent soil and stacked around the area inlet (on pervious surfaces), over-excavation around the inlet, and proprietary products providing equivalent functions.

Inlets Located on a Slope

For curb and gutter inlets on paved sloping streets, block and rock sock inlet protection is recommended in conjunction with curb socks in the gutter leading to the inlet. For inlets located along unpaved roads, also see the Check Dam Fact Sheet.

Maintenance and Removal

Inspect inlet protection frequently. Inspection and maintenance guidance includes:

- Inspect for tears that can result in sediment directly entering the inlet, as well as result in the contents of the BMP (e.g., gravel) washing into the inlet.
- Check for improper installation resulting in untreated flows bypassing the BMP and directly entering the inlet or bypassing to an unprotected downstream inlet. For example, silt fence that has not been properly trenched around the inlet can result in flows under the silt fence and directly into the inlet.
- Look for displaced BMPs that are no longer protecting the inlet. Displacement may occur following larger storm events that wash away or reposition the inlet protection. Traffic or equipment may also crush or displace the BMP.
- Monitor sediment accumulation upgradient of the inlet protection.

- Remove sediment accumulation from the area upstream of the inlet protection, as needed to maintain BMP effectiveness, typically when it reaches no more than half the storage capacity of the inlet protection. For silt fence, remove sediment when it accumulates to a depth of no more than 6 inches. Remove sediment accumulation from the area upstream of the inlet protection as needed to maintain the functionality of the BMP.
- Propriety inlet protection devices should be inspected and maintained in accordance with manufacturer specifications. If proprietary inlet insert devices are used, sediment should be removed in a timely manner to prevent devices from breaking and spilling sediment into the storm drain.

Inlet protection must be removed and properly disposed of when the drainage area for the inlet has reached final stabilization.

STABILIZED CONSTRUCTION ENTRANCE/EXIT INSTALLATION NOTES

1. SEE PLAN VIEW FOR
–LOCATION OF CONSTRUCTION ENTRANCE(S)/EXIT(S).
–TYPE OF CONSTRUCTION ENTRANCE(S)/EXITS(S) (WITH/WITHOUT WHEEL WASH, CONSTRUCTION MAT OR TRM).

2. CONSTRUCTION MAT OR TRM STABILIZED CONSTRUCTION ENTRANCES ARE ONLY TO BE USED ON SHORT DURATION PROJECTS (TYPICALLY RANGING FROM A WEEK TO A MONTH) WHERE THERE WILL BE LIMITED VEHICULAR ACCESS.

3. A STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE LOCATED AT ALL ACCESS POINTS WHERE VEHICLES ACCESS THE CONSTRUCTION SITE FROM PAVED RIGHT–OF–WAYS.

4. STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.

5. A NON–WOVEN GEOTEXTILE FABRIC SHALL BE PLACED UNDER THE STABILIZED CONSTRUCTION ENTRANCE/EXIT PRIOR TO THE PLACEMENT OF ROCK.

6. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.

STABILIZED CONSTRUCTION ENTRANCE/EXIT MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY TO THE STABILIZED ENTRANCE/EXIT TO MAINTAIN A CONSISTENT DEPTH.

5. SEDIMENT TRACKED ONTO PAVED ROADS IS TO BE REMOVED THROUGHOUT THE DAY AND AT THE END OF THE DAY BY SHOVELING OR SWEEPING. SEDIMENT MAY NOT BE WASHED DOWN STORM SEWER DRAINS.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM CITY OF BROOMFIELD, COLORADO, NOT AVAILABLE IN AUTOCAD)

EL PASO COUNTY FILE NO. PPR 19–042

TIMBERLINE STORAGE YARD
GRADING AND EROSION CONTROL DETAILS

PROJECT NO. 43–095 | DATE: 03/05/2020 | SCALE: HORIZONTAL: N/A VERTICAL: N/A | SHEET 7 OF 18 | GR05

DESIGNED BY: GW
DRAWN BY: GW
CHECKED BY: VAS

102 E. PIKES PEAK AVE. 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160
FOR AND ON BEHALF OF MVS CIVIL CONSULTANTS, INC.

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APRV'D. BY:	DATE:

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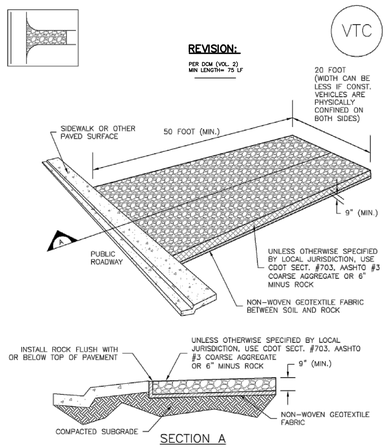
CAUTION

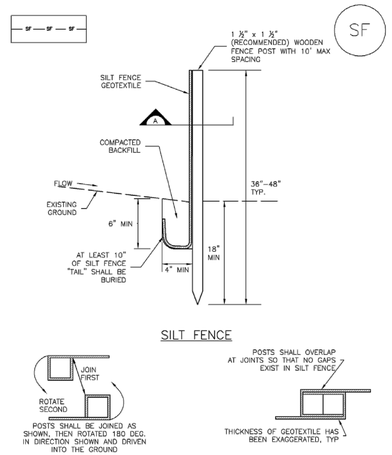
File: C:\Users\cpierce\Documents\43-095\dwg\43095_GRADING PLAN details.dwg Plotstamp: 3/5/2020 1:29 PM

Vehicle Tracking Control (VTC) SM-4



VTC-1. AGGREGATE VEHICLE TRACKING CONTROL

Silt Fence (SF) SC-1



SF-1. SILT FENCE

SC-1 Silt Fence (SF)

SILT FENCE INSTALLATION NOTES

1. SILT FENCE MUST BE PLACED AWAY FROM THE TOE OF THE SLOPE TO ALLOW FOR WATER PONDING. SILT FENCE AT THE TOE OF A SLOPE SHOULD BE INSTALLED IN A FLAT LOCATION AT LEAST SEVERAL FEET (2-5 FT) FROM THE TOE OF THE SLOPE TO ALLOW ROOM FOR PONDING AND DEPOSITION.

2. A UNIFORM 6" X 4" ANCHOR TRENCH SHALL BE EXCAVATED USING TRENCHER OR SILT FENCE INSTALLATION DEVICE. NO ROAD GRADERS, BACKHOES, OR SIMILAR EQUIPMENT SHALL BE USED.

3. COMPACT ANCHOR TRENCH BY HAND WITH A "JUMPING JACK" OR BY WHEEL ROLLING. COMPACTION SHALL BE SUCH THAT SILT FENCE RESISTS BEING PULLED OUT OF ANCHOR TRENCH BY HAND.

4. SILT FENCE SHALL BE PULLED TIGHT AS IT IS ANCHORED TO THE STAKES. THERE SHOULD BE NO NOTICEABLE SAG BETWEEN STAKES AFTER IT HAS BEEN ANCHORED TO THE STAKES.

5. SILT FENCE FABRIC SHALL BE ANCHORED TO THE STAKES USING 1" HEAVY DUTY STAPLES OR NAILS WITH 1" HEADS. STAPLES AND NAILS SHOULD BE PLACED 3" ALONG THE FABRIC DOWN THE STAKE.

6. AT THE END OF A RUN OF SILT FENCE ALONG A CONTOUR, THE SILT FENCE SHOULD BE TURNED PERPENDICULAR TO THE CONTOUR TO CREATE A "J-HOOK." THE "J-HOOK" EXTENDING PERPENDICULAR TO THE CONTOUR SHOULD BE OF SUFFICIENT LENGTH TO KEEP RUNOFF FROM FLOWING AROUND THE END OF THE SILT FENCE (TYPICALLY 10' - 20').

7. SILT FENCE SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.

SILT FENCE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF THE SILT FENCE SHALL BE REMOVED AS NEEDED TO MAINTAIN THE FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY 6".

5. REPAIR OR REPLACE SILT FENCE WHEN THERE ARE SIGNS OF WEAR, SUCH AS SAGGING, TEARING, OR COLLAPSE.

6. SILT FENCE IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION, OR IS REPLACED BY AN EQUIVALENT PERIMETER SEDIMENT CONTROL BMP.

7. WHEN SILT FENCE IS REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

T-6 Sand Filter

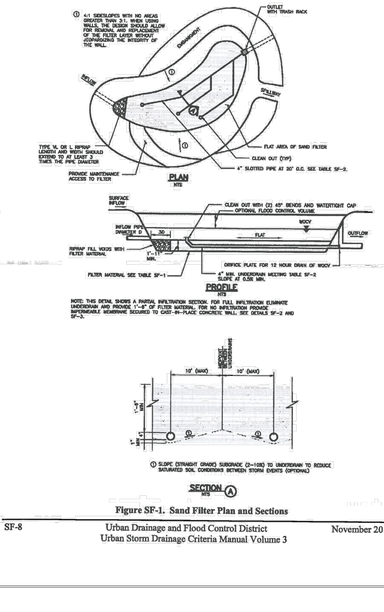


Figure SF-1. Sand Filter Plan and Sections

SC-1 Silt Fence (SF)

SILT FENCE INSTALLATION NOTES

1. SILT FENCE MUST BE PLACED AWAY FROM THE TOE OF THE SLOPE TO ALLOW FOR WATER PONDING. SILT FENCE AT THE TOE OF A SLOPE SHOULD BE INSTALLED IN A FLAT LOCATION AT LEAST SEVERAL FEET (2-5 FT) FROM THE TOE OF THE SLOPE TO ALLOW ROOM FOR PONDING AND DEPOSITION.

2. A UNIFORM 6" X 4" ANCHOR TRENCH SHALL BE EXCAVATED USING TRENCHER OR SILT FENCE INSTALLATION DEVICE. NO ROAD GRADERS, BACKHOES, OR SIMILAR EQUIPMENT SHALL BE USED.

3. COMPACT ANCHOR TRENCH BY HAND WITH A "JUMPING JACK" OR BY WHEEL ROLLING. COMPACTION SHALL BE SUCH THAT SILT FENCE RESISTS BEING PULLED OUT OF ANCHOR TRENCH BY HAND.

4. SILT FENCE SHALL BE PULLED TIGHT AS IT IS ANCHORED TO THE STAKES. THERE SHOULD BE NO NOTICEABLE SAG BETWEEN STAKES AFTER IT HAS BEEN ANCHORED TO THE STAKES.

5. SILT FENCE FABRIC SHALL BE ANCHORED TO THE STAKES USING 1" HEAVY DUTY STAPLES OR NAILS WITH 1" HEADS. STAPLES AND NAILS SHOULD BE PLACED 3" ALONG THE FABRIC DOWN THE STAKE.

6. AT THE END OF A RUN OF SILT FENCE ALONG A CONTOUR, THE SILT FENCE SHOULD BE TURNED PERPENDICULAR TO THE CONTOUR TO CREATE A "J-HOOK." THE "J-HOOK" EXTENDING PERPENDICULAR TO THE CONTOUR SHOULD BE OF SUFFICIENT LENGTH TO KEEP RUNOFF FROM FLOWING AROUND THE END OF THE SILT FENCE (TYPICALLY 10' - 20').

7. SILT FENCE SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.

SILT FENCE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF THE SILT FENCE SHALL BE REMOVED AS NEEDED TO MAINTAIN THE FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY 6".

5. REPAIR OR REPLACE SILT FENCE WHEN THERE ARE SIGNS OF WEAR, SUCH AS SAGGING, TEARING, OR COLLAPSE.

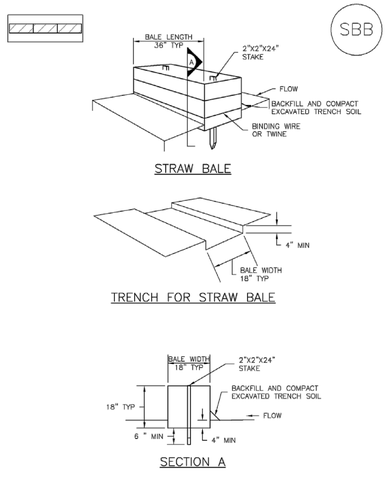
6. SILT FENCE IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION, OR IS REPLACED BY AN EQUIVALENT PERIMETER SEDIMENT CONTROL BMP.

7. WHEN SILT FENCE IS REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

SC-3 Straw Bale Barrier (SBB)



SBB-1. STRAW BALE

Straw Bale Barrier (SBB) SC-3

STRAW BALE INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   -LOCATION(S) OF STRAW BALES.

2. STRAW BALES SHALL CONSIST OF CERTIFIED WEED FREE STRAW OR HAY. LOCAL JURISDICTIONS MAY REQUIRE PROOF THAT BALES ARE WEED FREE.

3. STRAW BALES SHALL CONSIST OF APPROXIMATELY 5 CUBIC FEET OF STRAW OR HAY AND WEIGH NOT LESS THAN 35 POUNDS.

4. WHEN STRAW BALES ARE USED IN SERIES AS A BARRIER, THE END OF EACH BALE SHALL BE TIGHTLY ABUTTING ONE ANOTHER.

5. STRAW BALE DIMENSIONS SHALL BE APPROXIMATELY 36"X18"X18".

6. A UNIFORM ANCHOR TRENCH SHALL BE EXCAVATED TO A DEPTH OF 4". STRAW BALES SHALL BE PLACED SO THAT BINDING TWINE IS ENCOMPASSING THE VERTICAL SIDES OF THE BALE(S). ALL EXCAVATED SOIL SHALL BE PLACED ON THE UPHILL SIDE OF THE STRAW BALE(S) AND COMPACTED.

7. TWO (2) WOODEN STAKES SHALL BE USED TO HOLD EACH BALE IN PLACE. WOODEN STAKES SHALL BE 2"X2"X24". WOODEN STAKES SHALL BE DRIVEN 6" INTO THE GROUND.

STRAW BALE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. STRAW BALES SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED, ROTTEN, OR DAMAGED BEYOND REPAIR.

5. SEDIMENT ACCUMULATED UPSTREAM OF STRAW BALE BARRIER SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY ¼ OF THE HEIGHT OF THE STRAW BALE BARRIER.

6. STRAW BALES ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

7. WHEN STRAW BALES ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Sand Filter T-6

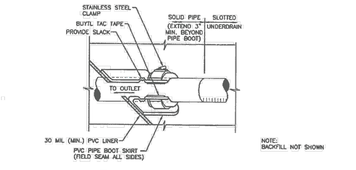


Figure SF-2. Geomembrane Liner/Underdrain Penetration Detail

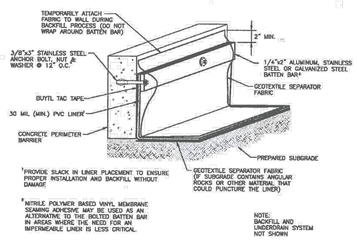


Figure SF-3. Geomembrane Liner/Concrete Connection Detail

EL PASO COUNTY FILE NO. PPR 19-042

TIMBERLINE STORAGE YARD
GRADING AND EROSION CONTROL DETAILS

PROJECT NO. 43-095 | SCALE: HORIZONTAL: N/A VERTICAL: N/A | DATE: 03/05/2020 | SHEET 8 OF 18 | GR06

DESIGNED BY: GW
DRAWN BY: GW
CHECKED BY: VAS

102 E. PIKES PEAK AVE. 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS: NO. | DATE: | BY: | DESCRIPTION: | APRV'D. 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

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- **Turf Reinforcement Mat (TRM)**: A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh, and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.

Tables RECP-1 and RECP-2 provide guidelines for selecting rolled erosion control products appropriate to site conditions and desired longevity. Table RECP-1 is for conditions where natural vegetation alone will provide permanent erosion control, whereas Table RECP-2 is for conditions where vegetation alone will not be adequately stable to provide long-term erosion protection due to flow or other conditions.

Table RECP-1. ECTC Standard Specification for Temporary Rolled Erosion Control Products
(Adapted from Erosion Control Technology Council 2005)

Product Description	Slope Applications*		Channel Applications*	Minimum Tensile Strength[1]	Expected Longevity
	Maximum Gradient	C Factor[2,3]	Max. Shear Stress[3,4,6]		
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft^2 (12 Pa)	5 lbs/ft (0.073 kN/m)	Up to 12 months
Netless Rolled Erosion Control Blankets	4:1 (H:V)	≤0.10 @ 4:1	0.5 lbs/ft^2 (24 Pa)	5 lbs/ft (0.073 kN/m)	
Single-net Erosion Control Blankets & Open Weave Textiles	3:1 (H:V)	≤0.15 @ 3:1	1.5 lbs/ft^2 (72 Pa)	50 lbs/ft (0.73 kN/m)	
Double-net Erosion Control Blankets	2:1 (H:V)	≤0.20 @ 2:1	1.75 lbs/ft^2 (84 Pa)	75 lbs/ft (1.09 kN/m)	
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft^2 (12 Pa)	25 lbs/ft (0.36 kN/m)	24 months
Erosion Control Blankets & Open Weave Textiles (slowly degrading)	1.5:1 (H:V)	≤0.25 @ 1.5:1	2.00 lbs/ft^2 (96 Pa)	100 lbs/ft (1.45 kN/m)	24 months
Erosion Control Blankets & Open Weave Textiles	1:1 (H:V)	≤0.25 @ 1:1	2.25 lbs/ft^2 (108 Pa)	125 lbs/ft (1.82 kN/m)	36 months

* C Factor and shear stress for mulch control nettings must be obtained with netting used in conjunction with pre-applied mulch material. (*See Section 5.3 of Chapter 7 Construction BMPs for more information on the C Factor.*)

[1] Minimum Average Roll Values, Machine direction using ECTC Mod. ASTM D 5035.

[2] C Factor calculated as ratio of soil loss from RECP protected slope (tested at specified or greater gradient, H:V) to ratio of soil loss from unprotected (control) plot in large-scale testing.

[3] Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in) soil loss) during a 30-minute flow event in large-scale testing.

[4] The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.01 - 0.05.

[5] Acceptable large-scale test methods may include ASTM D 6459, or other independent testing deemed acceptable by the engineer.

[6] Per the engineer's discretion. Recommended acceptable large-scale testing protocol may include ASTM D 6460, or other independent testing deemed acceptable by the engineer.

Table RECP-2. ECTC Standard Specification for Permanent[1] Rolled Erosion Control Products
(Adapted from: Erosion Control Technology Council 2005)

Product Type	Slope Applications	Channel Applications	
TRMs with a minimum thickness of 0.25 inches (6.35 mm) per ASTM D 6525 and UV stability of 80% per ASTM D 4355 (500 hours exposure).	Maximum Gradient	Maximum Shear Stress[4,5]	Minimum Tensile Strength[2,3]
	0.5:1 (H:V)	6.0 lbs/ft^2 (288 Pa)	125 lbs/ft (1.82 kN/m)
	0.5:1 (H:V)	8.0 lbs/ft^2 (384 Pa)	150 lbs/ft (2.19 kN/m)
	0.5:1 (H:V)	10.0 lbs/ft^2 (480 Pa)	175 lbs/ft (2.55 kN/m)

[1] For TRMs containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.

[2] Minimum Average Roll Values, machine direction only for tensile strength determination using ASTM D 6818 (Supersedes Mod. ASTM D 5035 for RECPs)

[3] Field conditions with high loading and/or high survivability requirements may warrant the use of a TRM with a tensile strength of 44 kN/m (3,000 lb/ft) or greater.

[4] Required minimum shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in.) soil loss) during a 30-minute flow event in large scale testing.

[5] Acceptable large-scale testing protocols may include ASTM D 6460, or other independent testing deemed acceptable by the engineer.

Design and Installation

RECPs should be installed according to manufacturer's specifications and guidelines. Regardless of the type of product used, it is important to ensure no gaps or voids exist under the material and that all corners of the material are secured using stakes and trenching. Continuous contact between the product and the soil is necessary to avoid failure. Never use metal stakes to secure temporary erosion control products. Often wooden stakes are used to anchor RECPs; however, wood stakes may present installation and maintenance challenges and generally take a long time to biodegrade. Some local jurisdictions have had favorable experiences using biodegradable stakes.

This BMP Fact Sheet provides design details for several commonly used ECB applications, including:

ECB-1 Pipe Outlet to Drainageway

ECB-2 Small Ditch or Drainageway

ECB-3 Outside of Drainageway

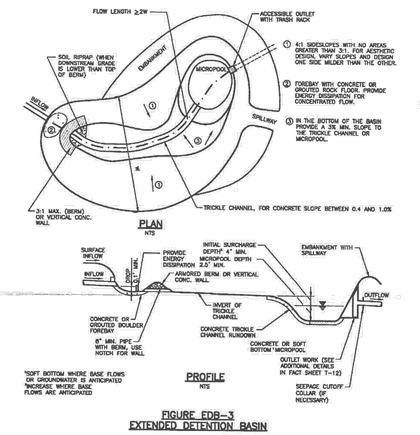


Figure EDB-3. Extended Detention Basin (EDB) Plan and Profile

Additional Details are provided in BMP Fact Sheet T-12. This includes outlet structure details including orifice plates and trash racks.

STABILIZED STAGING AREA MAINTENANCE NOTES

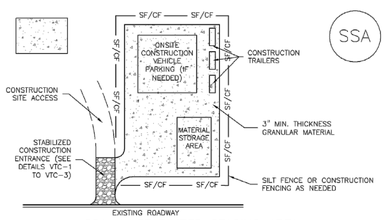
5. STABILIZED STAGING AREA SHALL BE ENLARGED IF NECESSARY TO CONTAIN PARKING, STORAGE, AND UNLOADING/LOADING OPERATIONS.

6. THE STABILIZED STAGING AREA SHALL BE REMOVED AT THE END OF CONSTRUCTION. THE GRANULAR MATERIAL SHALL BE REMOVED OR, IF APPROVED BY THE LOCAL JURISDICTION, USED ON SITE, AND THE AREA COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

NOTE: MANY MUNICIPALITIES PROHIBIT THE USE OF RECYCLED CONCRETE AS GRANULAR MATERIAL FOR STABILIZED STAGING AREAS DUE TO DIFFICULTIES WITH RE-ESTABLISHMENT OF VEGETATION IN AREAS WHERE RECYCLED CONCRETE WAS PLACED.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)



SSA-1. STABILIZED STAGING AREA

STABILIZED STAGING AREA INSTALLATION NOTES

1. SEE PLAN VIEW FOR
   -LOCATION OF STAGING AREA(S).
   -CONTRACTOR MAY ADJUST LOCATION AND SIZE OF STAGING AREA WITH APPROVAL FROM THE LOCAL JURISDICTION.

2. STABILIZED STAGING AREA SHOULD BE APPROPRIATE FOR THE NEEDS OF THE SITE. OVERSIZING RESULTS IN A LARGER AREA TO STABILIZE FOLLOWING CONSTRUCTION.

3. STAGING AREA SHALL BE STABILIZED PRIOR TO OTHER OPERATIONS ON THE SITE.

4. THE STABILIZED STAGING AREA SHALL CONSIST OF A MINIMUM 3" THICK GRANULAR MATERIAL.

5. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.

6. ADDITIONAL PERIMETER BMPs MAY BE REQUIRED INCLUDING BUT NOT LIMITED TO SILT FENCE AND CONSTRUCTION FENCING.

STABILIZED STAGING AREA MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY IF RUTTING OCCURS OR UNDERLYING SUBGRADE BECOMES EXPOSED.

Minimizing Long-Term Stabilization Requirements

- Utilize off-site parking and restrict vehicle access to the site.
- Use construction mats in lieu of rock when staging is provided in an area that will not be disturbed otherwise.
- Consider use of a bermed contained area for materials and equipment that do not require a stabilized surface.
- Consider phasing of staging areas to avoid disturbance in an area that will not be otherwise disturbed.

See Detail SSA-1 for a typical stabilized staging area and SSA-2 for a stabilized staging area when materials staging in roadways is required.

Maintenance and Removal

Maintenance of stabilized staging areas includes maintaining a stable surface cover of gravel, repairing perimeter controls, and following good housekeeping practices.

When construction is complete, debris, unused stockpiles and materials should be recycled or properly disposed. In some cases, this will require disposal of contaminated soil from equipment leaks in an appropriate landfill. Staging areas should then be permanently stabilized with vegetation or other surface cover planned for the development.

EL PASO COUNTY FILE NO. PPR 19-042

TIMBERLINE STORAGE YARD
GRADING AND EROSION CONTROL DETAILS
PROJECT NO. 43-095 | SCALE: HORIZONTAL: N/A VERTICAL: N/A | DATE: 03/05/2020 | SHEET 9 OF 18 | GR07
DESIGNED BY: GW DRAWN BY: GW CHECKED BY: VAS

102 E. PIKES PEAK AVE., 5TH FLOOR
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

FOR AND ON BEHALF OF MVS CIVIL CONSULTANTS, INC.

REVISIONS: NO. | DATE | BY | DESCRIPTION | APRV'D. BY | DATE

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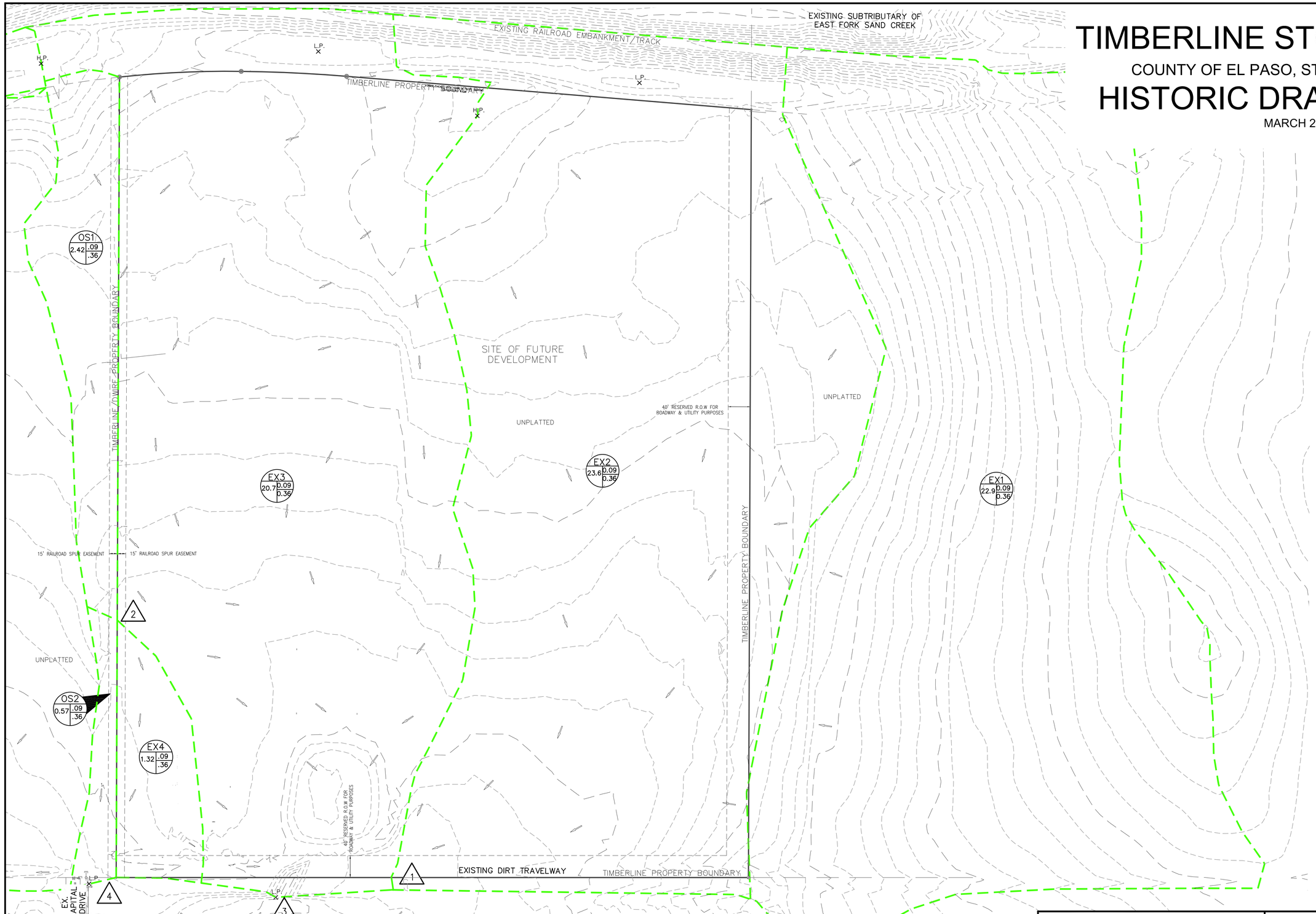
PROPOSED/EXISTING DRAINAGE MAP

TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

HISTORIC DRAINAGE MAP

MARCH 2020



LEGEND

BASIN DESIGNATION — Z; ACRES — 25; C5 — .25; C100 — .35

- 6 — SURFACE DESIGN POINT (DP)
- BASIN BOUNDARY
- (6920) — EXISTING CONTOUR
- PARCEL BOUNDARY
- EXISTING FLOW DIRECTION ARROW
- H.P. — HIGH POINT
- L.P. — LOW POINT

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
EX1	22.93	7.6	51.0
EX2	23.63	5.0	33.6
EX3	20.71	4.2	28.4
EX4	1.32	0.4	2.7
OS1	2.42	0.8	5.1
OS2	0.57	0.2	1.3
OS3	12.72	3.6	24.4
OS4	0.66	0.2	1.6
OS5	3.19	1.0	6.7
OS6	0.36	0.1	0.7

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN & DES. PTS
1	11.5	77.3	EX1,EX2
2	0.7	4.4	OS1
3	14.2	95.4	DP1,DP2,EX3
4	0.6	3.8	EX4,OS2
5	0.2	1.6	OS4
6	0.8	5.5	OS5
7	3.1	20.8	OS3,OS6

1" = 80'

0 40 80 160

Scale in Feet

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M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

TIMBERLINE STORAGE YARD

EXISTING DRAINAGE MAP

PROJECT NO. 43-095	SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A	DATE: 03/4/2020	
DESIGNED BY: GT DRAWN BY: CMN CHECKED BY: VAS		SHEET 1 OF 2	EDM

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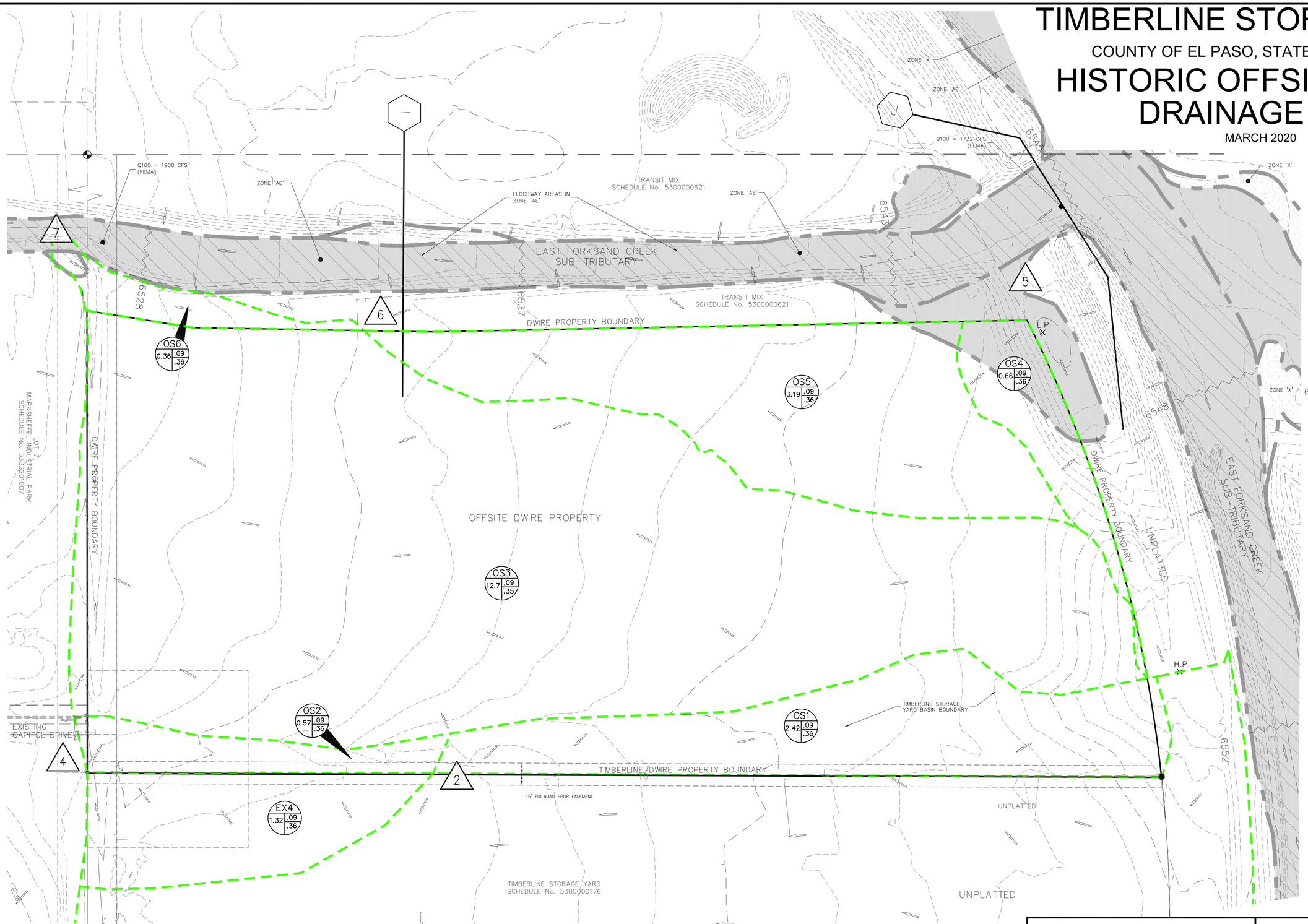
TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

HISTORIC OFFSITE DWIRE DRAINAGE MAP

MARCH 2020



LEGEND

BASIN DESIGNATION — Z; 25 (ACRES); .25 (C5); .35 (C100)

- SURFACE DESIGN POINT (DP)
- BASIN BOUNDARY
- TIMBERLINE STORAGE YARD BASIN BOUNDARY
- (6920) EXISTING INDEX CONTOUR (10')
- EXISTING NOMINAL CONTOUR (2')
- 6920 FEMA BASE FLOOD EL. (NGVD29)
- DWIRE STORAGE YARD SITE BOUNDARY
- EXISTING FLOW DIRECTION ARROW
- H.P. HIGH POINT
- L.P. LOW POINT
- FEMA CROSS SECTION ID

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
EX1	22.93	7.6	51.0
EX2	23.63	5.0	33.6
EX3	20.71	4.2	28.4
EX4	1.32	0.4	2.7
OS1	2.42	0.8	5.1
OS2	0.57	0.2	1.3
OS3	12.72	3.6	24.4
OS4	0.66	0.2	1.6
OS5	3.19	1.0	6.7
OS6	0.36	0.1	0.7

DESIGN POINT SUMMARY			
DESIGN POINT	Q_5	Q_{100}	BASIN & DES. PTS
1	11.5	77.3	EX1,EX2
2	0.7	4.4	OS1
3	14.2	95.4	DP1,DP2,EX3
4	0.6	3.8	EX4,OS2
5	0.2	1.6	OS4
6	0.8	5.5	OS5
7	3.1	20.8	OS3,OS6

1" = 60'

0 30 60 120

Scale in Feet

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

TIMBERLINE STORAGE YARD

HISTORIC OFFSITE DWIRE DRAINAGE MAP

PROJECT NO. 43-117

SCALE: HORIZONTAL: 1"=60' VERTICAL: N/A

DATE: 3/4/2020

DESIGNED BY: GT
DRAWN BY: DLM
CHECKED BY: VAS

SHEET 2 OF 2

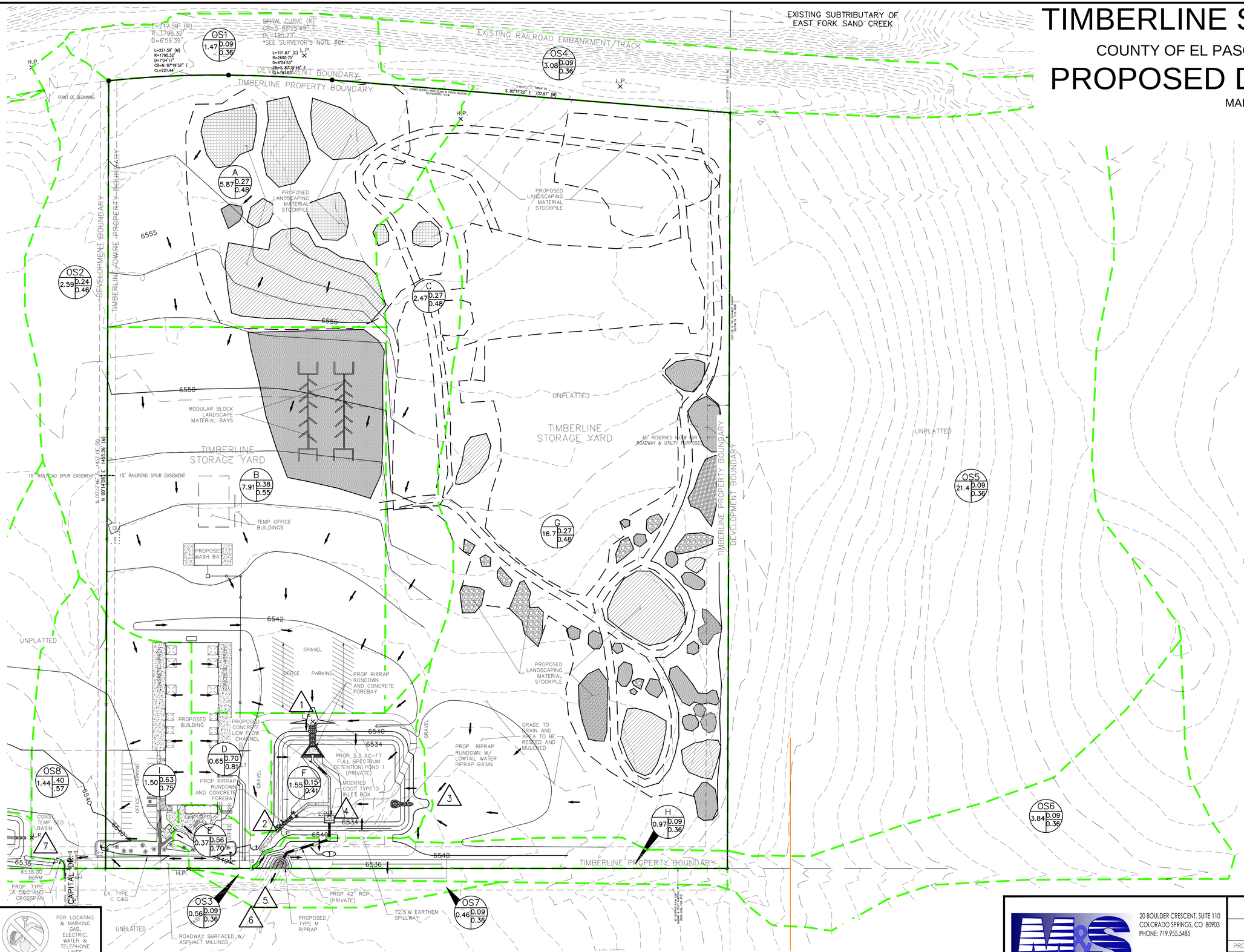
EDM

TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

MARCH 2020



LEGEND

- BASIN DESIGNATION — Z; ACRES — 25; C5 — .25; C100 — .35
- PIPE RUN (PR) REFERENCE LABEL — 4
- SURFACE DESIGN POINT (DP) — 6
- BASIN BOUNDARY
- (6920) EXISTING CONTOUR
- PROP CONTOUR
- PARCEL BOUNDARY
- TIMBERLINE STORAGE YARD SITE BOUNDARY
- STORM SEWER PIPE
- FUTURE STORM SEWER PIPE
- INLET
- FUTURE INLET
- EXISTING FLOW DIRECTION ARROW
- EMERGENCY OVERFLOW DIRECTION
- FLOW DIRECTION
- FLARED END SECTION
- H.P. HIGH POINT
- L.P. LOW POINT
- CROSSPAN

1" = 80'

0 40 80 160

Scale in Feet

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	5.87	5.8	17.3
B	7.91	10.4	25.9
C	2.47	2.3	6.9
D	0.65	2.3	4.6
E	0.37	0.9	1.8
F	1.55	0.9	4.4
G	16.67	13.6	40.9
H	0.97	0.4	2.5
I	1.50	4.9	9.8
OS1	1.47	0.4	2.8
OS2	2.59	2.2	7.0
OS3	0.56	0.2	1.2
OS4	3.08	1.0	6.6
OS5	21.36	6.6	44.4
OS6	3.84	1.0	6.4
OS7	0.46	0.2	1.2
OS8	1.44	2.1	5.2

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	16.0	45.6	OS1, OS2, A, B, C	RIPRAP RUNDOWN INTO FULL-SPECTRUM DETENTION POND
2	2.8	5.6	D, E	RIPRAP RUNDOWN INTO FSD POND
3	20.4	85.9	G, OS4, OS5	RIPRAP RUNDOWN INTO FSD POND
4	36.4	127.6	F, DP1, DP2, DP3	TOTAL FLOW TO FSD
5	0.4	71.5	PR1	PROP FSD POND RELEASE
6	1.8	80.6	H, OS3, OS7, OS6, PR1	EXISTING SWALE
7	3.6	13.0	I, OS8	DWIRE POND

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING BASIN/DP/STR
1	0.4	71.5	42" RCP	POND OUTFALL

POND 1 FULL SPECTRUM DETENTION BASIN DATA

SPILLWAY CREST EL=6538.50
TOP OF EMBANKMENT EL=6540.20
100-YR VOLUME=2.721 AC-FT
100-YR INFLOW=123.9 CFS
100-YR RELEASE=71.5 CFS
WQ WATER SURFACE EL=6533.40
WQ VOLUME=0.623 AC-FT.
EURV WATER SURFACE EL=6534.51
EURV VOLUME=1.350 AC-FT
100-YR WATER SURFACE EL=6536.31

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M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

TIMBERLINE STORAGE YARD

PROPOSED DRAINAGE MAP

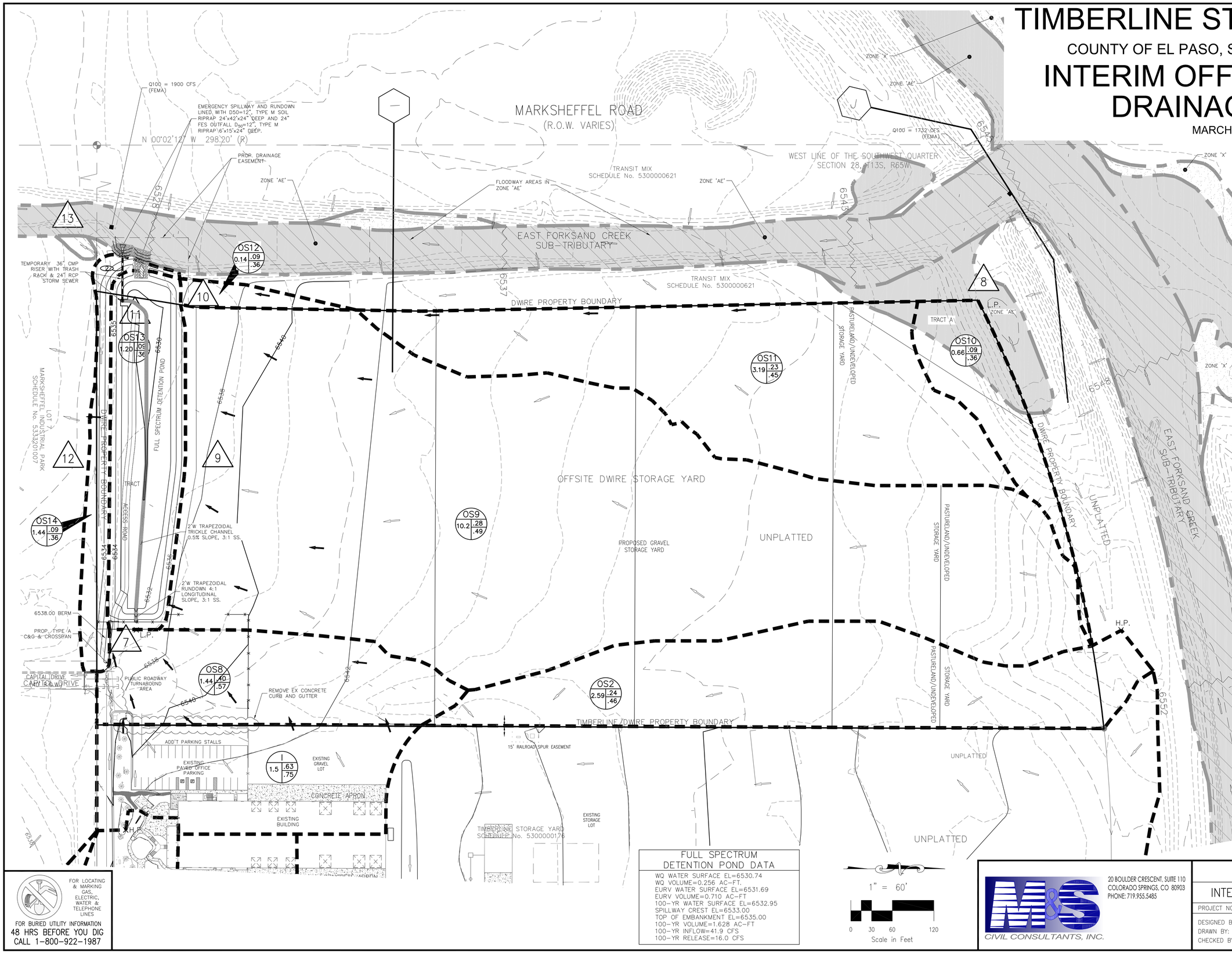
PROJECT NO. 43-095
SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A
DATE: 3/4/2020
DESIGNED BY: GT
DRAWN BY: CMN
CHECKED BY: VAS
SHEET 1 OF 2
PDM

TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

INTERIM OFFSITE DWIRE DRAINAGE MAP

MARCH 2020



LEGEND

- BASIN DESIGNATION — Z; 25 (ACRES); .25 (C5); .35 (C100)
- 4 — PIPE RUN REFERENCE LABEL
- 6 — SURFACE DESIGN POINT (DP)
- PROPOSED BASIN BOUNDARY
- TIMBERLINE STORAGE YARD BASIN BOUNDARY
- (6920) — EXISTING CONTOUR
- 6920 — PROPOSED CONTOUR
- PROPOSED FENCE
- PROPOSED STORM SEWER PIPE
- DWIRE STORAGE YARD SITE BOUNDARY
- 6920 — FEMA BASE FLOOD EL. (NGVD29)
- FLARED END SECTION
- INLET/OUTLET STRUCTURE
- PROPOSED RIPRAP
- PERMANENT EROSION CONTROL BLANKET
- EXISTING FLOW DIRECTION ARROW
- PROPOSED FLOW DIRECTION
- EMERGENCY SPILLWAY OVERFLOW DIRECTION
- H.P. — HIGH POINT
- L.P. — LOW POINT
- FEMA CROSS SECTION ID

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
I	1.50	4.9	9.8
OS2	2.59	2.2	7.0
OS8	1.44	2.1	5.2
OS9	10.24	9.3	27.3
OS10	0.66	0.2	1.6
OS11	3.19	2.5	8.4
OS12	0.14	0.0	0.3
OS13	1.2	0.3	2.3
OS14	1.44	0.5	3.6

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN & DES. PTS
7	3.6	13.0	BASIN I,OS8
8	0.2	1.6	OS10
9	9.3	27.3	OS9
10	2.6	8.7	OS11,OS12
11	15.3	49.4	OS13,DP7,DP9,DP10
12	0.5	3.6	OS14
13	0.4	16.0	TEMP DWIRE FSD POND RELEASE

PIPE RUN SUMMARY

PIPE RUN	Q_5	Q_{100}	CONTRIBUTING DES. PTS, STRUCTURES
2	0.4	16.0	TEMP DWIRE FSD OUTLET STRUCTURE

FULL SPECTRUM DETENTION POND DATA

WQ WATER SURFACE EL=6530.74
WQ VOLUME=0.256 AC-FT.
EURV WATER SURFACE EL=6531.69
EURV VOLUME=0.710 AC-FT
100-YR WATER SURFACE EL=6532.95
SPILLWAY CREST EL=6533.00
TOP OF EMBANKMENT EL=6535.00
100-YR VOLUME=1.628 AC-FT
100-YR INFLOW=41.9 CFS
100-YR RELEASE=16.0 CFS

1" = 60'

0 30 60 120
Scale in Feet

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

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

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TIMBERLINE STORAGE YARD

INTERIM OFFSITE DWIRE DRAINAGE MAP

PROJECT NO. 43-117
DESIGNED BY: GT
DRAWN BY: DLM
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=60' VERTICAL: N/A
DATE: 3/4/2020
SHEET 2 OF 2
PDM