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Final Drainage Report

Mulligan Pines Subdivision

Replat of Lot 15 Pine Creek Subdivision Filing No. 2

Project Number 51478

July 31, 2020

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Final Drainage Report

for

Mulligan Pines Subdivision
Replat of Lot 15 Pine Creek Subdivision Filing No. 2

Project No. 51478

July 31, 2020

prepared for

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9735 Brassie Court
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prepared by

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Statements and Acknowledgments

Engineer's Statement

This report and plan for the drainage design of Mulligan Pines Subdivision was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

____ ________________

David R. Gorman, P.E. Colorado No. 31672 Date
For and on Behalf of MVE, Inc.

Developer's Statement

Cascade Financial International, LLC hereby certifies that the drainage facilities for Mulligan Pines Subdivision shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Mulligan Pines Subdivision, guarantee that final drainage design review will absolve Cascade Financial International, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

____ ________________

Barry Farah Date
Cascade Financial International, LLC
9735 Brassie Court
Colorado Springs, CO 80920

City of Colorado Springs Statement

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

____ ________________

for the City Engineer Date
City of Colorado Springs

Conditions:

Contents

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the Mulligan Pines Subdivision being a Replat of Lot 15 Pine Creek Subdivision Filing No. 2. The owner intends to create a three-lot residential subdivision form the existing lot and make the lots available for single family residential construction. This report is presented as part of the Development Plan and Replat applications for the site. The report presents the stormwater management issues specific to this site and discusses the aspects of the drainage design that addresses those issues. The report and included maps present results of the final hydrologic and drainage facility sizing and analyses. The report recommends drainage improvements to the site and identifies drainage requirements relative to the proposed development. This report has been prepared and submitted in accordance with the requirements of the City of Colorado Springs Development Plan approval process and in conformance with the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2. An **Appendix** is included with this report with pertinent calculations and data used in the drainage analysis.

1 General Location and Description

1.1 Location

Proposed Mulligan Pines Subdivision project site consists of Replat of Lot 15 Pine Creek Subdivision Filing No. 2 having El Paso County Tax ID number 62283-05-004. The site is located within the Southwest ¼ of Section 28, Township 12 South, Range 66 West of the 6^{th} Principal Meridian in the City of Colorado Springs, El Paso County, Colorado. The site is situated on the north side of Mulligan Drive, between Brassie Court and Chapel Hills Drive. A **Vicinity Map** is included in the **Appendix**.

Mulligan Pines Subdivision is 1.61 acres in area and is zoned R1-9/CR DF (Single-Family Residential, 9000 SF Lots with Conditions of Record and Design Flexibility Overlay). The south side of the site is adjacent to Mulligan Drive, a 36 foot wide improved asphalt surfaced public street with Type 1 concrete curb and gutter in a 60 foot wide right-of-way (collector). Lots 4-6 Pine Creek Subdivision Filing No. 2 (zoned R1-9/CR DF) lies to the south of Mulligan Drive. Lot 16, Pine Creek Subdivision Filing No. 2, the site of an existing residence (zoned R1-9/CR DF) is adjacent to the site on the west side. Brassie Court is a 28 foot wide improved asphalt surfaced public street with Type 1 concrete curb and gutter in a 50 foot wide right-of-way (local residential) is also adjacent to the site on the northwest corner along with Lot 19, Pine Creek Subdivision Filing No. 2 (zoned R1-9/CR DF). Lot 1 Martinez Place subdivision (zoned R) is located along the north side of the site. Lot 14, Pine Creek Subdivision Filing No. 2 lies east of the site and has an existing residence zoned R1-9/CR DF.

1.2 Description of Property

The Mulligan Pines Subdivision is currently platted as Lot 15, Pine Creek Subdivision Filing No. 2 and contain no existing improvements. The site contains existing native vegetation consisting dense evergreen trees, native grasses and low-lying brush. All ground cover is in fair to good condition. The site contains a northeast to southwest running ridge so that there are two general directions of runoff drainage in the site. The northwesterly portion of the site slopes northwest towards Brassie

Court at slopes ranging from 3% to 33%. The southeast portion drains south towards Mulligan Drive at slopes ranging from 18% to 35%.

Pine Creek is located approximately 600 feet south of the site and flows from northeast to southwest. A golf course is located between the creek and residential lots located along the south side of Mulligan Drive. Pine Creek has a FEMA designated flood plain with Base Flood Elevations determined. The floodplain does not extend into the site. A public storm drain system has inlets at low points in Brassie Court and Mulligan Drive and pipes that convey collected flows towards Pine Creek on the south. The site is located on near the north edge of the Pine Creek Major Drainage Basin, which drains into Monument Creek to the west.

According to the National Resource Conservation Service, the soil in the Mulligan Pines Subdivision site is made up of one soil type. The Tomhah-Crowfoot complex (map unit 93) is contained in Hydrologic Soil Group B. The Tomah component of the complex is deep and well drained. Permeability is moderately rapid, surface runoff is medium, and the hazard of erosion is moderate. The Crowfoot component is also deep and well drained. Permeability is moderate, surface runoff is medium slow, and the hazard of erosion is moderate. An NRCS summary report containing a soil map and data tables from the National Cooperative Soil Survey and relevant Official Soil Series Descriptions (OSD) are included in the **Appendix**.[1] [2]

A soils report for the site was prepared by American Geoservices titled “Geotechnical & Geologic Hazards Evaluation Report, 2150 Mulligan Drive, Colorado Springs, CO 80920, Parcel 6228305004, Lot 1, Lot 2, Lot 3” dated July 22, 2020.[3] The report address potential geologic and soil hazards with regard to residential construction on the lots and includes slope stability analyses and a recommended minimum building setback line due to the geologic conditions. The conclusion is that the lots are appropriate for proposed use provided that the procedures, recommendations and mitigation measures contained in the report are followed. Drainage recommendations are made regarding micro-drainage conditions around the proposed residential structures which will be followed by the future home builders. The proposed building envelopes shown on the Development Plan are located outside of the recommended minimum building setback line.

The current Flood Insurance Study of the region includes a Flood Insurance Rate Map (FIRM), effective on December 7, 2018.[4] The proposed subdivision is included in Community Panel Number 08041C0506 G of the Flood Insurance Rate Maps for El Paso County and Incorporated Areas. No portion of the site lies within FEMA designated Special Flood Hazard Areas (SFHA's). An excerpt of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the **Appendix**.

The proposed replat will create three single family residential lots in place of the one existing lot. Lot 1 will contain 0.672 acres, Lot 2 will be 0.530 acres and Lot 3 will be 0.409 acres in area. Lot 1 will have access from Brassie Court on the west, utilizing the existing shared driveway access point with adjacent Lot 16 Pine Creek Subdivision Filing No. 2. Lots 2 and 3 will access Mulligan Drive with new driveway access points. Building Envelopes are designated on each lot by on the Development Plan. Total potential area of disturbance for all three lots, including building envelopes and driveway accesses, is less than 0.5 acres. The majority of the existing topography, trees and ground cover are to be preserved in the developed conditions in keeping with the surrounding neighborhood. No overlot grading or clearing will occur on the site and disturbance during residential construction will be kept to a minimum. Drainage runoff is anticipated to drain according to the same sub-basin delineations and patterns as in existing conditions.

1.3 Referenced Drainage Reports

The Mulligan Pines Subdivision site and the surrounding areas have been studied in previous drainage reports which were referenced and reviewed in the preparation of this report as listed below:

1 WSS
2 OSD
3 Geotech Report
4 FIRM

The Pine Creek Drainage Basin Planning Study (DBPS) was prepared in 1988 by Obering, Wurth & Associates.[5] This report established flow rates in Pine Creek with the concept of a golf course adjacent to the creek along with regional detention facility at Briargate Parkway. The site is located in sub-basin 20 of the DBPS. No public drainage improvements are recommended in or near the site in this report.

The Pine Creek DBPS was amended three times since the original report. On July 29, 1992 Obering, Wurth & Associates prepared a report titled "Amendment No. 1 to Pine Creek Drainage Basin Planning Study as approved by City Council 12/18/88, & as approved by El Paso County Commissioners 8/25/88".[6] This report added an upstream regional detention facility and updated the requirements for the downstream regional detention facility. The second amendment was from October 1998 by JR Engineering, Ltd. and titled Amendment No. 2 to Pine Creek Drainage Basin Planning Study and Master Development Drainage Plan for Pine Creek Subdivision (Portion Contributing to Pine Creek).[7] This report added more detention within the basin and updated the hydrology. "Amendment No. 3 to Pine Creek Drainage Basin Planning Study and Master Development Drainage Plan for the Pine Creek and Cordera Neighborhoods (Portions Contributing to Pine Creek) was also prepared by JR Engineering and dated February 2003. This report accounted for changes to the development characteristics in the basin and updated the hydrologic for sub-basins and Pine Creek reaches.[8] The most recent amendment was prepared in February 2012 and relates to a retrofit of a detention facility that is non-tributary to the project site or immediate downstream areas.

The site was included in "Addendum to Pine Creek Subdivision Filing No. 1, Drainage Report & Plan(MDDP, PDR & FDR)" by Obering, Wurth & Associates dated January, 1992, which was a precursor to the Pine Creek Subdivision Filing No. 2 Final Drainage Letter.[9]

The site was originally platted and developed as a part of Pine Creek Subdivision Filing No. 2. The report titled Preliminary & Final Drainage Letter and Plan, Pine Creek Subdivision Filing No. 2 was prepared by Obering, Wurth & Associates in September 1992.[10] The site is contained within sub-basins I-5 and I-6 in this report which indicates the storm drainage system in Brassie Court and Mulligan Drive draining to Pine Creek to the south. The Brassie Court and Mulligan Drive streets and drainage system were installed in accordance with this 1992 drainage report.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The Mulligan Pines Subdivision project site is located in the northwestern portion of the Pine Creek Major Drainage Basin lying south of the Kettle Creek drainage basin and north of the South Pine Creek drainage basin in northeast Colorado Springs. The Pine Creek Major Drainage Basin is approximately 3200 acres extending approximately 17 miles east of Voyager Parkway (Colorado State Highway 83). As previously mentioned, the Pine Creek Major Drainage Basin was studied by Drainage Basin Planning Studies and Amendments. The Basin drains to Pine Creek flowing northeast to southwest which drains to Monument Creek west of Interstate 25.

2.2 Sub-Basin Description

The existing site is divided into two sub-basins separated by the ridge that is aligned from northeast to southwest through the property. A small offsite sub-basin drains to the northeast corner of the site. No other offsite sub-basins contribute flows to the site. The Existing Drainage Map is included in the **Appendix** which shows elevation contours, drainage basin delineations and existing drainage basin data.

5 1988 MDDP-Obering Wurth
6 1992 DBPS Update-Obering Wurth
7 1998 DBPS Update-JR
8 2003 DBPS Update-JR
9 1992 MDDP-Obering Wurth
10 1992 Drainage Report-Obering Wurth

Existing sub-basin EX-A1 is located at the northwest portion of the site and drains east towards Brassie Court. Sub-basin EX-A1 consists of mostly pervious open space with native trees and vegetation, but also the paved driveway serving adjacent Lot 16, Pine Creek Subdivision Filing No. 2. Flows from this sub-basin exit offsite into Brassie Court and continue southwest in the street to a low point containing two sump catch basins.

Existing offsite sub-basins EX-OSB1 contains a small area of adjacent yard and roof near the northeast corner of the site. This sub-basin drains south into sub-basin EX-B2 and combines with the flows traveling south towards Mulligan Drive.

Existing sub-basin EX-B2 is the majority of the southeastern portion of the site and consists of pervious open space with native trees and vegetation. This sub-basin accepts the offsite flows from EX-OSB1 and the combined flows drain south into Mulligan Drive. Once offsite, the flows continue to flow in the street to a low point contain catch basins in sump condition. The flows continue south in both pipe flow and overland flow to Pine Creek located approximately 600 feet to the south. More detailed sub-basin descriptions for the existing sub-basins are discussed in the sections below.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for Mulligan Pines Subdivision has been prepared according to the report guidelines presented in the *City of Colorado Springs Drainage Criteria Manual* (DCM)[11]. The hydrologic analysis is based on a collection of data from the DCM, the NCSS Web Soil Survey[12], Topographic mapping from FIMS, and proposed layout developed by the owner. Construction projects that disturb less than 1.0 acres in area are not required by City of Colorado Springs Drainage Criteria to provide water quality treatment with Water Quality Capture Volume (WQCV) for the disturbed area. Mulligan Pines Subdivision will have a total disturbance area of less than ½ acre with water quality treatment not required.

3.2 Hydrologic Criteria

For this Final Drainage Report, the Rational Method as described in the *City of Colorado Springs Drainage Criteria Manual* has been used for the onsite Storm Runoff calculations, as the development and onsite sub-basins are less than 130 acres in area. “Colorado Springs Rainfall Intensity Duration Frequency” curves, Figure 6-5 in the DCM, was used to obtain the design rainfall values; a copy is included in the **Appendix**. The “Overland (Initial) Flow Equation” (Eq. 6-8) in the DCM, and Manning's equation with estimated depths were used in time of concentration calculations. “Runoff Coefficients for Rational Method”, Table 6-6 in the DCM, was utilized as a guide in estimating runoff coefficient and Percent Impervious values; a copy is included in the **Appendix**. Peak runoff discharges were calculated for each drainage sub-basin for both the 5-year storm event and the 100-year storm event with the Rational Method formula, (Eq. 6-5) in the DCM.[13]

The existing storm drain inlets downstream of the site were analyzed using UDFCD UD-Inlet. Storm Drain Hydraulic Grade Lines for the existing offsite storm drain system were calculated for the the 5-year and 100-year rainfall events using UDFCD UD-Sewer using the standard method. The pipes were verified contain the 5-year contributing flows with no surcharging. The calculations for the storm drain inlets and piping is included in the **Appendix** of this report.

11 DCM Section 4.3 and Section 4.4
12 WSS
13 DCM

4 Drainage Facility Design

4.1 General Concept

The existing site is a vacant existing platted lot that is to be replatted into three single-family residential lots. The adjacent Brassie Court and Mulligan Drive roadways were constructed in 1993 including the storm drain inlets and pipes that collect and convey flows from the the streets to the outfall leading to Pine Creek on the south. The onsite and offsite drainage basins that contribute flow to the existing storm drain system were analyzed using current drain criteria. It is found that elements of the storm drain system are undersized in the existing and proposed developed Major Storm scenario (100-year rainfall event) due to changes in the criteria and due to hydrologic assumptions made at the time of the system design. However, flows are conveyed to the outfall point in an adequate and safe manner. The project will add two residences in the property that was originally platted for one residence. The increases in flows from the existing undeveloped site to the developed condition are small with regard to the total flows in Brassie Court and Mulligan Drive from the surrounding neighborhood. The intent of the drainage concept presented in this Final Drainage Report for the Mulligan Pines Subdivision project is to utilize the existing site grades and storm drainage infrastructure, including storm drain inlets and storm drain piping to deliver the onsite and offsite storm runoff to the outflow point as intended in the previously approved and drainage reports and construction plans for the site.

The two onsite drainage sub-basins, together with the one directly-contributing offsite sub-basin, were analyzed to determine the flows generated by the site. The sub-basins contributing to the offsite drainage inlets and pipes were also analyzed according to the general basin delineations indicated in the Pine Creek Subdivision Filing No. 2 Final Drainage Report.[14] These sub-basins include the project site. Input data and results for all calculations are included in the **Appendix**. Drainage maps of existing and proposed conditions, as well as the offsite areas are also included in the **Appendix**. The existing drainage conditions and the proposed drainage concept is described in more detail below.

4.2 Sub-Basin Specific Details

Existing Conditions

Existing Sub-Basin EX-A1 - Existing sub-basin EX-A1, comprising the northwestern portion of the replat site, is 0.60 acres in area and consists of mostly pervious open space with native trees and vegetation along with paved driveway serving adjacent Lot 16 Pine Creek Subdivision Filing No. 2. Existing sub-basin EX-A1 generates peak discharges of Q_5 = 0.3 cfs and Q_{100} = 1.7 cfs that drains offsite to the west and into Brassie Court. These flows continue to flow southwest in Brassie Court to a low spot in the roadway located approximately 180 feet west of the site. The flows join the flows from the surrounding neighborhood as contained in sub-basins E-1 and I-5 at Design Point A (DP A).

Existing Design Point A (DP A)

Sub-Basin E-1 is 3.6 acres in area and is located north of the site and contains a portion of Springcrest Filing No. 2. Sub-basin E-5 drains to the northeast terminus of Brassie Court with peak runoff discharges of Q_5 = 1.8 cfs and Q_{100} = 8.8 cfs. These flows combine with the discharges from sub-basin I-5 and continue southwest in Brassie Court to the low point which is designated Design Point A in the Pine Creek Subdivision Filing No. 2 Final Drainage Report.

Sub-Basin I-5 contains portions of Pine Creek Subdivision Filing No. 2 that drain to Brassie Court, including the area of onsite Sub-Basin EX-A1. The area of sub-basin I-5 is 4.2 acres. This sub-basin produces peak storm runoff discharges of Q_5 = 4.7 cfs and Q_{100} = 14.1 cfs that converge at the low point in Brassie Court, joining the flows from sub-basin E-1 with combined peak discharges of Q_5 = 5.9 cfs and Q_{100} = 21.2 cfs at DP A. Two public 5' city standard D-10R inlets collect all the flows at DP A. A public 20" diameter steel storm drain pipe conveys the flows south, between Lots 17 & 18 Pine Creek Subdivision Filing No. 2, to an existing public Type 1 Manhole on the south edge of

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Mulligan Drive. Depths of ponding at DP A are 0.4' in the 5-year event and 1.6' in the 100-year event. The depth of ponding in the 100-year event is due to flow conditions in the downstream pipe. The ponding is contained within the street right-of-way. Flows continue east in an existing public 24" RC Pipe storm drain to a public 6' city standard D-10R inlet at a low point on the south side of Mulligan Drive, joining other runoff in sub-basin I-6 at Design Point B (DP B).

Existing Offsite Sub-Basin EX-OSB1 - Existing offsite sub-basin EX-OSB1, is located north of the northeast corner of the site and contains a portion of Lot 1 Martinez Place subdivision with natural yard area and portion of the residential roof. The sub-basin is 0.09 acres in area and drains south, directly into the site at sub-basin EX-B2 with peak discharges of Q_5 = 0.1 cfs and Q_{100} = 0.4 cfs. These flows join the flows from sub-basin EX-B2 and continue to flow south to Mulligan Drive.

Existing Sub-Basin EX-B2 - Existing sub-basin EX-B2 comprises the southern and eastern portions of the property, separated from sub-basin EX-A1 by the ridge line that runs northeast to southwest through the site. This sub-basin is 1.01 acres in area and contains open space vegetated with the natural coniferous trees, native grasses and brush. The sub-basin accepts the flows from EX-OSB1 and drains generally to the south towards Mulligan Drive with peak discharges of Q_5 = 0.4 cfs and Q_{100} = 2.9 cfs. Combined discharges of Q_5 = 0.5 cfs and Q_{100} = 3.2 cfs enter Mulligan Drive and flow to the low point located approximately 125 feet east of the southwest corner of the site which is designated Design Point B (DP B) in the Pine Creek Subdivision Filing No. 2 Final Drainage Report.[15] Offsite flows from other parts of the sub-basin I-6 and sub-basin E-2 converge at DP B.

Existing Design Point B (DP B)

Sub-Basin E-2 is 7.5 acres located northeast of the site that drains south towards Mulligan Drive and into sub-basin I-6. This sub-basin contains 2 ½ acre rural residential development and a portion of the Skyline recreational trail. Sub-basin E-2 generates flows of Q_5 = 3.5 cfs and Q_{100} = 17.7 cfs which joins flows from sub-basin I-6 as they enter Mulligan Drive towards DP B.

Sub-Basin I-6 contains a portion of Pine Creek Subdivision Filing No. 2 that drains to Mulligan Drive, including the area of onsite Sub-Basin EX-B2. Sub-basin E-2 also flows into I-6. The area of sub-basin I-6 is 7.6 acres. This sub-basin produces peak storm runoff discharges of Q_5 = 10.0 cfs and Q_{100} = 27.3 cfs that joins the flows from sub-basin E-2 as is enters Mulligan Drive. Combined peak discharges of Q_5 = 12.7 cfs and Q_{100} = 42.7 cfs converge at the DP B low point in Mulligan Drive as surface flows. Two public 6' city standard D-10R inlets collect flows of Q_5 = 12.7 cfs and Q_{100} = 36.4 cfs. The 100-year flow collected by the inlets is limited by the flow conditions in the downstream public 24" RC Pipe, causing overflow of excess stormwater to the 20' drainage easement south of the roadway. The inlets collect all of the 5-year discharges but in the 100-year event, 22.5 cfs overflows the south curb in a 20' drainage easement located between Lot 4 Lot 5 of Pine Creek Subdivision Filing No. 2 as provided for in the previous 1992 Final Drainage Report. This surface flow path downstream of DP B is landscaped, well stabilized and well maintained with no indication of erosion. Depths of ponding at DP B are 6.5" in the 5-year event and 1.0 feet in the 100-year event. The flows collected at DP B join the piped flows collected and conveyed from DP A in the existing public 24" RC Pipe also located inside the 20' drainage easement. The existing combined flows in the pipe are Q_5 = 18.6 cfs and Q_{100} = 57.6 cfs. The piped flows are discharged at the south boundary of Pine Creek Subdivision Filing No. 2 at Design Point C (DP C) where they are joined by the overflows from DP B.

Existing Design Point C (DP C)

The piped flows from DP B that exits the public 24" RC Pipe Flared End Section at DP C are joined by the overflows from DP B flowing on the ground surface in the 20' drainage easement. The combined flows at DP C are Q_5 = 16.9 cfs and Q_{100} = 58.9 cfs. These flows enter a pond located within the Pine Creek Golf Course where they join additional offsite flows and continue to flow south to Pine Creek. The flow pathways downstream of DP C are landscaped, well stabilized and well maintained with no indication of erosion.

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Proposed Conditions

Sub-Basin A1 - Sub-basin A1, comprising the northwestern portion of the replat site, contains the building envelope for Lot 1 along with the new driveway extension to the structure. The remaining portions of the site will consist of landscaped area and pervious open space with native trees and vegetation. The sub-basin area will remain at 0.60 acres as in existing conditions. Sub-basin A1 generates developed peak discharges of Q_5 = 0.7 cfs and Q_{100} = 2.2 cfs that drains offsite to the west and into Brassie Court. The developed discharges represent insignificant increases in flow of 0.4 cfs in the 5-year event and 0.5 cfs in the 100-year rainfall event. The depth of ponding in the 100-year event is due to flow conditions in the downstream pipe. The developed flows continue to flow southwest in Brassie Court to the low spot in the roadway located approximately 180 feet west of the site. The flows join the flows from the surrounding neighborhood as contained in sub-basins E-1 and I-5 at Design Point A (DP A).

Design Point A (DP A)

Sub-Basin E-1 will remain unchanged in the developed condition and will continue to deliver peak runoff discharges of Q_5 = 1.8 cfs and Q_{100} = 8.8 cfs to the northeast terminus of Brassie Court. These flows combine with the discharges from sub-basin I-5 and continue southwest in Brassie Court to the low point designated Design Point A in the Pine Creek Subdivision Filing No. 2 Final Drainage Report.

Sub-Basin I-5 contains portions of Pine Creek Subdivision Filing No. 2 that drain to Brassie Court, including the area of onsite sub-basin A1 discussed above. The area of sub-basin I-5 will remain at 4.2 acres as in existing conditions. The developed sub-basin produces peak storm runoff discharges of Q_5 = 5.2 cfs and Q_{100} = 14.7 cfs. This represents an increase in flow of 0.5 cfs in the 5-year rainfall event and 0.6 cfs in the 100-year event due to the single-family residential construction in proposed Lot 1. The flows from sub-basin I-5 converge at the low point in Brassie Court, joining the flows from sub-basin E-1 with combined peak discharges of Q_5 = 6.3 cfs and Q_{100} = 21.7 cfs at DP A. This is an increases of 0.4 cfs in the 5-year rainfall event and 0.5 cfs in the 100-year event. The two existing public 5' city standard D-10R inlets collect all the flows at DP A. Depths of ponding at DP A are 0.4' in the 5-year event and 2.0' in the 100-year event. The depth of ponding in the 100-year event is due to flow conditions in the downstream pipe. The ponding is contained within the street right-of-way. An existing public 20” diameter steel storm drain pipe conveys the flows south, between Lots 17 & 18 Pine Creek Subdivision Filing No. 2, to an existing public Type 1 Manhole on the south edge of Mulligan Drive. Flows continue east in an existing public 24” RC Pipe storm drain to a public 6' city standard D-10R inlet at a low point on the south side of Mulligan Drive, joining other runoff in sub-basin I-6 at Design Point B (DP B).

Offsite Sub-Basin OSB1 - Offsite sub-basin OSB1 will remain the same as described for the existing conditions with no changes. Sub-basin OSB1 drains south into onsite sub-basin B2 with peak discharges of Q_5 = 0.1 cfs and Q_{100} = 0.4 cfs, which join the flows from sub-basin B2 and continue to flow south to Mulligan Drive.

Sub-Basin B2 - Sub-basin B2 comprises the southern and eastern portions of the property as described for existing conditions and will remain 1.01 acres in area. The sub-basin will contain the building envelopes for proposed Lot 2 and Lot 3 of the replat along with the paved driveways extending from Mulligan Drive. The balance of the sub-basin will be composed of landscaping and open space vegetated with the natural coniferous trees, native grasses and brush. The sub-basin accepts the flows from OSB1 and drains generally to the south towards Mulligan Drive with peak discharges of Q_5 = 1.5 cfs and Q_{100} = 4.3 cfs, being minor increases of 1.1 cfs and 1.5 cfs for the 5-year and 100-year rainfall events respectively. Combined discharges of Q_5 = 1.6 cfs and Q_{100} = 4.7 cfs enter Mulligan Drive and flow to the low point located approximately 125 feet east of the southwest corner of the site which is designated Design Point B (DP B) in the Pine Creek Subdivision Filing No. 2 Final Drainage Report.[16] This represents an increase of 1.1 cfs in the 5-year event and 1.5 cfs in the 100-year event. Offsite flows from other parts of the sub-basins I-6 and E-2 converge at DP B.

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Design Point B (DP B)

Sub-Basin E-2 will remain unchanged in the developed condition and will continue to deliver peak runoff discharges of Q_5 = 3.5 cfs and Q_{100} = 17.7 cfs which join with flows from sub-basin I-6 as they enter Mulligan Drive and flow to DP B.

Sub-Basin I-6 contains a portion of Pine Creek Subdivision Filing No. 2 that drains to Mulligan Drive, including the area of onsite Sub-Basin B2. Sub-basin E-2 also flows into I-6. The area of sub-basin I-6 will remain 7.6 acres in the developed condition. Developed I-6 produces peak storm runoff discharges of Q_5 = 10.9 cfs and Q_{100} = 28.6 cfs that joins the flows from sub-basin E-2 as is enters Mulligan Drive. Combined peak discharges of Q_5 = 13.4 cfs and Q_{100} = 43.6 cfs converge at the DP B low point in Mulligan Drive as surface flows. This is a minor increase of Q_5 = 0.7 cfs and Q_{100} = 0.9 cfs over existing conditions. Two public 6' city standard D-10R inlets collect flows of Q_5 = 13.4 cfs and Q_{100} = 36.4 cfs with the 100-year flow collection being limited by flow conditions in the downstream public 24” RC Pipe. The inlets collect all of the 5-year discharges, but in the 100-year event, 25.0 cfs overflows the south curb in a 20' drainage easement located between Lot 4 Lot 5 of Pine Creek Subdivision Filing No. 2 as provided for in the previous 1992 Final Drainage Report. This surface flow path downstream of DP B is landscaped, well stabilized and well maintained with no indication of erosion. The flows collected at DP B join the piped flows collected and conveyed from DP A in the existing public 24” RC Pipe also located inside the 20' drainage easement. The combined flows in the pipe are Q_5 = 19.7 cfs and Q_{100} = 57.6 cfs. The piped flows are discharged at the south boundary of Pine Creek Subdivision Filing No. 2 at Design Point C (DP C) where they are joined by the overflows from DP B.

Existing Design Point C (DP C)

The piped flows from DP B that exits the public 24” RC Pipe Flared End Section at DP C are joined by the overflows from DP B flowing on the ground surface in the 20' drainage easement. The combined flows at DP C are Q_5 = 18.6 cfs and Q_{100} = 61.4 cfs, representing minor flow increases of Q_5 = 1.7 cfs and Q_{100} = 2.5 cfs . These flows enter a pond located within the Pine Creek Golf Course where they join additional offsite flows and continue to flow south to Pine Creek. The flow pathways downstream of DP C are landscaped, well stabilized and well maintained with no indication of erosion.

4.3 Drainage Facilities

The existing drainage facilities downstream of the site consist of City of Colorado Springs D10R inlets, steel pipe (installed by boring) and Reinforced Concrete Pipe (RCP) as described in the section above. No new drainage facilities are proposed for this project. The existing inlets were analyzed using the UDFCD Inlet worksheets, which are included in the **Appendix**. The Hydraulic Grade Line calculations for the storm drain pipe system for the existing and developed 5-year and 100-year scenarios were performed using UDFCD UD-Sewer. The HGL calculations for the storm drain system are included in the **Appendix**.

4.4 Water Quality Enhancement Best Management Practices

The City of Colorado Springs Drainage Criteria Manual provides that sites with less than 1.0 acres of disturbance are not required to provide water quality treatment with Water Quality Capture Volume (WQVC). No provisions for water quality treatment will be made for the Mulligan Pines Subdivision.

4.4.1 Four Step Process

The City of Colorado Springs Drainage Criteria Manual Volume 2 (DCM v2) requires the consideration of a “Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long term source controls”.[17] The Four Step Process is incorporated in the project and the elements are discussed below.

17 DCM Vol 2 Chapt 1

1) Runoff reduction practices for the site is accomplished by the provision of significant open space and landscaped areas on the site. Significant portions of each lot is to be preserved in the existing natural condition with the establishment of designated building envelopes in keeping wit the characteristics of the surrounding neighborhood. Drainage from single-family residential roofs, patios and walkways will drain onto adjacent landscaped areas or the natural undisturbed open areas, providing elements of Minimized Directly Connected Impervious Areas (MDCIA) before exiting the site into the adjacent public rights-of-way and the public drainage system.

2) The City of Colorado Springs Drainage Criteria Manual provides that sites with less than 1.0 acres of disturbance are not required to provide water quality treatment with Water Quality Capture Volume (WQVC). No provisions for water quality treatment will be made for the Mulligan Pines Subdivision.

3) There are no significant open drainageways on the site. The disturbed areas within the site will be landscaped and reseeded with the construction of the residences. Flows from the site drain into the existing paved public streets and storm drains. Areas downstream of the site which receive surface flows from the surrounding drainage sub-basins have flow pathways that are landscaped, well stabilized and well maintained with no indication of erosion. No further stabilization is required.

4) The site contains no outdoor storage areas or storage of potentially harmful substances. No Site Specific or Other Source Control BMP's are required.

5 Drainage Improvement Opinion of Probable Costs

5.1 Public Non-reimbursable Drainage Improvements

There are no Public Non-Reimbursable Drainage Improvements in connection with the Mulligan Pines Subdivision.

5.2 Private Non-reimbursable Drainage Improvements

There are no Private non-reimbursable Drainage Improvements for Mulligan Pines Subdivision.

5.3 Private Non-reimbursable Permanent BMP Improvements

There are no Private non-reimbursable Permanent BMP Improvements associated with Mulligan Pines Subdivision.

6 Drainage Fees

The Mulligan Pines Subdivision consists of a Replat of Lot 15 Pine Creek Subdivision Filing No. 2. The site is in the Pine Creek Drainage basin, which is a closed basin for the purposed of drainage and bridge fees. No Drainage or Bridge fees are due for this project.

7 Conclusion

This Final Drainage Report for Mulligan Pines Subdivision presents a drainage concept that includes the construction of three single-family residences in place of the one residence previously planned. No new drainage facilities are recommended for the project. The proposed development of said project and this Final Drainage Report is in general conformance with the previously filed drainage reports which include this area. Storm runoff form this site will not adversely affect the downstream storm drain facilities or surrounding developments.

References

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Addendum to Pine Creek Subdivision Filing No. 1, Drainage Report & Plan (MDDP, PDR & FDR). Obering Wurth & Associates (Colorado Springs, CO: , January 1992).

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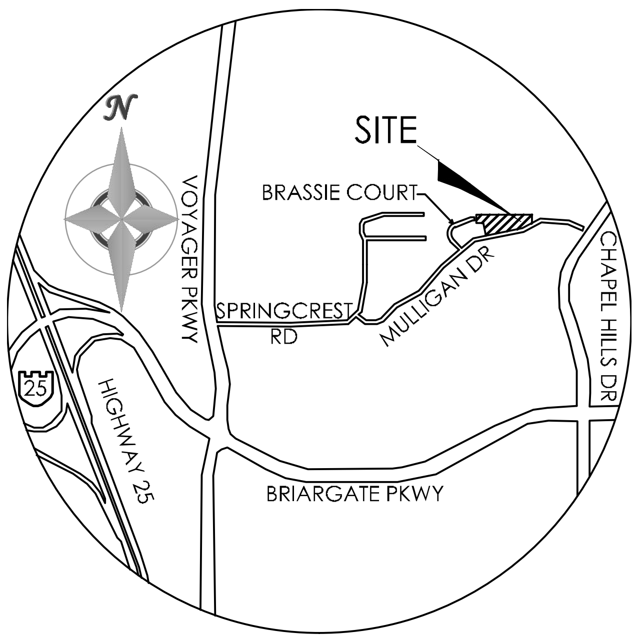
Drainage Criteria Manual Volume 2, Stormwater Quality Policies, Procedures and Best Management Practices (BMPs). City of Colorado Springs City Engineering Division (Colorado Springs, Colorado: , May 2014).

Appendices

1 General Maps and Supporting Data

Vicinity Map
Portion of Flood Insurance Rate Map
NCSS Soil Report
Soil Description

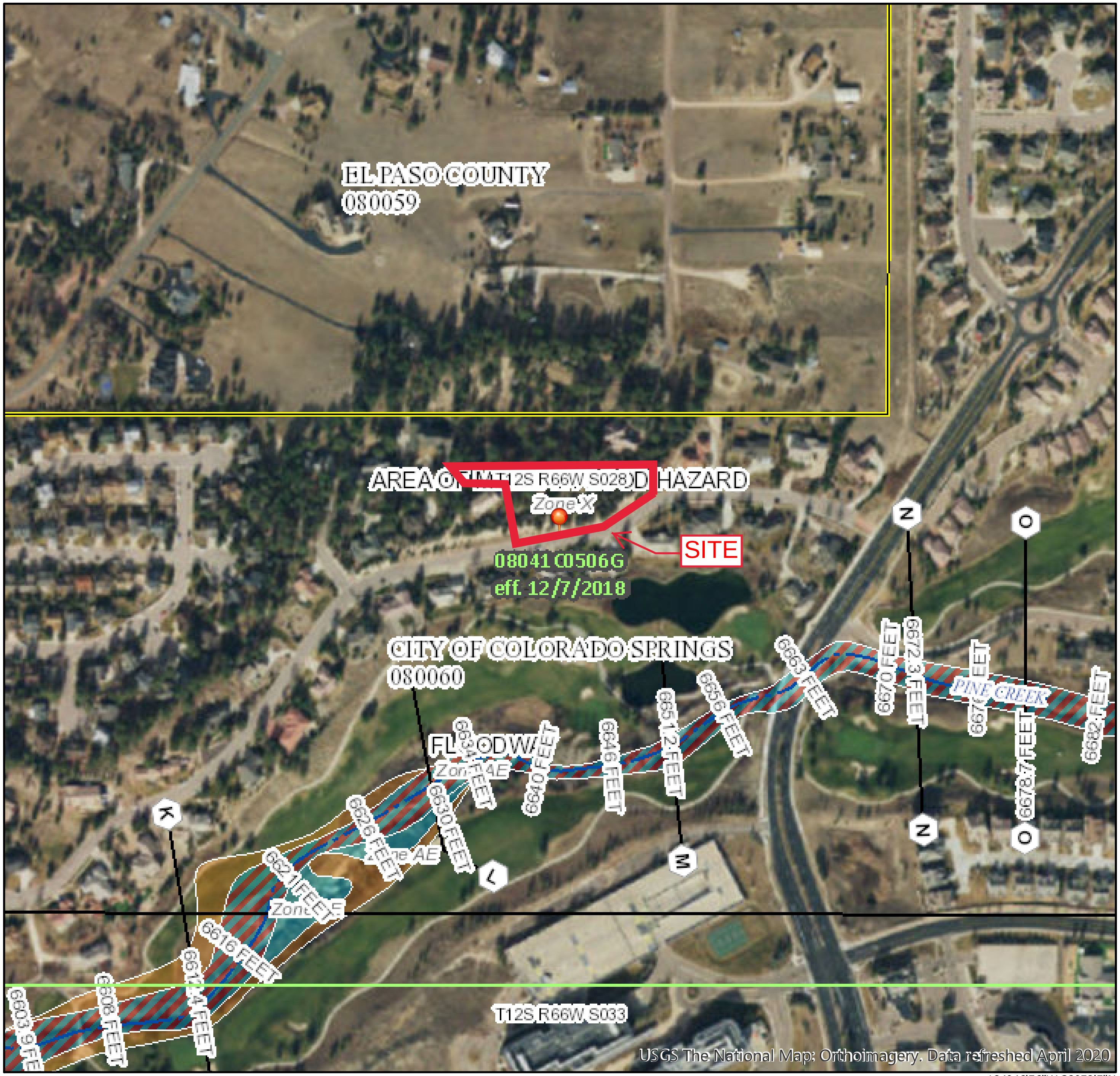


VICINITY MAP

NOT TO SCALE

National Flood Hazard Layer FIRMette

104°47'34"W 38°58'33"N



104°46'56"W 38°58'5"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/23/2020 at 6:44 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

United States Department of Agriculture

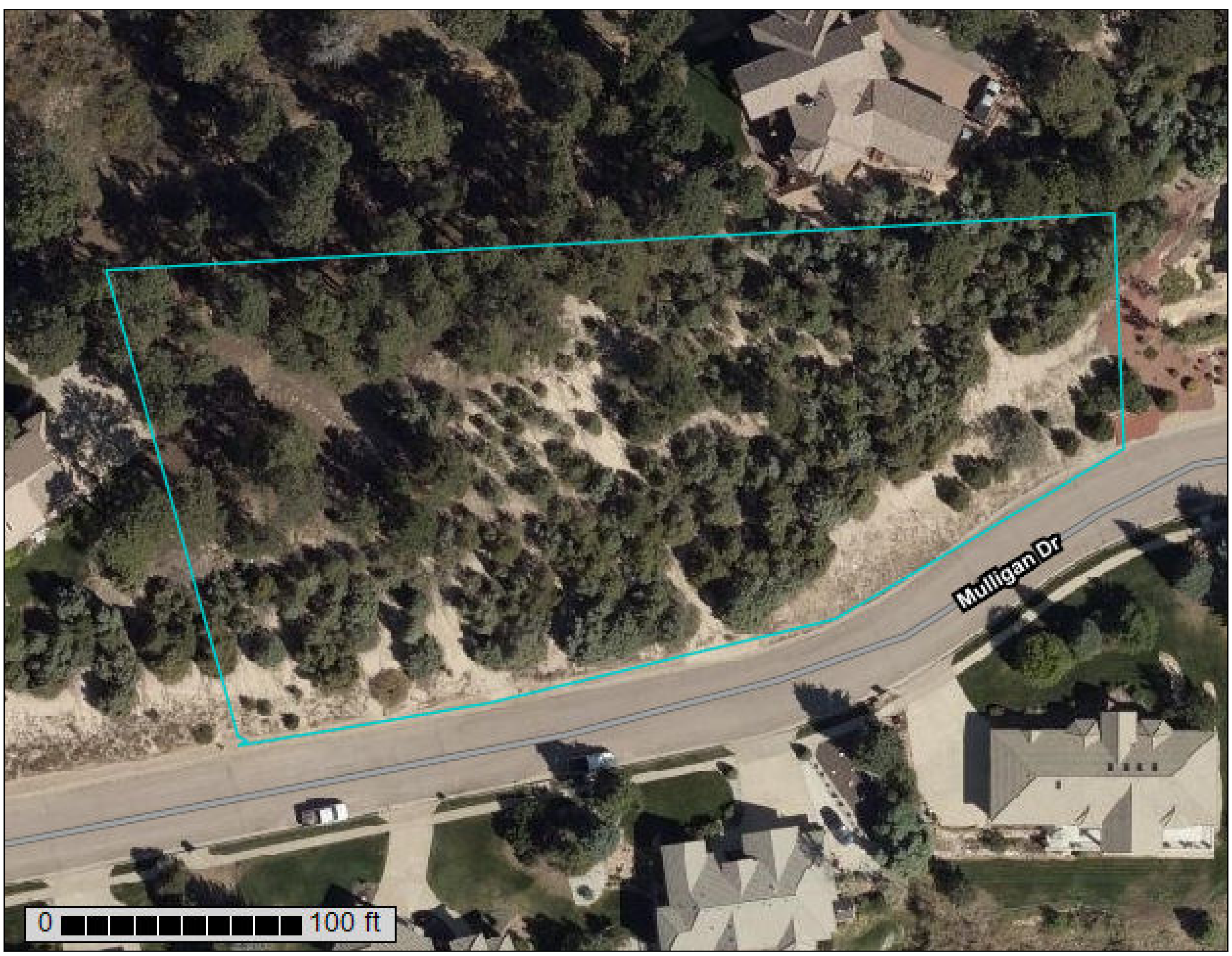
NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for

El Paso County Area, Colorado



June 23, 2020

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Soil Map

Map Scale: 1:708 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 10, 20, 40, 60

Feet: 0, 30, 60, 120, 180

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	1.5	100.0%
Totals for Area of Interest		**1.5**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

93—Tomah-Crowfoot complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 36bb
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

References

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strength. Special designs for buildings and roads are required to offset these limitations. Methods of sewage disposal other than septic tank absorption fields are needed because of the limited depth to bedrock. Capability subclass VIe.

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes. These gently sloping to moderately sloping soils are on alluvial fans, hills, and ridges in the uplands. Elevation ranges from about 7,300 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 42 degrees F, and the average frost-free period is about 120 days.

The Tomah soil makes up about 50 percent of the complex, the Crowfoot soil about 30 percent, and other soils about 20 percent.

Included with these soils in mapping are areas of Elbeth sandy loam, 3 to 8 percent slopes; Kettle gravelly loamy sand, 3 to 8 percent slopes; and Pring coarse sandy loam, 3 to 8 percent slopes.

The Tomah soil is deep and well drained. It formed in alluvium or residuum derived from arkose beds. Typically, the surface layer is dark grayish brown loamy sand about 10 inches thick. The subsurface layer is very pale brown coarse sand about 12 inches thick. The subsoil, about 26 inches thick, is a matrix of very pale brown coarse sand in which are embedded many thin bands and lamellae of pale brown coarse sandy clay loam. The substratum is very pale brown coarse sand to a depth of 60 inches or more.

Permeability of the Tomah soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

The Crowfoot soil is deep and well drained. It formed in sediment weathered from arkosic sandstone. Typically, the surface layer is grayish brown loamy sand about 12 inches thick. The subsurface layer is very pale brown sand about 11 inches thick. The subsoil is light yellowish brown sandy clay loam about 13 inches thick. The substratum is very pale brown coarse sand to a depth of about 68 inches.

Permeability of the Crowfoot soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

This complex is used as rangeland, for wildlife habitat, and as homesites.

Native vegetation is mainly mountain muhly, bluestem, mountain brome, needleandthread, and blue grama. These soils are subject to invasion by Kentucky bluegrass and Gambel oak. Noticeable forbs are hairy goldenrod, geranium, milkvetch, low larkspur, fringed sage, and buckwheat.

Properly locating livestock watering facilities helps to control grazing. Timely deferment of grazing is needed to protect the plant cover.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and moderate available water capacity are the principal limitations for the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

These soils are best suited to habitat for openland wildlife such as pronghorn antelope and sharp-tailed grouse. Although sharp-tailed grouse are not plentiful, they could be encouraged on these soils, especially where brush species are interspersed with grasses and forbs. If these soils are used as rangeland, wildlife production can be increased by managing livestock grazing to preclude overuse of the more desirable grass species and depletion of the various brush species.

These soils have good potential for use as homesites. The main limitation of the Crowfoot soil is frost-action potential. Roads and streets need to be designed to minimize frost-heave damage. Maintaining the existing vegetation on building sites during construction helps to control erosion. Capability subclass IVe.

93—Tomah-Crowfoot loamy sands, 8 to 15 percent slopes. These moderately sloping to strongly sloping soils are on alluvial fans, hills, and ridges in the uplands. Elevation ranges from about 7,300 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 42 degrees F, and the average frost-free period is about 120 days.

The Tomah soil makes up about 50 percent of the complex, the Crowfoot soil about 30 percent, and other soils about 20 percent.

Included with these soils in mapping are areas of Elbeth sandy loam, 8 to 15 percent slopes; Peyton-Pring complex, 8 to 15 percent slopes; and Kettle gravelly loamy sand, 8 to 40 percent slopes.

The Tomah soil is deep and well drained. It formed in alluvium or residuum derived from arkose beds. Typically, the surface layer is dark grayish brown loamy sand about 10 inches thick. The subsurface layer is very pale brown coarse sand about 12 inches thick. The subsoil, about 26 inches thick, consists of a matrix of very pale brown coarse sandy clay loam. The substratum is very pale brown coarse sand to a depth of 60 inches or more.

Permeability of the Tomah soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies are present in some drainageways and along stock trails.

The Crowfoot soil is deep and well drained. It formed in sediment weathered from arkosic sandstone. Typically, the surface layer is grayish brown loamy sand about 12 inches thick. The subsurface layer is very pale brown sand about 11 inches thick. The subsoil is light yellowish brown sandy clay loam about 13 inches thick. The substratum is very pale brown coarse sand to a depth of about 68 inches.

Permeability of the Crowfoot soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies are present in some drainageways and along stock trails.

The soils in this complex are used as rangeland, for recreation and wildlife habitat, and as homesites.

Native vegetation is mainly mountain muhly, bluestem, mountain brome, needleandthread, and blue grama. These soils are subject to invasion by Kentucky bluegrass and Gambel oak. Noticeable forbs are hairy goldenrod, geranium, milkvetch, low larkspur, fringed sage, and buckwheat.

Proper location of livestock watering facilities helps to control grazing. Timely deferment of grazing is needed to protect the plant cover.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and moderate available water capacity are the main limitations for the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

These soils are best suited to habitat for openland wildlife species, such as pronghorn antelope and sharp-tailed grouse. Although sharp-tailed grouse are not plentiful, they could be encouraged on these soils, especially where brush species are interspersed with grasses and forbs. If these soils are used as rangeland, wildlife production can be increased by managing livestock grazing to preclude overuse of the more desirable grass species and depletion of the various brush species.

The main limitations for urban uses are frost-action potential and slope on the Crowfoot soil and slope on the Tomah soil. Buildings and roads must be designed to overcome these limitations. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Maintaining the existing vegetation on building sites during construction helps to control erosion. Capability subclass VIe.

94—Travessilla-Rock outcrop complex, 8 to 90 percent slopes. This moderately sloping to extremely steep complex is mostly on rocky uplands (fig. 5). Elevation ranges from 6,200 to 6,700 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 140 days.

The Travessilla soil makes up about 45 percent of the complex, Rock outcrop about 30 percent, and included areas about 25 percent.

Included with this complex in mapping are areas of Bresser sandy loam, 5 to 9 percent slopes, Elbeth sandy loam, 8 to 15 percent slopes, Kettle gravelly loamy sand, 8 to 40 percent slopes, and Louviers silty clay loam, 3 to 18 percent slopes. The Elbeth and Kettle soils commonly are on the north-facing slopes.

The Travessilla soil is shallow and well drained. It formed in residuum derived from sandstone. Typically, the surface layer is light brownish gray sandy loam about 3 inches thick. The underlying material is pale brown sandy loam about 8 inches thick. Hard arkosic sandstone that has some fractures is at a depth of about 11 inches.

Permeability of the Travessilla soil is moderately rapid. Effective rooting depth is 6 to 20 inches. Available water capacity is low. Surface runoff is medium to rapid, and the hazard of erosion is high. Gullies are common along drainageways and trails.

Rock outcrop occurs mostly as ledges on cliffs.

This complex is used for urban development, as homesites, and for recreation and wildlife habitat.

This complex is suited to the production of ponderosa pine. The main limitations are the presence of stones and rock outcrop on the surface and a high hazard of erosion. Stones on the surface can hinder felling, yarding, and other operations involving the use of equipment. Practices must be used to minimize soil erosion when harvesting timber. The low available water capacity can influence seedling survival.

Wildlife on these soils is limited mostly to small animals such as cottontail, squirrel, and birds because of the extent of urban development. Ponderosa pine, mountain-mahogany, Gambel oak, and various grasses provide food, cover, and nesting areas.

This complex is extensively used for urban development and as homesites (fig. 6). The main limitations for these uses are depth to bedrock, rock outcrop, and steep slopes. Septic tank absorption fields do not function properly because of the depth to bedrock. Special designs for buildings and roads and streets are needed to overcome the limitations. Plans for homesite development should provide for the preservation of as many trees as possible because of their esthetic value. Capability subclass VIIe.

95—Truckton loamy sand, 1 to 9 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown loamy sand about 8 inches thick. The subsoil is brown sandy loam about 18 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 3 to 5 percent sloeps; Bresser sandy loam, 5 to 9 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; and Truckton sandy loam, 3 to 9 percent slopes.

Permeability of this Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is moderate to high.

2 Hydrologic Calculations

City of Colorado Springs DCM Runoff Coefficients – Table 6-6

Colorado Springs DCM Rainfall Intensity Duration Frequency – Figure 6-5

Site Hydrology

- Sub-Basin Time of Concentration – Form SF-1
- 5-yr Sub-Basin and Combined Flows – Form SF-2
- 100-yr Sub-Basin and Combined Flows – Form SF-2
- Sub-Basin Calculations

Overall Hydrology Including Onsite & Offsite Areas

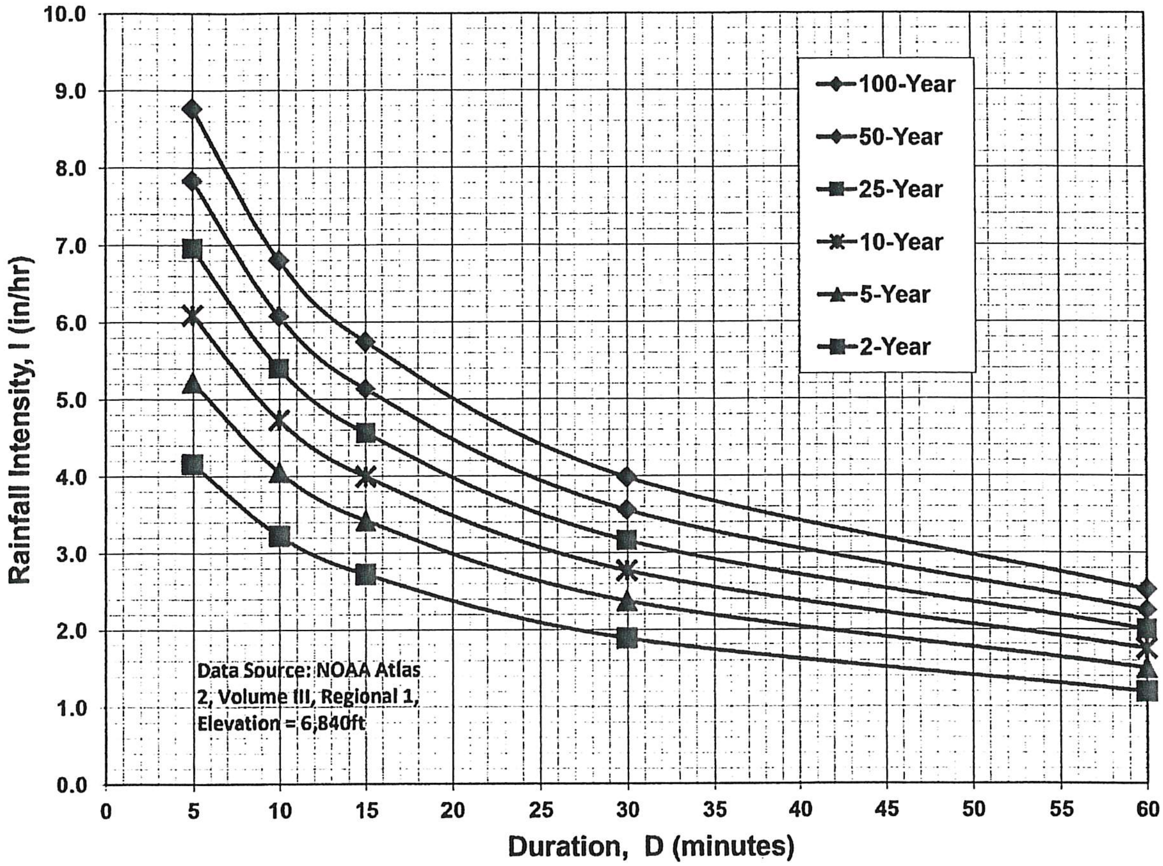
- Sub-Basin Time of Concentration – Form SF-1
- 5-yr Sub-Basin and Combined Flows – Form SF-2
- 100-yr Sub-Basin and Combined Flows – Form SF-2
- Sub-Basin Calculations

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

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

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

$$I_{5} = -1.50 \ln(D) + 7.583$$

$$I_{2} = -1.19 \ln(D) + 6.035$$

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

Job No.: **51478**
Project: **Mulligan Pines**

Date: **8/3/2020 12:29**
Calcs By: **TJW**
Checked By:

Time of Concentration (Modified from Standard Form SF-1)

Sub-	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		
Basin	Area (Acres)	C_5	C_{100}/CN	% Imp.	L_0 (ft)	S_0 (%)	t_i (min)	L_{0t} (ft)	S_{0t} (ft/ft)	v_{0sc} (ft/s)	t_t (min)	L_{0c} (ft)	S_{0c} (ft/ft)	v_{0c} (ft/s)	t_c (min)	L (min)	$t_{c,alt}$ (min)	t_c (min)
EX-A1	0.60	0.13	0.38	6%	76	24%	5.4	292	0.058	1.7	2.9	0	0.000	0.0	0.0	368	12.0	8.3
EX-OSB1	0.09	0.23	0.46	20%	88	23%	5.3	0	0.000	0.0	0.0	0	0.000	0.0	0.0	88	10.5	5.3
EX-B2	1.01	0.08	0.35	0%	100	28%	6.1	41	0.244	3.5	0.2	0	0.000	0.0	0.0	141	10.8	6.3
EX-OSB1&EX-B2	1.11	0.09	0.36	2%	0	0%		0	0.000	0.0		0	#####	38.0	0.0	0		0.0
A1	0.60	0.27	0.49	24%	76	24%	4.6	292	0.058	1.7	2.9	0	0.000	0.0	0.0	368	12.0	7.5
OSB1	0.09	0.23	0.46	20%	88	23%	5.3	0	0.000	0.0	0.0	0	0.000	0.0	0.0	88	10.5	5.3
B2	1.01	0.29	0.50	26%	100	28%	4.9	41	0.244	3.5	0.2	0	0.000	0.0	0.0	141	10.8	5.1
OSB1&B2	1.11	0.28	0.50	26%	0	0%		0	0.000	0.0		0	#####	38.0	0.0	0		0.0

Job No.: **51478**
Project: **Mulligan Pines**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **UDFCD**

Date: **8/3/2020 12:29**
Calcs By: **TJW**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C5	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
	EX-A1	0.60	0.13	8.3	0.08	4.36	0.33															
	EX-OSB1	0.09	0.23	5.3	0.02	5.02	0.11															
	EX-B2	1.01	0.08	6.3	0.08	4.76	0.39															
EX-OSB1&EX-B2		1.11	0.09					6.3	0.10	4.76	0.5											
	A1	0.60	0.27	7.5	0.16	4.51	0.72															
	OSB1	0.09	0.23	5.3	0.02	5.02	0.11															
	B2	1.01	0.29	5.1	0.29	5.06	1.47															
OSB1&B2		1.11	0.28					5.1	0.31	5.06	1.6											

Rainfall Intensity: I = (28.5 * P1) / (10 + tc)^0.786
P1: 1.5

Job No.: **51478**
Project: **Mulligan Pines**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **UDFCD**

Date: **8/3/2020 12:29**
Calcs By: **TJW**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C100	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
	EX-A1	0.60	0.38	8.3	0.23	7.32	1.68															
	EX-OSB1	0.09	0.46	5.3	0.04	8.43	0.36															
	EX-B2	1.01	0.35	6.3	0.35	8.00	2.83															
EX-OSB1&EX-B2		1.11	0.36					6.3	0.40	8.00	3.2											
	A1	0.60	0.49	7.5	0.29	7.57	2.20															
	OSB1	0.09	0.46	5.3	0.04	8.43	0.36															
	B2	1.01	0.50	5.1	0.51	8.51	4.31															
OSB1&B2		1.11	0.50					5.1	0.55	8.51	4.7											

Rainfall Intensity: I = (28.5 * P1) / (10 + tc)^0.786
P1: 2.52

Sub-Basin Ex-A1 Runoff Calculations

Job No.:	**51478**	Date:	**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	24,583	0.56	0.02	0.08	0.15	0.25	0.3	0.35	0%
Driveways & Walks	1,463	0.03	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**26,046**	**0.60**	**0.07**	**0.13**	**0.19**	**0.29**	**0.34**	**0.38**	**5.6%**
	26046								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft; C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	368	35	-	-	-	-	
Initial Time	76	18	0.237	-	5.4	12.0	UDFCD Formula RO-3
Shallow Channel	292	17	0.058	1.7	2.9	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**8.3**	**min.**	

Storage Volume

40 -hr release time; a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.46	4.36	5.08	5.81	6.53	7.32
Runoff (cfs)	0.1	**0.3**	0.6	1.0	1.3	**1.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.3**	0.6	1.0	1.3	**1.7**
UDFCD: I = (28.5 * P1) / (10 + tc)^0.786						
PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin Ex-OSB1 Runoff Calculations

Job No.:	**51478**	Date:	**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	3,228	0.07	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	634	0.01	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	232	0.01	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**4,094**	**0.09**	**0.18**	**0.23**	**0.29**	**0.37**	**0.41**	**0.46**	**19.6%**
	4000								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	88	20	-	-	-	-	
Initial Time	88	20	0.227	-	5.3	10.5	UDFCD Formula RO-3
Shallow Channel			0.000	0.0	0.0	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**5.3**	**min.**	

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.98	5.02	5.85	6.69	7.52	8.43
Runoff (cfs)	0.1	**0.1**	0.2	0.2	0.3	**0.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.1**	0.2	0.2	0.3	**0.4**
UDFCD: I = (28.5 * P1) / (10 + tc)^0.786						
PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin Ex-B2 Runoff Calculations

Job No.:	**51478**	Date:	**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	44,100	1.01	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**44,100**	**1.01**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	44100								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	141	38	-	-	-	-	
Initial Time	100	28	0.280	-	6.1	10.8	UDFCD Formula RO-3
Shallow Channel	41	10	0.244	3.5	0.2	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**6.3**	**min.**	

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV 0.00 (in)

WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.78	4.76	5.55	6.35	7.14	8.00
Runoff (cfs)	0.1	**0.4**	0.8	1.6	2.2	**2.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.4**	0.8	1.6	2.2	**2.8**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin A1 Runoff Calculations

Job No.:	**51478**	Date:	**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	19,567	0.45	0.02	0.08	0.15	0.25	0.3	0.35	0%
Driveways & Walks	3,794	0.09	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	2,685	0.06	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**26,046**	**0.60**	**0.22**	**0.27**	**0.32**	**0.41**	**0.45**	**0.49**	**23.8%**
	4000								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft; C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	368	35	-	-	-	-	
Initial Time	76	18	0.237	-	4.6	12.0	UDFCD Formula RO-3
Shallow Channel	292	17	0.058	1.7	2.9	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**7.5**	**min.**	

Storage Volume

40 -hr release time; a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft³)	0	0	0

Design Volume (ft³)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.58	4.51	5.26	6.01	6.76	7.57
Runoff (cfs)	0.5	**0.7**	1.0	1.5	1.8	**2.2**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.5	**0.7**	1.0	1.5	1.8	**2.2**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin OSB1 Runoff Calculations

Job No.:	**51478**	Date:	**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	3,228	0.07	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	634	0.01	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	232	0.01	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**4,094**	**0.09**	**0.18**	**0.23**	**0.29**	**0.37**	**0.41**	**0.46**	**19.6%**

4094

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	88	20	-	-	-	-	
Initial Time	88	20	0.227	-	5.3	10.5	UDFCD Formula RO-3
Shallow Channel			0.000	0.0	0.0	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch

t_c **5.3 min.**

Storage Volume

40 -hr release time   Detention is NOT required

a = 1   Water Quality is NOT required

EURV 0.00 (in)

WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.98	5.02	5.85	6.69	7.52	8.43
Runoff (cfs)	0.1	**0.1**	0.2	0.2	0.3	**0.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.1**	0.2	0.2	0.3	**0.4**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Sub-Basin B2 Runoff Calculations

Job No.:	**51478**	Date:	**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	31,920	0.73	0.02	0.08	0.15	0.25	0.3	0.35	0%
Driveways & Walks	6,984	0.16	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	5,196	0.12	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**44,100**	**1.01**	**0.24**	**0.29**	**0.34**	**0.42**	**0.46**	**0.50**	**26.4%**
	44100								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	141	38	-	-	-	-	
Initial Time	100	28	0.280	-	4.9	10.8	UDFCD Formula RO-3
Shallow Channel	41	10	0.244	3.5	0.2	-	UDFCD Formula RO-4
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**5.1**	**min.**	

Storage Volume

40 -hr release time   a = 1

Detention is NOT required
Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	4.02	5.06	5.91	6.75	7.60	8.51
Runoff (cfs)	1.0	**1.5**	2.0	2.9	3.6	**4.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.0	**1.5**	2.0	2.9	3.6	**4.3**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Combined Sub-Basin Runoff Calculations - EX-OSB1 & EX-B2

Includes Basins EX-OSB1 EX-B2

Job No.:	**51478**	Date:		**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**UDFCD**	Soil Type	**B**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	634	0.01	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	232	0.01	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	47,328	1.09	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**48,194**	**1.11**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**1.7%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	EX-B2	-	141	38	-	-	-	-	6.3
Channelized-1									
Channelized-2									
Channelized-3									
Total			141	38					

t_c (min) **6.3**

Storage Volume

40 -hr release time

Detention is NOT required

Water Quality is NOT required

EURV	0.00 (in)	a =	1
WQCV	0.00 (in)		

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.78	4.76	5.55	6.35	7.14	8.00
Site Runoff (cfs)	0.14	**0.49**	0.99	1.83	2.45	**3.18**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**0.5**	-	-	-	**3.2**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations - OSB1 & B2

Includes Basins OSB1 B2

Job No.:	**51478**	Date:	**8/3/2020 12:29**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**UDFCD**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	5,830	0.13	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	7,216	0.17	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	35,148	0.81	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**48,194**	**1.11**	**0.23**	**0.28**	**0.34**	**0.42**	**0.46**	**0.50**	**25.9%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	B2	-	141	38	-	-	-	-	5.1
Channelized-1									
Channelized-2									
Channelized-3									
Total			141	38					

t_c (min) **5.1**

Storage Volume

40 -hr release time

Detention is NOT required

Water Quality is NOT required

EURV	0.00 (in)	a =	1
WQCV	0.00 (in)		

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	4.02	5.06	5.91	6.75	7.60	8.51
Site Runoff (cfs)	1.04	**1.58**	2.21	3.12	3.85	**4.68**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**1.6**	-	-	-	**4.7**

UDFCD: I = (28.5 * P1) / (10 + tc)^0.786

PI	1.19	1.5	1.75	2	2.25	2.52

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Job No.: **51478**

Project: **Mulligan Pines**

Date: **7/31/2020 12:51**

Calcs By: **TJW**

Checked By:

Time of Concentration (Modified from Standard Form SF-1)

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		t_c
	Area (Acres)	C_5	C_{100}/CN	% Imp.	L_0 (ft)	S_0 (%)	t_i (min)	L_{0t} (ft)	S_{0t} (ft/ft)	v_{0sc} (ft/s)	t_t (min)	L_{0c} (ft)	S_{0c} (ft/ft)	v_{0c} (ft/s)	t_c (min)	L (min)	$t_{c,alt}$ (min)	(min)
E-1	3.60	0.13	0.39	7%	200	7%	13.0	355	0.090	2.1	2.8	0	0.000	0.0	0.0	555	13.1	13.1
E-2	7.45	0.13	0.38	7%	178	11%	10.5	450	0.053	1.6	4.6	0	0.000	0.0	0.0	628	13.5	13.5
EX-I-5	4.20	0.27	0.49	25%	100	6%	8.2	200	0.080	2.0	1.7	179	0.022	4.5	0.7	479	12.7	10.6
EX-DPA	7.80	0.21	0.44	17%	C&G	#####	8.8	0	0.000	0.0		0	#####	52.0	0.0	V-Ditch	0.0	0.0
EX-I-6	7.60	0.33	0.53	31%	100	9%	6.8	200	0.120	2.4	1.4	730	0.016	4.8	2.5	1030	15.7	10.7
EX-DPB	15.06	0.23	0.46	19%	0	0%		0	0.000	0.0		0	#####	44.0	0.0	0		0.0
EX-DPC	22.58	0.22	0.45	17%	0	0%		0	0.000	0.0		0	#####	60.0	0.0	Pipe		0.0
PP-I-5	4.20	0.30	0.51	28%	100	6%	8.0	200	0.080	2.0	1.7	179	0.022	4.5	0.7	479	12.7	10.3
PP-DPA	7.80	0.22	0.46	18%	C&G	#####	8.8	0	0.000	0.0		0	#####	52.0	0.0	V-Ditch	0.0	0.0
PP-I-6	7.60	0.35	0.55	34%	100	9%	6.5	200	0.120	2.4	1.4	730	0.016	4.8	2.5	1030	15.7	10.4
PP-DPB	15.06	0.24	0.47	21%	0	0%		0	0.000	0.0		0	#####	44.0	0.0	0		0.0
PP-DPC	22.86	0.24	0.46	20%	0	0%		0	0.000	0.0		0	#####	60.0	0.0	Pipe		0.0

Job No.: **51478**
Project: **Mulligan Pines**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **7/31/2020 12:51**
Calcs By: **TJW**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C5	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{Osc} (ft/s)	t_t (min)
	E-1	3.60	0.13	13.1	0.48	3.73	1.79															
	E-2	7.45	0.13	13.5	0.96	3.68	3.53															
	EX-I-5	4.20	0.27	10.6	1.16	4.04	4.67															
EX-DPA		7.80	0.21					13.9	1.64	3.63	5.9											
	EX-I-6	7.60	0.33	10.7	2.48	4.03	10.00															
EX-DPB		15.06	0.23					13.5	3.44	3.68	12.7											
EX-DPC		22.58	0.22					15.7	4.91	3.45	16.9											
	PP-I-5	4.20	0.30	10.3	1.26	4.08	5.15															
PP-DPA		7.80	0.22					13.9	1.74	3.63	6.3											
	PP-I-6	7.60	0.35	10.4	2.69	4.06	10.93															
PP-DPB		15.06	0.24					13.5	3.65	3.68	13.4											
PP-DPC		22.86	0.24					15.7	5.40	3.45	18.6											

DCM: I = C1 * ln (tc) + C2
C1: 1.5
C1: 7.583

Job No.: 51478
Project: Mulligan Pines
Design Storm: 100-Year Storm *(1% Probability)*
Jurisdiction: DCM

Date: 7/31/2020 12:51
Calcs By: TJW
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C100	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{osc} (ft/s)	t_t (min)
	E-1	3.60	0.39	13.1	1.40	6.26	8.75															
	E-2	7.45	0.38	13.5	2.87	6.18	17.70															
	EX-I-5	4.20	0.49	10.6	2.07	6.79	14.07															
EX-DPA		7.80	0.44					13.9	3.47	6.10	21.2											
	EX-I-6	7.60	0.53	10.7	4.04	6.77	27.33															
EX-DPB		15.06	0.46					13.5	6.91	6.18	42.7											
EX-DPC		22.58	0.45					15.7	10.18	5.79	58.9											
	PP-I-5	4.20	0.51	10.3	2.15	6.85	14.74															
PP-DPA		7.80	0.46					13.9	3.55	6.10	21.7											
	PP-I-6	7.60	0.55	10.4	4.19	6.82	28.61															
PP-DPB		15.06	0.47					13.5	7.06	6.18	43.6											
PP-DPC		22.86	0.46					15.7	10.61	5.79	61.4											

DCM: I = C1 * ln (tc) + C2
C1: 2.52
C1: 12.735

Sub-Basin E-1 Runoff Calculations

Job No.:	51478	Date:	7/31/2020 12:51
Project:	Mulligan Pines	Calcs by:	TJW
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	7,947	0.18	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	3,975	0.09	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	-	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	144,863	3.33	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**156,785**	**3.60**	**0.08**	**0.13**	**0.20**	**0.29**	**0.34**	**0.39**	**7.1%**
	156785								

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	555	46	-	-	-	-	
Initial Time	200	14	0.070	-	13.0	13.1	DCM Eq. 6-8
Shallow Channel	355	32	0.090	2.1	2.8	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**13.1 min.**		

Storage Volume

40 -hr release time
a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft³)	0	0	0

Design Volume (ft³)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.98	3.73	4.35	4.97	5.59	6.26
Runoff (cfs)	0.8	**1.8**	3.1	5.3	6.9	**8.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.8	**1.8**	3.1	5.3	6.9	**8.8**

DCM: $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin E-2 Runoff Calculations

Job No.:	**51478**	Date:		**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**B**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

Surface	Area (SF)	(Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	12,108	0.28	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	2,087	0.05	0.89	0.9	0.92	0.94	0.95	0.96	100%
Gravel	12,314	0.28	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	298,226	6.85	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**324,735**	**7.45**	**0.07**	**0.13**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	324735								

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	628	44	-	-	-	-	
Initial Time	178	20	0.112	-	10.5	13.5	DCM Eq. 6-8
Shallow Channel	450	24	0.053	1.6	4.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**13.5 min.**		

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.94	3.68	4.29	4.91	5.52	6.18
Runoff (cfs)	1.6	**3.5**	6.3	10.6	13.9	**17.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.6	**3.5**	6.3	10.6	13.9	**17.7**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Z:\51478\Calcs\Hydrology\51478-Overall Runoff Spreadsheet.xlsm
E-2

Sub-Basin EX-I-5 Runoff Calculations

Job No.:	**51478**	Date:	**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	14,584	0.33	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	17,063	0.39	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	14,864	0.34	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	136,646	3.14	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**183,157**	**4.20**	**0.23**	**0.27**	**0.33**	**0.41**	**0.45**	**0.49**	**24.6%**
	183157								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft; C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	479	26	-	-	-	-	
Initial Time	100	6	0.060	-	8.2	12.7	DCM Eq. 6-8
Shallow Channel	200	16	0.080	2.0	1.7	-	DCM Eq. 6-9
Channelized	179	4	0.022	4.5	0.7	-	C&G
				t_c	**10.6 min.**		

Storage Volume

40 -hr release time; a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.23	4.04	4.72	5.39	6.06	6.79
Runoff (cfs)	3.1	**4.7**	6.6	9.3	11.6	**14.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	3.1	**4.7**	6.6	9.3	11.6	**14.1**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin EX-I-6 Runoff Calculations

Job No.:	**51478**	Date:	**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	25,360	0.58	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	24,337	0.56	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	55,050	1.26	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	226,376	5.20	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**331,123**	**7.60**	**0.28**	**0.33**	**0.38**	**0.46**	**0.49**	**0.53**	**30.9%**
	331123								

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	1,030	45	-	-	-	-	
Initial Time	100	9	0.090	-	6.8	15.7	DCM Eq. 6-8
Shallow Channel	200	24	0.120	2.4	1.4	-	DCM Eq. 6-9
Channelized	730	12	0.016	4.8	2.5	-	C&G

t_c 10.7 min.

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV 0.00 (in)

WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft³)	0	0	0

Design Volume (ft³)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.22	4.03	4.70	5.37	6.05	6.77
Runoff (cfs)	6.9	**10.0**	13.6	18.6	22.7	**27.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	6.9	**10.0**	13.6	18.6	22.7	**27.3**

DCM: $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin PP-I-5 Runoff Calculations

Job No.:	**51478**	Date:	**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	17,269	0.40	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	20,695	0.48	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	14,864	0.34	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	130,329	2.99	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**183,157**	**4.20**	**0.25**	**0.30**	**0.36**	**0.43**	**0.47**	**0.51**	**27.9%**
	183157								

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	479	26	-	-	-	-	
Initial Time	100	6	0.060	-	8.0	12.7	DCM Eq. 6-8
Shallow Channel	200	16	0.080	2.0	1.7	-	DCM Eq. 6-9
Channelized	179	4	0.022	4.5	0.7	-	C&G
				t_c	**10.3 min.**		

Storage Volume

40 -hr release time
a = 1

Detention is NOT required
Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft³)	0	0	0

Design Volume (ft³)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.26	4.08	4.76	5.44	6.12	6.85
Runoff (cfs)	3.5	**5.2**	7.1	9.9	12.2	**14.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	3.5	**5.2**	7.1	9.9	12.2	**14.7**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin PP-I-6 Runoff Calculations

Job No.:	51478	Date:	7/31/2020 12:51
Project:	Mulligan Pines	Calcs by:	TJW
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	30,556	0.70	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	31,321	0.72	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	55,050	1.26	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	214,196	4.92	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**331,123**	**7.60**	**0.31**	**0.35**	**0.41**	**0.48**	**0.52**	**0.55**	**34.4%**
	331123								

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	1,030	45	-	-	-	-	
Initial Time	100	9	0.090	-	6.5	15.7	DCM Eq. 6-8
Shallow Channel	200	24	0.120	2.4	1.4	-	DCM Eq. 6-9
Channelized	730	12	0.016	4.8	2.5	-	C&G
				t_c	**10.4 min.**		

Storage Volume

40 -hr release time   a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0
V_i (ft^3)	0	0	0

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.24	4.06	4.74	5.42	6.10	6.82
Runoff (cfs)	7.7	**10.9**	14.6	19.7	23.9	**28.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	7.7	**10.9**	14.6	19.7	23.9	**28.6**

DCM: $I = C1 * \ln(tc) + C2$

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Combined Sub-Basin Runoff Calculations - Existing DPA

Includes Basins EX-I-5 E-1

Job No.:	**51478**	Date:	**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	22,531	0.52	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	21,038	0.48	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	14,864	0.34	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	281,509	6.46	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**339,942**	**7.80**	**0.16**	**0.21**	**0.27**	**0.36**	**0.40**	**0.44**	**16.5%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	E-1	-	555	46	-	-	-	-	13.1
Channelized-1	V-Ditch	2	28	2	9	0	2	5.0	0.1
Channelized-2	C&G	Concrete	179	4	9	0	0	4.0	0.7
Channelized-3									
Total			762	52					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **13.9**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.90	3.63	4.24	4.84	5.45	6.10
Site Runoff (cfs)	3.57	**5.94**	8.97	13.53	17.09	**21.17**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**5.9**	-	-	-	**21.2**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations - Existing DPB

Includes Basins E-2 EX-I-6

Job No.:	**51478**	Date:		**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**B**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	37,468	0.86	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	26,424	0.61	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	55,050	1.26	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	524,602	12.04	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	12,314	0.28	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**655,858**	**15.06**	**0.18**	**0.23**	**0.29**	**0.37**	**0.42**	**0.46**	**19.1%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	E-2	-	628	44	-	-	-	-	13.5
Channelized-1									
Channelized-2									
Channelized-3									
Total			628	44					

t_c (min) 13.5

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.94	3.68	4.29	4.91	5.52	6.18
Site Runoff (cfs)	7.87	**12.67**	18.68	27.61	34.62	**42.66**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**12.7**	-	-	-	**42.7**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations - Existing DPC

Includes Basins EX-DPA EX-DPB

Job No.:	**51478**	Date:	**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	59,999	1.38	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	47,462	1.09	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	69,914	1.61	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	806,111	18.51	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**983,486**	**22.58**	**0.17**	**0.22**	**0.28**	**0.36**	**0.41**	**0.45**	**17.4%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	EX-DPA	-	762	52	-	-	-	-	13.9
Channelized-1	Pipe	RCP	720	8	21	2	0	6.6	1.8
Channelized-2									
Channelized-3									
Total			1,482	60					

t_c (min) 15.7

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.75	3.45	4.02	4.60	5.17	5.79
Site Runoff (cfs)	10.32	**16.93**	25.30	37.86	47.66	**58.93**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**16.9**	-	-	-	**58.9**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations - Developed DPA

Includes Basins PP-I-5 E-1

Job No.:	**51478**	Date:	**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	25,216	0.58	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	24,670	0.57	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	14,864	0.34	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	275,192	6.32	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**339,942**	**7.80**	**0.17**	**0.22**	**0.28**	**0.37**	**0.41**	**0.46**	**18.3%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	E-1	-	555	46	-	-	-	-	13.1
Channelized-1	V-Ditch	2	28	2	9	0	2	5.0	0.1
Channelized-2	C&G	Concrete	179	4	9	0	0	4.0	0.7
Channelized-3									
Total			762	52					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **13.9**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.90	3.63	4.24	4.84	5.45	6.10
Site Runoff (cfs)	3.90	**6.34**	9.39	13.97	17.55	**21.66**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**6.3**	-	-	-	**21.7**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations - Developed DPB

Includes Basins E-2 PP-I-6

Job No.:	**51478**	Date:	**7/31/2020 12:51**
Project:	**Mulligan Pines**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	42,664	0.98	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	33,408	0.77	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	55,050	1.26	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	512,422	11.76	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	12,314	0.28	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**655,858**	**15.06**	**0.19**	**0.24**	**0.30**	**0.39**	**0.43**	**0.47**	**20.8%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	E-2	-	628	44	-	-	-	-	13.5
Channelized-1									
Channelized-2									
Channelized-3									
Total			628	44					

t_c (min) **13.5**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.94	3.68	4.29	4.91	5.52	6.18
Site Runoff (cfs)	8.52	**13.43**	19.52	28.46	35.52	**43.61**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**13.4**	-	-	-	**43.6**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Combined Sub-Basin Runoff Calculations - Developed DPC

Includes Basins PP-DPA PP-DPB

Job No.:	51478	Date:	7/31/2020 12:51
Project:	Mulligan Pines	Calcs by:	TJW
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Urban

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	Imperv.
Roofs	67,880	1.56	0.71	0.73	0.75	0.78	0.8	0.81	90%
Driveways & Walks	58,078	1.33	0.89	0.9	0.92	0.94	0.95	0.96	100%
Paved	69,914	1.61	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	787,614	18.08	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	12,314	0.28	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**995,800**	**22.86**	**0.19**	**0.24**	**0.30**	**0.38**	**0.42**	**0.46**	**20.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	PP-DPA	-	762	52	-	-	-	-	13.9
Channelized-1	Pipe	RCP	720	8	22	2	0	6.6	1.8
Channelized-2									
Channelized-3									
Total			1,482	60					

t_c (min) **15.7**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.75	3.45	4.02	4.60	5.17	5.79
Site Runoff (cfs)	11.69	**18.60**	27.21	39.93	49.94	**61.41**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**18.6**	-	-	-	**61.4**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

3 Hydraulic Calculations

Storm Inlet Calculations

Storm Pipe Calculations
- Existing Conditions
- Developed Conditions

Existing Storm Drain Design Drawings

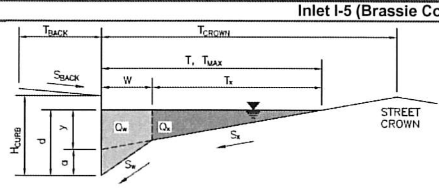
Version 4.06 Released August 2018

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

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

Project: 51478 - Mulligan Pines

Inlet ID: Inlet I-5 (Brassie Court)



Gutter Geometry (Enter data in the blue cells)

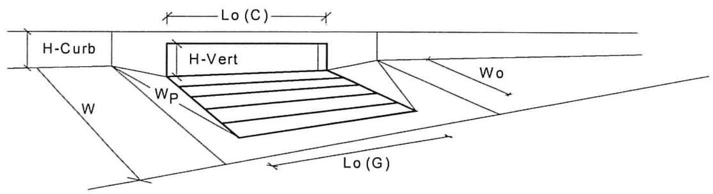
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	6.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions				

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet: Colorado Springs D-10-R	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.25	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.47	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.87	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	6.3	33.7	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.3	21.7	cfs

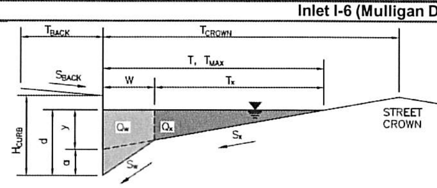
Version 4.06 Released August 2018

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

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

Project: 51478 - Mulligan Pines

Inlet ID: Inlet I-6 (Mulligan Drive)



Gutter Geometry (Enter data in the blue cells)

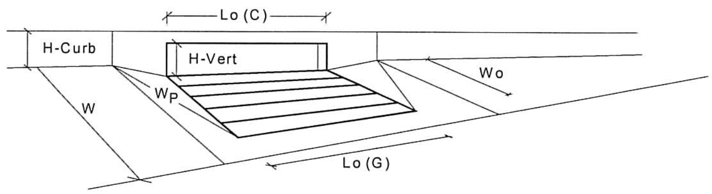
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	19.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

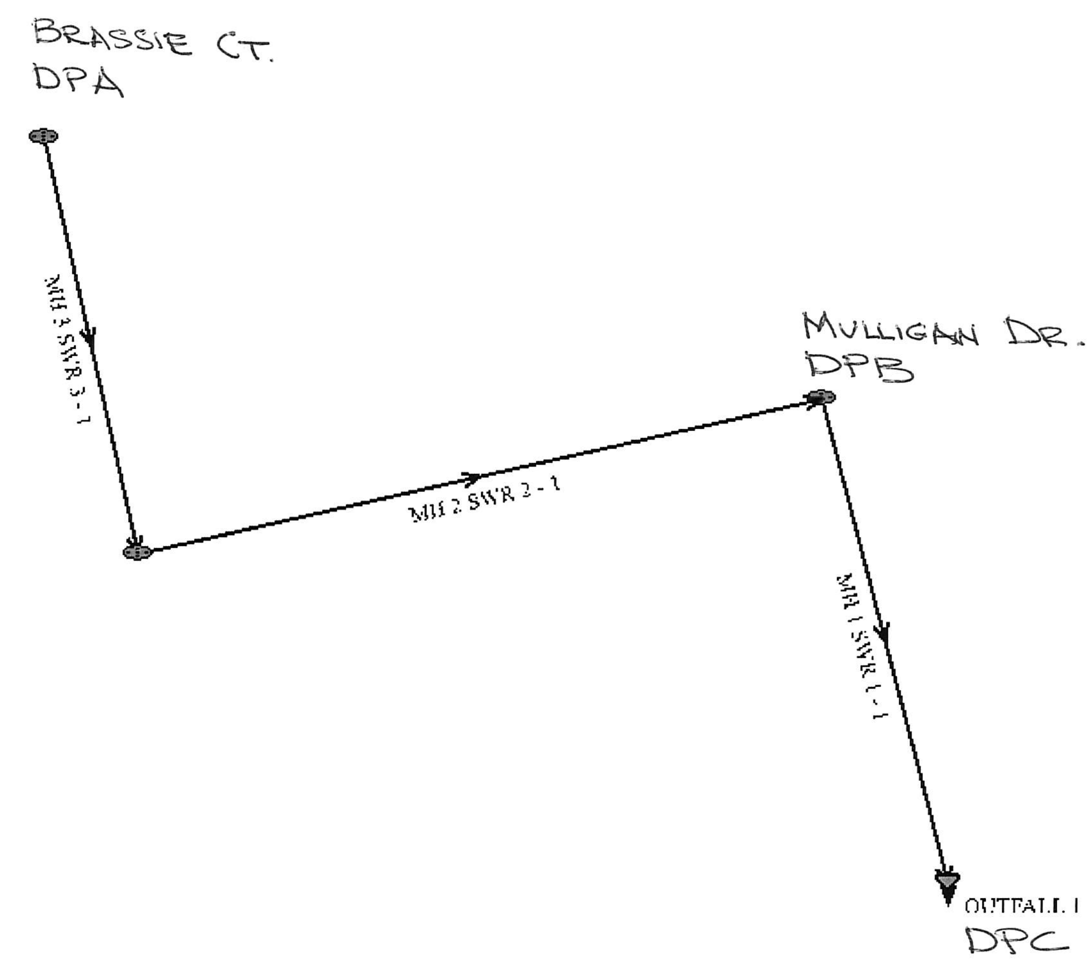
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input) — Colorado Springs D-10-R				
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.5	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	6.00	6.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.38	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.61	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.90	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	13.6	40.9	cfs
WARNING: Inlet Capacity less than Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	13.4	43.6	cfs


BRASSIE CT.
DPA
MH 3 SWR 3 - 1
MH 2 SWR 2 - 1
MULLIGAN DR.
DPB
MH 1 SWR 1 - 1
OUTFALL 1
DPC

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
7/29/2020 9:49:49 AM

UDSewer Results Summary

Project Title: 51478-Mulligan Pines
Project Description: Existing Storm System - 5YR Existing Conditions

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 0.00

Manhole Input Summary:

		Given Flow		Sub Basin Information							
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6668.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	6676.78	18.60	12.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 2 SWR 2 - 1	6679.33	5.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 3 SWR 3 - 1	6684.86	5.90	5.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
MH 1 SWR 1 - 1	0.00	0.00	0.00	0.00	12.70	0.00	0.00	0.00	18.60	
MH 2 SWR 2 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.90	
MH 3 SWR 3 - 1	0.00	0.00	0.00	0.00	5.90	0.00	0.00	0.00	5.90	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	135.00	6660.98	6.3	6669.48	0.013	0.00	0.00	CIRCULAR	24.00 in	24.00 in
MH 2 SWR 2 - 1	438.00	6669.78	0.7	6672.85	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
MH 3 SWR 3 - 1	204.00	6673.15	2.6	6678.45	0.011	1.00	0.00	CIRCULAR	20.00 in	20.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
MH 1 SWR 1 - 1	56.93	18.12	18.63	7.11	9.44	16.21	3.73	Supercritical	18.60	0.00	
MH 2 SWR 2 - 1	18.98	6.04	10.30	4.58	9.19	5.33	1.25	Supercritical Jump	5.90	8.00	
MH 3 SWR 3 - 1	26.58	12.18	10.90	4.86	6.40	9.80	2.77	Supercritical	5.90	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
MH 1 SWR 1 - 1	18.60	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 2 SWR 2 - 1	5.90	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 3 SWR 3 - 1	5.90	CIRCULAR	20.00 in	20.00 in	12.00 in	12.00 in	20.00 in	20.00 in	2.18	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 0.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		

Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
MH 1 SWR 1 - 1	6660.98	6669.48	0.00	0.00	6661.76	6671.03	6665.84	5.97	6671.82
MH 2 SWR 2 - 1	6669.78	6672.85	0.07	0.00	6671.83	6673.71	6671.89	2.14	6674.03
MH 3 SWR 3 - 1	6673.15	6678.45	0.11	0.00	6673.82	6679.36	6675.17	4.55	6679.72

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

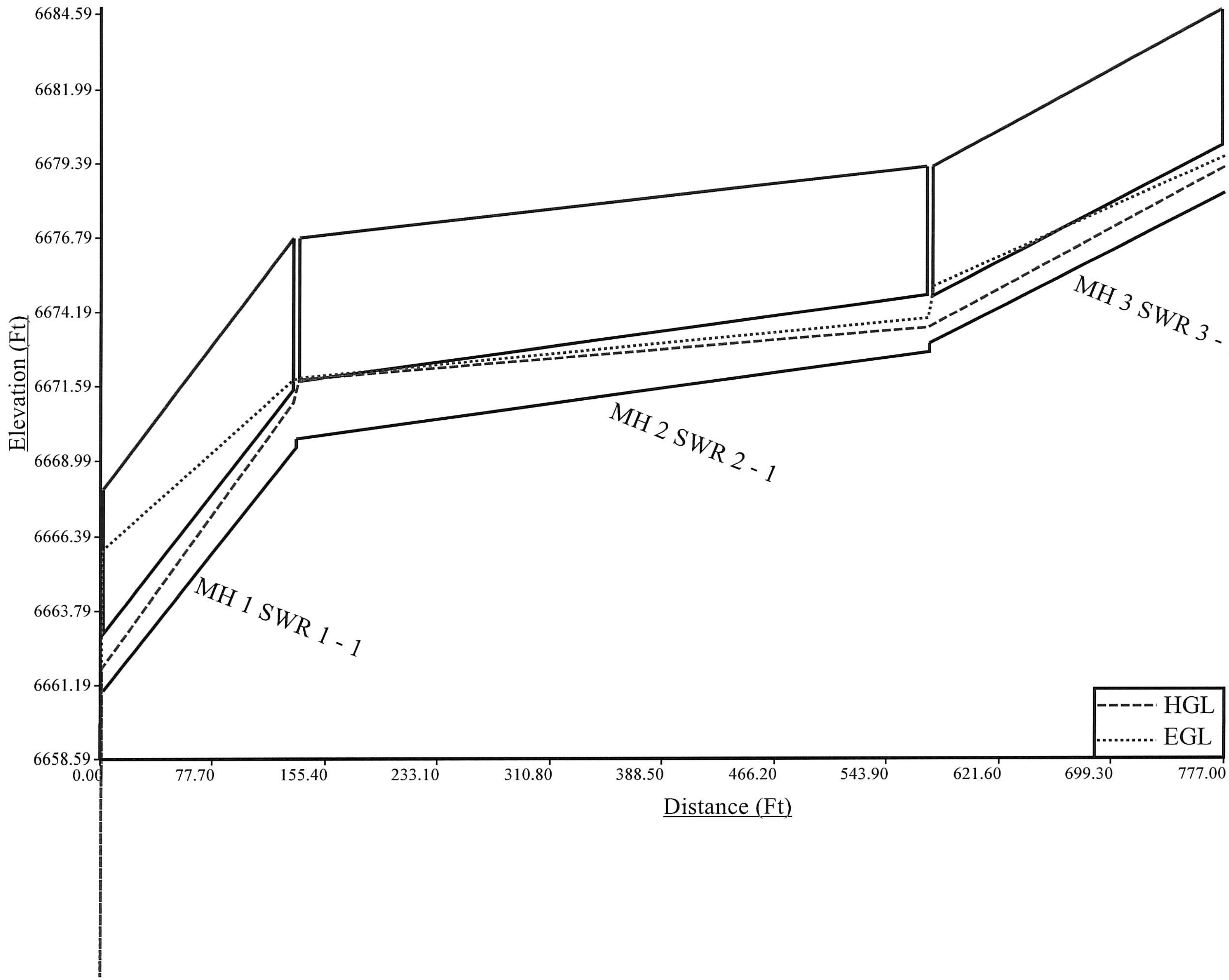
The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
MH 1 SWR 1 - 1	135.00	3.00	4.00	5.50	13.05	7.61	4.78	13.60	7.88	5.05	289.64	
MH 2 SWR 2 - 1	438.00	3.00	4.00	5.50	12.99	7.58	4.75	11.96	7.06	4.23	851.67	
MH 3 SWR 3 - 1	204.00	2.67	4.00	5.11	11.70	6.74	4.30	12.15	6.97	4.52	352.48	

Total earth volume for sewer trenches = 1494 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Existing 5yr Storm



Program: UDSEWER Math Model Interface 2.1.1.4 Run Date: 7/29/2020 9:59:09 AM	UDSewer Results Summary
Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 7/29/2020 9:59:09 AM	**Project Title:** 51478-Mulligan Pines **Project Description:** Existing Storm System - 100YR Existing Conditions

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 0.00

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6668.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	6676.78	57.60	36.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 2 SWR 2 - 1	6679.33	21.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 3 SWR 3 - 1	6684.86	21.20	21.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
MH 1 SWR 1 - 1	0.00	0.00	0.00	0.00	36.40	0.00	0.00	0.00	57.60	
MH 2 SWR 2 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.20	Surface Water Present (Downstream)
MH 3 SWR 3 - 1	0.00	0.00	0.00	0.00	21.20	0.00	0.00	0.00	21.20	Surface Water Present (Downstream)

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	135.00	6660.98	6.3	6669.48	0.013	0.00	0.00	CIRCULAR	24.00 in	24.00 in
MH 2 SWR 2 - 1	438.00	6669.78	0.7	6672.85	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
MH 3 SWR 3 - 1	204.00	6673.15	2.6	6678.45	0.011	1.00	0.00	CIRCULAR	20.00 in	20.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
MH 1 SWR 1 - 1	56.93	18.12	24.00	18.33	24.00	18.33	0.00	Pressurized	57.60	135.00	Velocity is Too High
MH 2 SWR 2 - 1	18.98	6.04	24.00	6.75	24.00	6.75	0.00	Pressurized	21.20	438.00	
MH 3 SWR 3 - 1	26.58	12.18	19.06	9.89	13.50	13.53	2.38	Pressurized	21.20	204.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
MH 1 SWR 1 - 1	57.60	CIRCULAR	24.00 in	24.00 in	27.00 in	27.00 in	24.00 in	24.00 in	3.14	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
MH 2 SWR 2 - 1	21.20	CIRCULAR	24.00 in	24.00 in	27.00 in	27.00 in	24.00 in	24.00 in	3.14	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
MH 3 SWR 3 - 1	21.20	CIRCULAR	20.00 in	20.00 in	21.00 in	21.00 in	20.00 in	20.00 in	2.18	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width.

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.

- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 0.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1 SWR 1 - 1	6660.98	6669.48	0.00	0.00	6662.98	6671.68	6668.19	8.71	6676.90
MH 2 SWR 2 - 1	6669.78	6672.85	0.93	0.00	6677.13	6680.95	6677.83	3.83	6681.66
MH 3 SWR 3 - 1	6673.15	6678.45	1.47	0.00	6682.42	6685.79	6683.89	3.37	6687.26

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

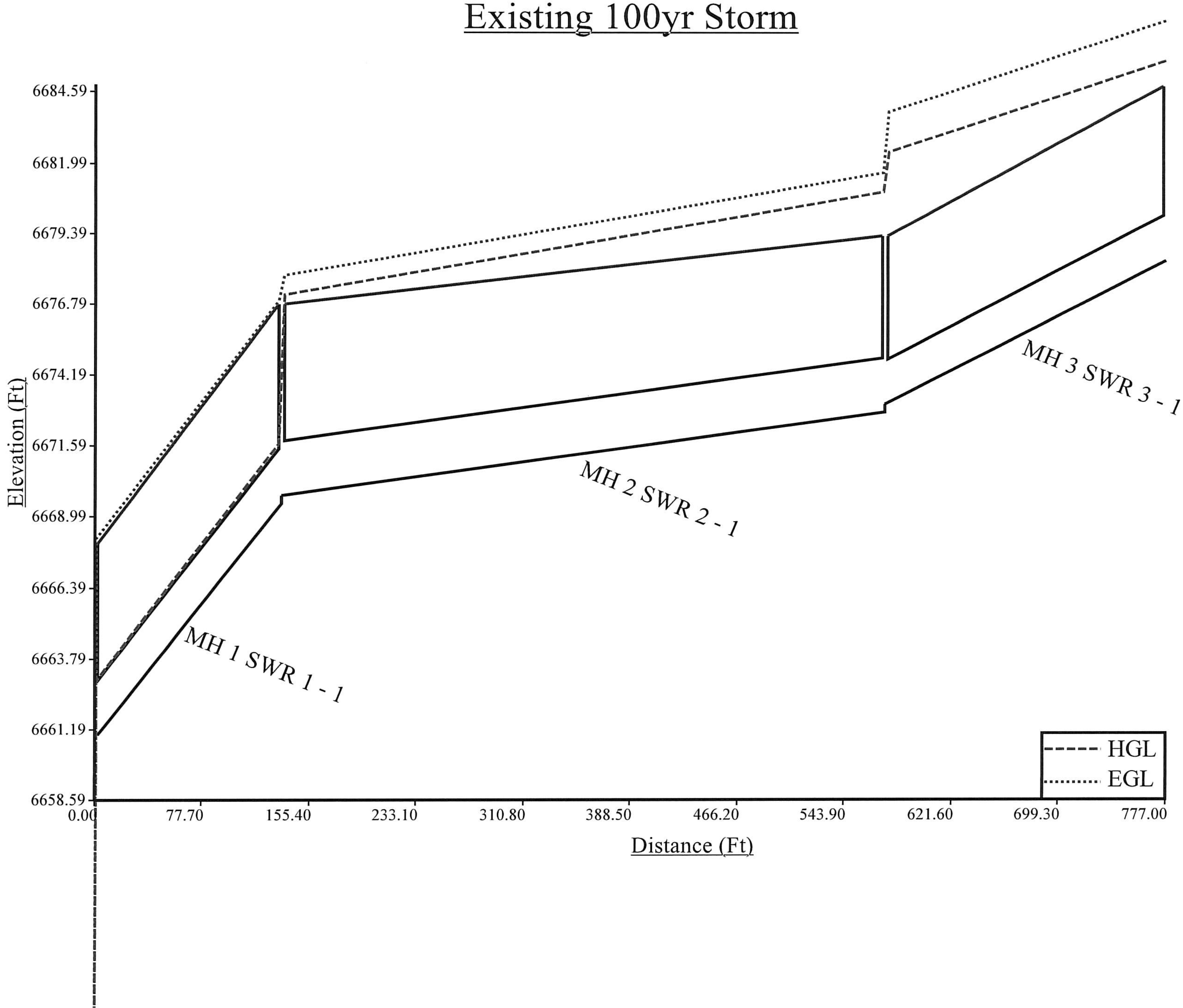
					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
MH 1 SWR 1 - 1	135.00	3.00	4.00	5.50	13.05	7.61	4.78	13.60	7.88	5.05	289.64	
MH 2 SWR 2 - 1	438.00	3.00	4.00	5.50	12.99	7.58	4.75	11.96	7.06	4.23	851.67	
MH 3 SWR 3 - 1	204.00	2.67	4.00	5.11	11.70	6.74	4.30	12.15	6.97	4.52	352.48	

Total earth volume for sewer trenches = 1494 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.

- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Existing 100yr Storm



Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 7/29/2020 9:53:57 AM	**UDSewer Results Summary** **Project Title:** 51478-Mulligan Pines **Project Description:** Existing Storm System - 5YR Developed Conditions

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 0.00

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6668.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	6676.78	19.70	13.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 2 SWR 2 - 1	6679.33	6.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 3 SWR 3 - 1	6684.86	6.30	6.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
MH 1 SWR 1 - 1	0.00	0.00	0.00	0.00	13.40	0.00	0.00	0.00	19.70	
MH 2 SWR 2 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.30	
MH 3 SWR 3 - 1	0.00	0.00	0.00	0.00	6.30	0.00	0.00	0.00	6.30	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	135.00	6660.98	6.3	6669.48	0.013	0.00	0.00	CIRCULAR	24.00 in	24.00 in
MH 2 SWR 2 - 1	438.00	6669.78	0.7	6672.85	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
MH 3 SWR 3 - 1	204.00	6673.15	2.6	6678.45	0.011	1.00	0.00	CIRCULAR	20.00 in	20.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
MH 1 SWR 1 - 1	56.93	18.12	19.14	7.33	9.74	16.47	3.72	Supercritical	19.70	0.00	
MH 2 SWR 2 - 1	18.98	6.04	10.66	4.67	9.52	5.43	1.24	Supercritical Jump	6.30	23.46	
MH 3 SWR 3 - 1	26.58	12.18	11.28	4.97	6.63	9.98	2.77	Supercritical	6.30	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
MH 1 SWR 1 - 1	19.70	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 2 SWR 2 - 1	6.30	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
MH 3 SWR 3 - 1	6.30	CIRCULAR	20.00 in	20.00 in	12.00 in	12.00 in	20.00 in	20.00 in	2.18	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 0.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		

Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
MH 1 SWR 1 - 1	6660.98	6669.48	0.00	0.00	6661.79	6671.07	6666.00	5.91	6671.91
MH 2 SWR 2 - 1	6669.78	6672.85	0.08	0.00	6671.93	6673.74	6671.99	2.08	6674.08
MH 3 SWR 3 - 1	6673.15	6678.45	0.13	0.00	6673.87	6679.39	6675.24	4.53	6679.77

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

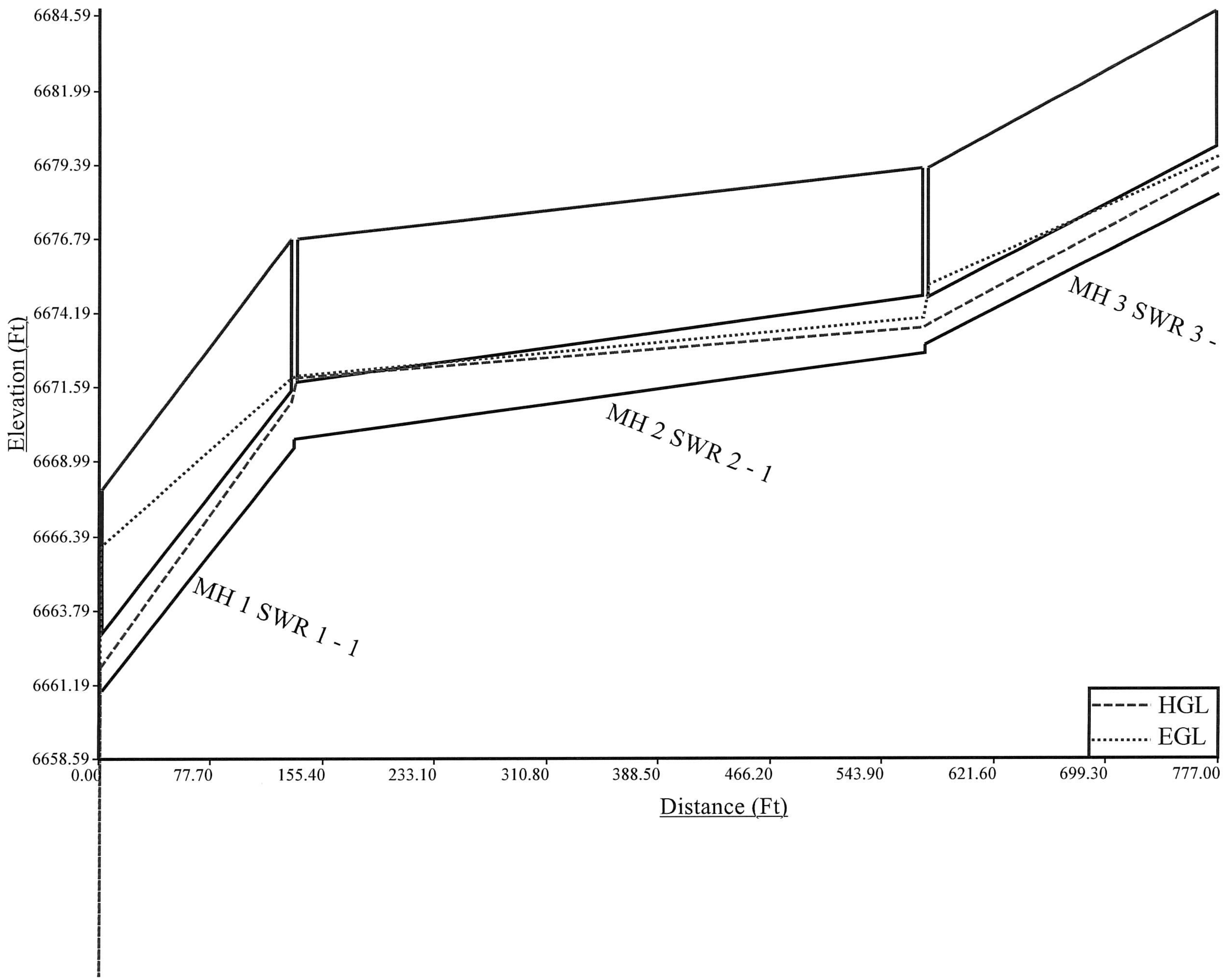
The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
MH 1 SWR 1 - 1	135.00	3.00	4.00	5.50	13.05	7.61	4.78	13.60	7.88	5.05	289.64	
MH 2 SWR 2 - 1	438.00	3.00	4.00	5.50	12.99	7.58	4.75	11.96	7.06	4.23	851.67	
MH 3 SWR 3 - 1	204.00	2.67	4.00	5.11	11.70	6.74	4.30	12.15	6.97	4.52	352.48	

Total earth volume for sewer trenches = 1494 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Developed 5yr Storm



Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 7/29/2020 10:07:00 AM	# UDSewer Results Summary **Project Title:** 51478-Mulligan Pines **Project Description:** Existing Storm System - 100YR Developed Conditions

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 0.00

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6668.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	6676.78	57.60	35.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 2 SWR 2 - 1	6679.33	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 3 SWR 3 - 1	6684.86	21.70	21.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
MH 1 SWR 1 - 1	0.00	0.00	0.00	0.00	35.90	0.00	0.00	0.00	57.60	
MH 2 SWR 2 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.70	Surface Water Present (Downstream)
MH 3 SWR 3 - 1	0.00	0.00	0.00	0.00	21.70	0.00	0.00	0.00	21.70	Surface Water Present (Downstream)

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	135.00	6660.98	6.3	6669.48	0.013	0.00	0.00	CIRCULAR	24.00 in	24.00 in
MH 2 SWR 2 - 1	438.00	6669.78	0.7	6672.85	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
MH 3 SWR 3 - 1	204.00	6673.15	2.6	6678.45	0.011	1.00	0.00	CIRCULAR	20.00 in	20.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
MH 1 SWR 1 - 1	56.93	18.12	24.00	18.33	24.00	18.33	0.00	Pressurized	57.60	135.00	Velocity is Too High
MH 2 SWR 2 - 1	18.98	6.04	24.00	6.91	24.00	6.91	0.00	Pressurized	21.70	438.00	
MH 3 SWR 3 - 1	26.58	12.18	19.13	10.10	13.74	13.59	2.36	Pressurized	21.70	204.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
MH 1 SWR 1 - 1	57.60	CIRCULAR	24.00 in	24.00 in	27.00 in	27.00 in	24.00 in	24.00 in	3.14	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
MH 2 SWR 2 - 1	21.70	CIRCULAR	24.00 in	24.00 in	27.00 in	27.00 in	24.00 in	24.00 in	3.14	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
MH 3 SWR 3 - 1	21.70	CIRCULAR	20.00 in	20.00 in	21.00 in	21.00 in	20.00 in	20.00 in	2.18	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width.

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.

- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 0.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1 SWR 1 - 1	6660.98	6669.48	0.00	0.00	6662.98	6671.68	6668.19	8.71	6676.90
MH 2 SWR 2 - 1	6669.78	6672.85	0.98	0.00	6677.14	6681.15	6677.88	4.01	6681.89
MH 3 SWR 3 - 1	6673.15	6678.45	1.54	0.00	6682.68	6686.22	6684.22	3.53	6687.75

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

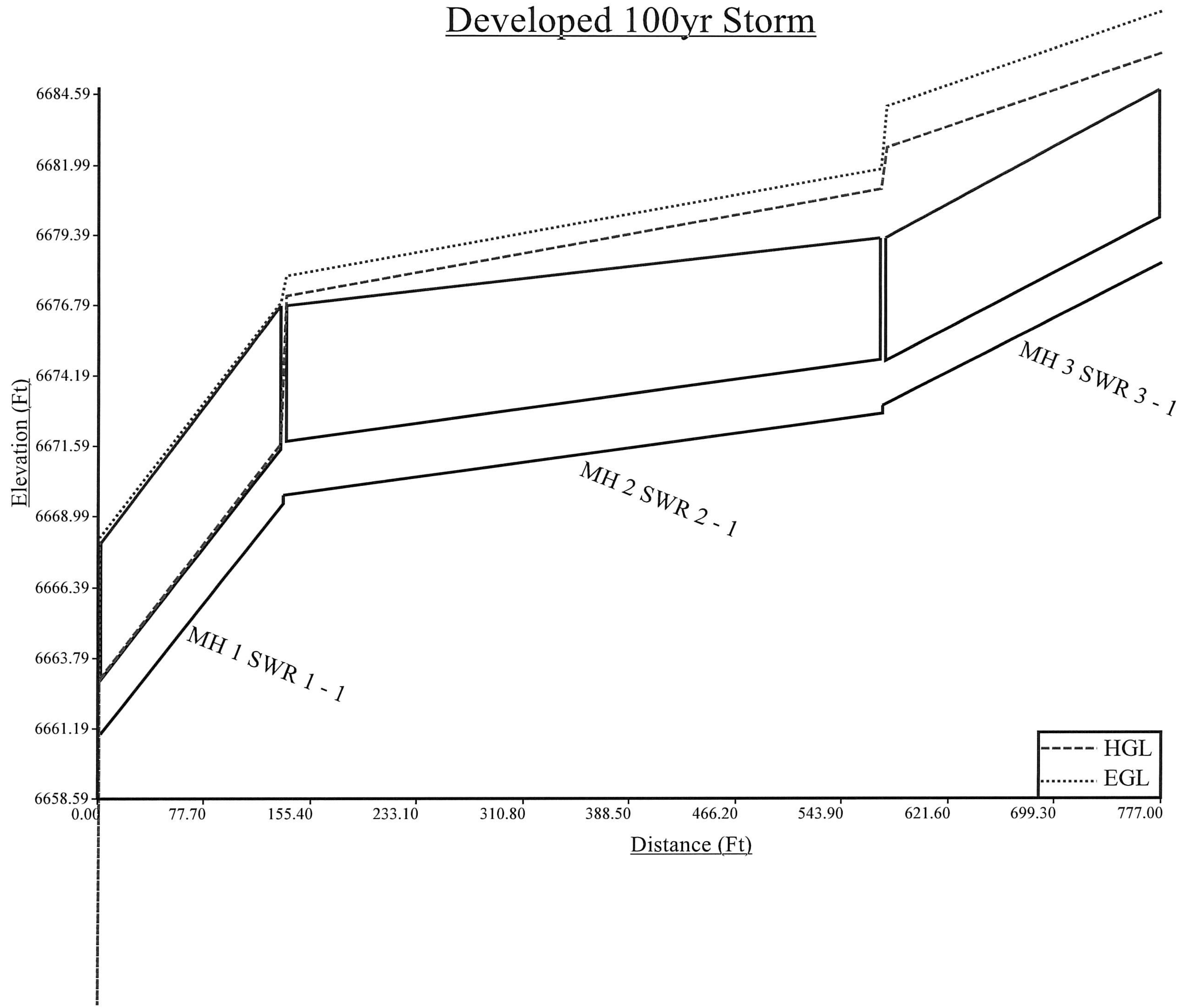
					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
MH 1 SWR 1 - 1	135.00	3.00	4.00	5.50	13.05	7.61	4.78	13.60	7.88	5.05	289.64	
MH 2 SWR 2 - 1	438.00	3.00	4.00	5.50	12.99	7.58	4.75	11.96	7.06	4.23	851.67	
MH 3 SWR 3 - 1	204.00	2.67	4.00	5.11	11.70	6.74	4.30	12.15	6.97	4.52	352.48	

Total earth volume for sewer trenches = 1494 cubic yards.

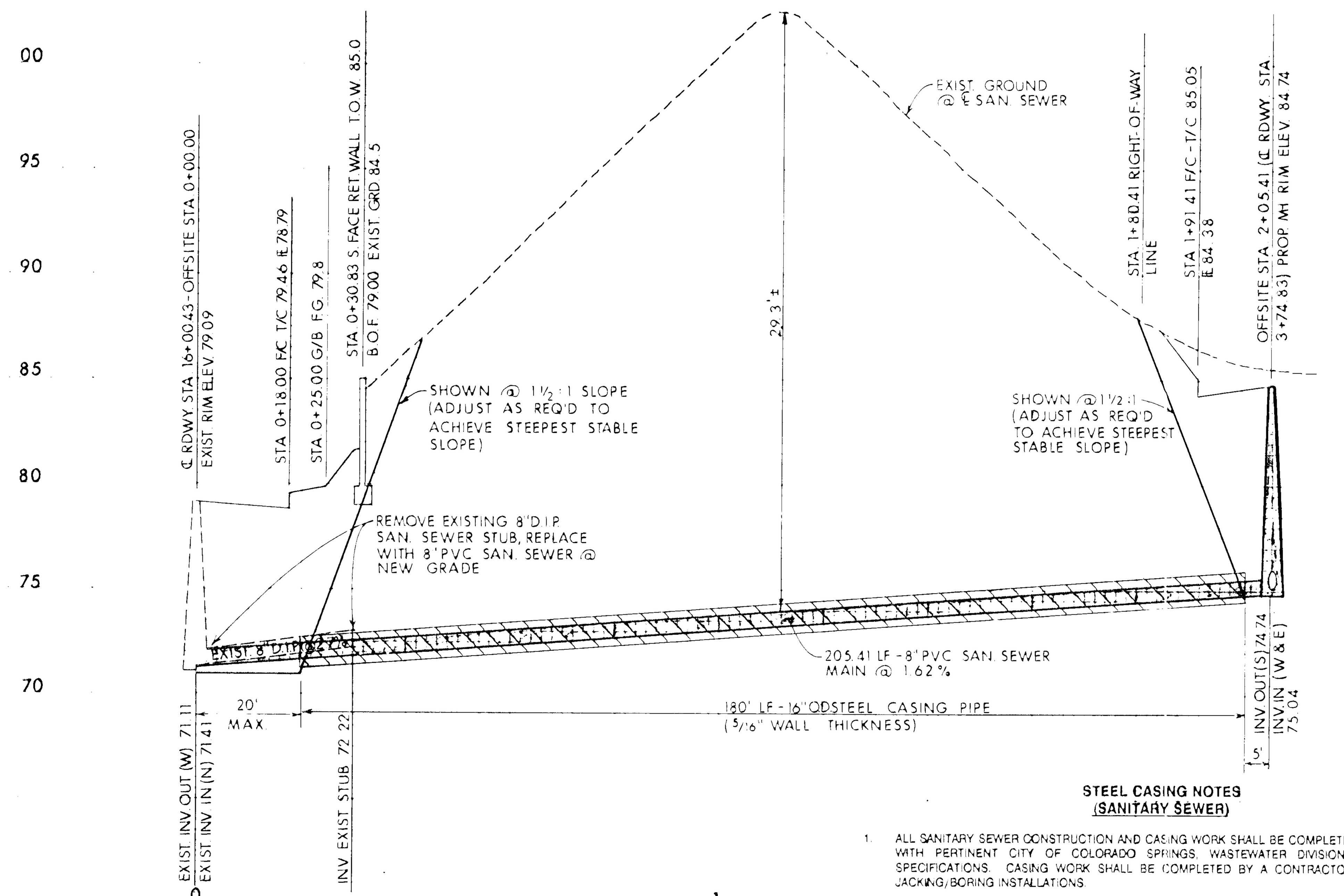
- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.

- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Developed 100yr Storm



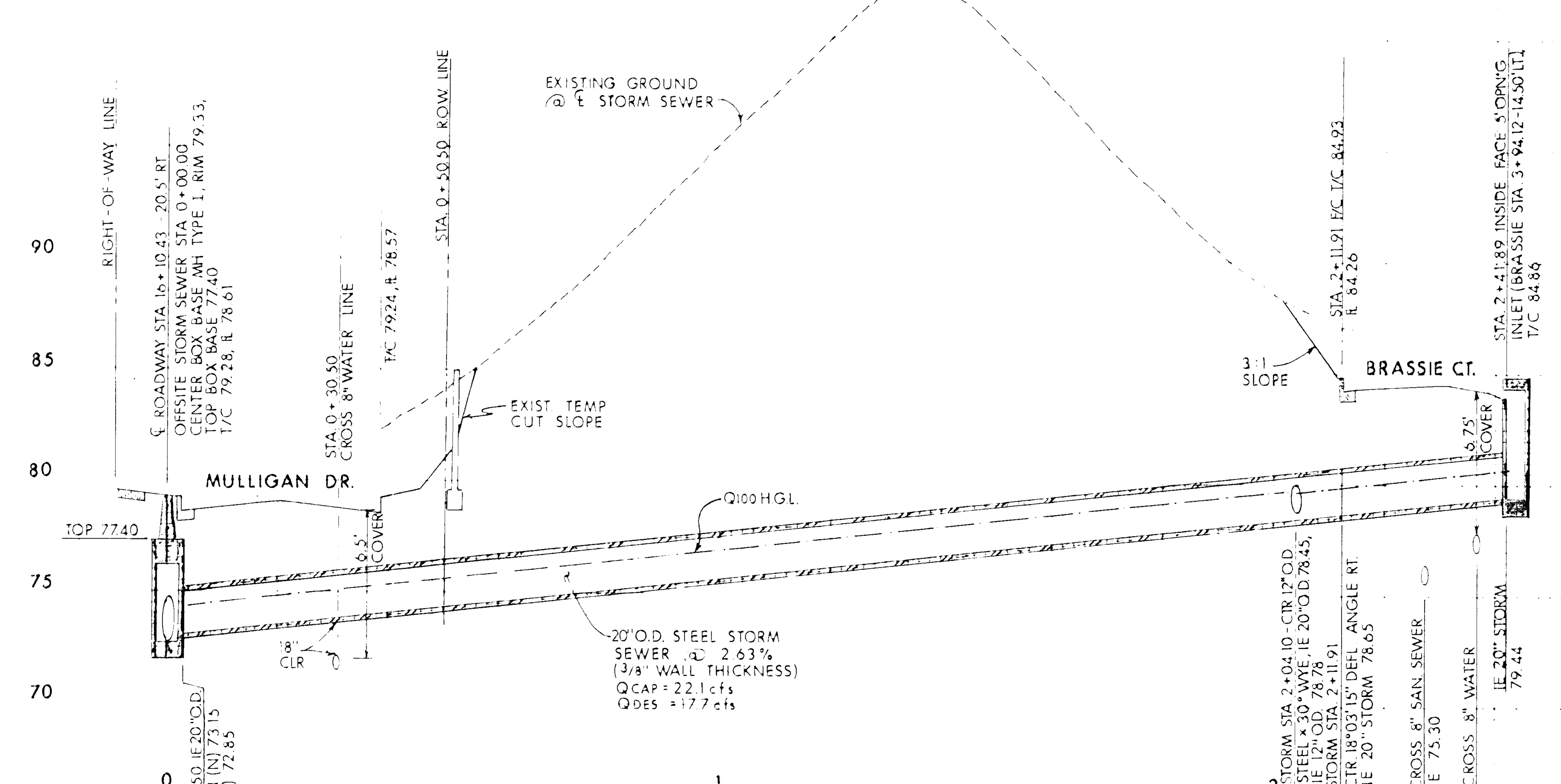
PINEWOODS SUB. (PLAT BOOK E-4, PAGE 177)
NOTE: 4' DETACHED CONCRETE SIDEWALK SHALL BE CONSTRUCTED IN THE APPROXIMATE LOCATION SHOWN HEREON. LOCATION WILL BE DIRECTED BY THE OWNER IN THE FIELD. AN EASEMENT WILL BE PROVIDED AFTER CONSTRUCTION.
CITY OF COLORADO SPRINGS
FILED IN ACCORDANCE WITH SECTION 15-3-1503 (ENACTED AS ORDINANCE 82-56) OF THE CODE OF THE CITY OF COLORADO SPRINGS, AS AMENDED.
CITY ENGINEER 11/2/92
ENGINEER'S DRAINAGE STATEMENT:
THESE PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE CITY FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY THE NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
Roland G. Obering 8/14/92
ROLAND G. OBERING, P.E. & P.L.S. COLORADO 13226
DEVELOPER'S STATEMENT:
ALL SANITARY SEWER CONSTRUCTION SHALL BE TO CITY OF COLORADO SPRINGS STANDARDS AND SPECIFICATIONS. MATERIALS SHALL BE PVC OR D.I.P. AS NOTED.
SET MANHOLE RIMS (IN PAVEMENT AREAS) 0.3 FOOT BELOW FINISHED TOP OF PAVEMENT ELEVATION AT TIME OF CONSTRUCTION. RAISE TO TOP OF PAVEMENT ELEVATION AFTER PAVING.
ALL SANITARY SEWER MAINS AND MANHOLES WITHIN THE EASEMENTS SHALL BECOME THE PROPERTY OF, AND SHALL BE MAINTAINED BY THE CITY OF COLORADO SPRINGS.
ANY CHANGES OR ALTERATIONS EFFECTING THE GRADE ALIGNMENT, ELEVATION AND/OR DEPTH OF COVER OF SEWERS AND APPURTENANCES SHOWN ON THIS DRAWING SHALL BE THE RESPONSIBILITY OF THE DEVELOPER.
SIGNED OWNER/DEVELOPER DATE 8/17/92
BENCHMARK: SANITARY SEWER MANHOLE RIM IN SPRINGCREST ROAD ON WEST PROPERTY LINE OF PINE CREEK SUB. FILING NO. 1 EL. 6620.34 U.S.G.S.
TRAFFIC REVIEW: REVIEWED BY TITLE DATE 10-29-92
BRASSIE COURT
CONSTRUCT ROCK SLOPE/WALL AS REQUIRED TO PROTECT EXISTING TREES (typ.)
CONSTRUCT ROCK SLOPE/WALL AS REQUIRED TO PROTECT EXIST. TREES
EXISTING DIA PINES TO BE RELOCATED BY OWNER
RETAINING WALL
DESIGN DATA:
SIDEWALK WIDTH 4'; LOCATION: Attached / Detached, 6" from P/L; CURB TYPE 1B 2B 3D; R/W WIDTH 55'-50'; F/C-F/C 34'-28'; STREET TYPE HILLSIDE-RES.; R-VALUE CBR=17; ASPHALT THICKNESS: AC Surface 3" [5"]; AC Base; AGG. BASE THICKNESS: Class 6, Class 5 4" [N/A]
*SIDEWALK-AS SHOWN ON PLAN
( )=FULL DEPTH ASPHALT ALTERNATE
* REFER TO PAVEMENT DESIGN LETTER BY CTL THOMPSON, FEB 11, 1993 (JOB NO CS-3268) FOR FINAL DESIGN.
REVIEW: STREET DESIGN, ROUGH CUT REVIEW, DATE 11/9/92, FINAL REVIEW, DATE 2/25/93
DRAINAGE DESIGN: FILED IN ACCORDANCE WITH SECTION 15-3-906 OF THE CODE OF COLORADO SPRINGS 1980, AS AMENDED, DATE 10/30/92
NOTE: DESIGN SPEED TO BE POSTED @ 20 MPH
STATEMENTS:
THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN; THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.
RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.
THE DESIGN SHOWN CONFORMS TO THE APPROVED PLAN OR PLAT ON FILE WITH THE CITY OF COLORADO SPRINGS. IT IS UNDERSTOOD THAT SUBSEQUENT REVISIONS TO THIS PLAN MAY BE REQUIRED BY THE CITY IF ADJACENT ZONING, PLATTING OR MASTER DEVELOPMENT PLAN CHANGES OCCUR.
PINE CREEK SUB. FILING NO. 1 (PLAT BOOK E-5, PAGE 47)
MATCH EXISTING CURB
LIMITS OF EXISTING CURB CONSTRUCTION FILING NO. 1
MULLIGAN DRIVE (60') (SEE SHEET 1)
EXIST. CROSS PAN
PRE-EXCAVATION CHECKLIST
GAS AND OTHER UTILITY LINES OF RECORD SHOWN ON PLANS.
UTILITIES CENTRAL LOCATING CALLED AT LEAST 2 BUSINESS DAYS AHEAD.
UTILITIES LOCATED AND MARKED
EMPLOYEE BRIEFED ON MARKING AND COLOR CODES.
EMPLOYEES TRAINED ON EXCAVATION AND SAFETY PROCEDURES FOR NATURAL GAS LINES.
WHEN EXCAVATION APPROACHES GAS LINES, EMPLOYEES EXPOSE LINES BY CAREFULL PROBING AND HAND DIGGING.
A.G.A./A.P.W.A. STANDARD UTILITY MARKING COLOR CODE
NATURAL GAS - YELLOW; ELECTRIC - RED; WATER - BLUE; WASTEWATER - GREEN
TOP OF CURB LEFT SIDE
EXISTING GROUND @ LEFT CURBLINE
TOP OF CURB RIGHT SIDE
EXISTING GROUND @ RIGHT CURB
173.42 LF - 8" SAN. SEWER MAIN @ 1.78%
107.04 LF - 8" SAN. SEWER MAIN @ 2.56%
ADD SOILS LETTER FOR CURB/GUTTER REVIEW - TLW/CMB 11/24/92
ADD STORM/SAN. SEWER DESIGN - TLW/CMB 10/9/92
SHEET TITLE: BRASSIE COURT PLAN and PROFILE
PROJECT: PINE CREEK SUBDIVISION FILING NO. 2
PREPARED BY: Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-6200
SCALE 1" = 20'
DATE 8-12-92
DESIGNED BY TLW
CHECKED BY TLW
DRAWN BY CMB
PROJECT NO. 91025
SHEET NO. 2 of 3 SHEETS



OFFSITE SANITARY SEWER PROFILE A

STEEL CASING NOTES
(SANITARY SEWER)

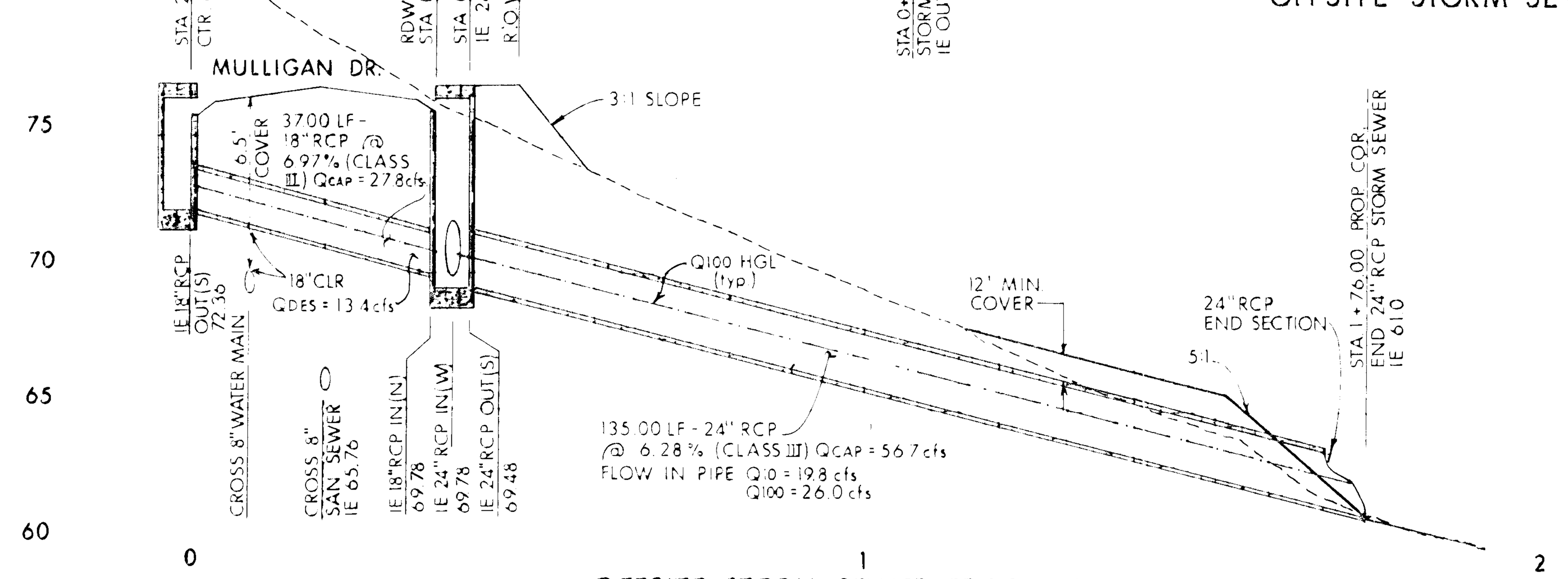
1. ALL SANITARY SEWER CONSTRUCTION AND CASING WORK SHALL BE COMPLETED IN ACCORDANCE WITH PERTINENT CITY OF COLORADO SPRINGS, WASTEWATER DIVISION STANDARDS AND SPECIFICATIONS. CASING WORK SHALL BE COMPLETED BY A CONTRACTOR EXPERIENCED IN JACKING/BORING INSTALLATIONS.
2. STEEL CASING PIPE FOR THE SANITARY SEWER INSTALLATION SHALL BE 5/16" THICKNESS BY 16" O.D. STEEL MEETING AWWA C200 STANDARDS. CASING PIPE SHALL BE INSTALLED BY JACKING OR BORING TO THE LINES AND GRADES SHOWN OR ESTABLISHED.
3. JOINTS SHALL BE BUTT WELDED AND SHALL CONFORM TO THE REQUIREMENTS OF THE AMERICAN WELDING SOCIETY (AWS) CODE AND THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC).
4. THE CARRIER PIPE SHALL BE 8" PVC (SDR 35) MEETING THE REQUIREMENTS OF ASTM D-3034 WITH 12½ FOOT LAYING LENGHTS. PIPE SHALL BE INSTALLED IN THE CASING PIPE FROM THE LOWER END.
5. THE CARRIER PIPE SHALL BE INSTALLED WITH CASING INSULATORS, PSI MODEL A8 (STEEL CASING INSULATOR) OR APPROVED EQUAL IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. A MINIMUM OF THREE (3) INSULATORS SHALL BE USED TO SUPPORT EACH 12½ FOOT PIPE JOINT.
6. THE ENDS OF THE CASING PIPE SHALL BE SEALED WITH PSI END SEAL OR APPROVED EQUAL INSTALLED IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.



OFFSITE STORM SEWER PROFILE A

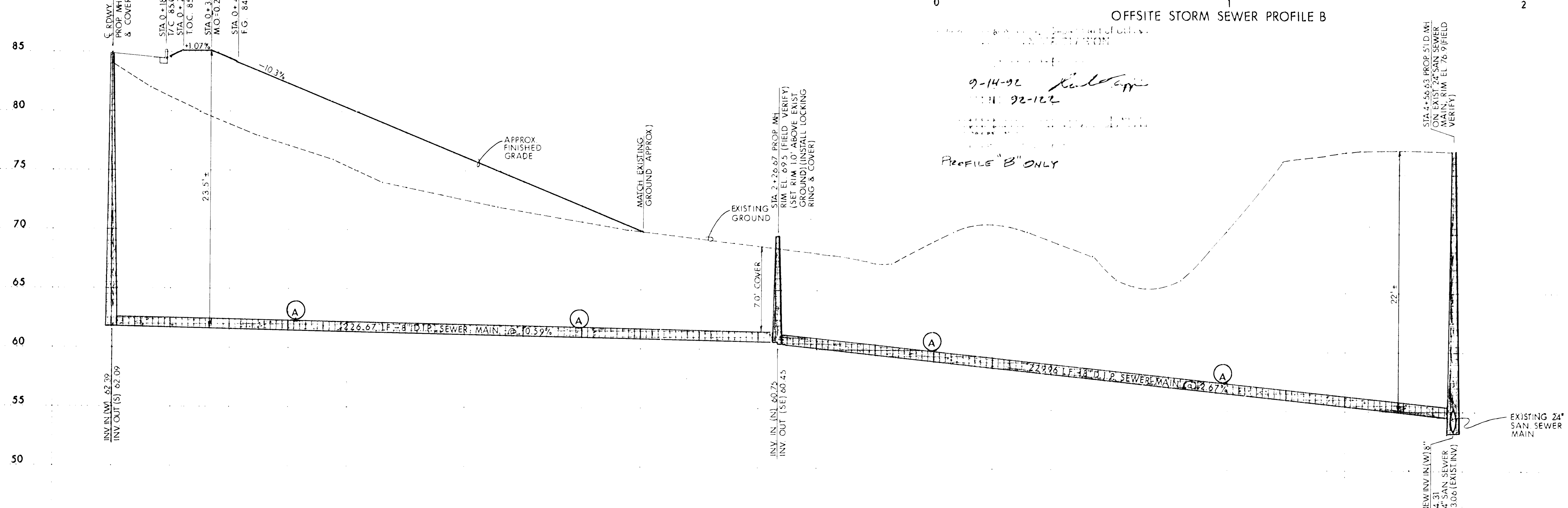
STEEL STORM SEWER NOTES

1. ALL STEEL STORM SEWER CONSTRUCTION SHALL BE COMPLETED IN ACCORDANCE WITH PERTINENT CITY OF COLORADO SPRINGS, ENGINEERING DIVISION STANDARDS AND SPECIFICATIONS. WORK SHALL BE COMPLETED BY CONTRACTOR EXPERIENCED IN JACKING/BORING AND WELDING OF STEEL PIPE.
2. STEEL STORM SEWER PIPE SHALL BE A MINIMUM 3/8" THICKNESS BY 20" O.D. STEEL (AWWA C200) INSTALLED BY JACKING OR BORING BETWEEN ± STA. 0+50 AND 2+10. INSTALLATION IN OTHER AREAS SHALL BE BY CONVENTIONAL MEANS. THE STEEL LATERAL SHALL BE A MINIMUM 3/8" THICKNESS BY 12" O.D. STEEL, FIELD WELDED.
3. JOINTS AND BENDS SHALL BE BUTT WELDED AND SHALL CONFORM TO REQUIREMENTS OF THE AMERICAN WELDING SOCIETY (AWS) CODE AND THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) SPECIFICATIONS.



OFFSITE STORM SEWER PROFILE B

9-14-92
92-122
PROFILE "B" ONLY



OFFSITE SANITARY SEWER PROFILE B

ENGINEER'S DRAINAGE STATEMENT:

THESE PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE CITY FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY THE NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.

Roland G. Obering
ROLAND G. OBERING, P.E. & P.L.S. COLORADO 13226

DEVELOPER'S STATEMENT:

ALL SANITARY SEWER CONSTRUCTION SHALL BE TO CITY OF COLORADO SPRINGS STANDARDS AND SPECIFICATIONS. MATERIALS SHALL BE PVC OR DIP AS NOTED.

SET MANHOLE RIMS (IN PAVEMENT AREAS) 0.3 FOOT BELOW FINISHED TOP OF PAVEMENT ELEVATION AT TIME OF CONSTRUCTION. RAISE TO TOP OF PAVEMENT ELEVATION AFTER PAVING.

ALL SANITARY SEWER MAINS AND MANHOLES WITHIN THE EASEMENTS SHALL BECOME THE PROPERTY OF, AND SHALL BE MAINTAINED BY THE CITY OF COLORADO SPRINGS.

ANY CHANGES OR ALTERATIONS EFFECTING THE GRADE ALIGNMENT, ELEVATION AND/OR DEPTH OF COVER OF SEWERS AND APPURTENANCES SHOWN ON THIS DRAWING SHALL BE THE RESPONSIBILITY OF THE DEVELOPER.

SIGNED: [signature] OWNER/DEVELOPER DATE 8/19/92

STATEMENT:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN; THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.
RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

REVIEW:

STREET DESIGN:
ROUGH CUT REVIEW ________ DATE ________
FINAL REVIEW ________ DATE ________
DRAINAGE DESIGN:
FILED IN ACCORDANCE WITH SECTION 15-3-906 OF THE CODE OF COLORADO SPRINGS 1980, AS AMENDED TRM for City Eng DATE 10/27/92

DESIGN DATA: N/A

SIDEWALKS: WIDTH ________
LOCATION: Attached ☐
Detached, 6" from P/L ☐
CURB TYPE 1 ☐ 2 ☐ 3 ☐
R/W WIDTH ________ F/C - F/C ________
STREET TYPE ________ HVEEM ________

ASPHALT THICKNESS:
AC Surface ________
AC Base ________
AGG. BASE THICKNESS:
Class 6 ________
Class 5 ________
Class 2 ________

SCALE: HORIZ. 1" = 20' VERT. 1" = 5'

BENCHMARK: SANITARY SEWER MANHOLE RIM IN SPRINGCREST ROAD ON WEST PROPERTY LINE OF PINE CREEK SUB. FILING NO. 1, EL. 6620.34 U.S.G.S.

REVISIONS:

NO.	DESCRIPTION	DATE
1	REV. PER WASTEWATER COMMENTS	9-10-92

ENGINEER: Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado 80907
Phone (719) 531-6200

DESIGNED BY: TLW DATE: AUG. 1992
DRAWN BY: CMB DATE: AUG. 1992
CHECKED BY: TLW DATE: AUG. 1992

PROJECT OFFSITE SANITARY & STORM SEWER PROFILES
FROM MULLIGAN DRIVE TO SOUTH
SUBDIVISION PINE CREEK SUBDIVISION FILING NO. 2
DRAINAGE BASIN PINE CREEK DRAINAGE BASIN
JOB NO. 91025 SHEET 3 OF 8

STATEMENT:
THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN; THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.

RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

REVIEW: Curb & Gutter Review: ORM for City Eng 11/23/92
STREET DESIGN:
ROUGH CUT REVIEW ORM for City Eng
DATE 10/30/92
FINAL REVIEW ORM for City Eng
DATE 2/24/93
DRAINAGE DESIGN:
FILED IN ACCORDANCE WITH SECTION 15-3-906 OF THE CODE OF COLORADO SPRINGS 1980, AS AMENDED ORM for City Eng
DATE 10/30/92

DESIGN DATA:
SIDEWALKS: WIDTH 4'*
LOCATION: Attached ☐
Detached, 6" from P/L ☒
CURB TYPE 1☒ 2☐ 3☐
R/W WIDTH 60'
F/C-F/C 36'
STREET TYPE RESIDENTIAL
~~HVEEM~~ CBR- SEE BELOW
ASPHALT THICKNESS:
AC Surface SEE BELOW
AC Base
AGG. BASE THICKNESS:
Class 6 SEE BELOW
Class 5
Class 2
* SOUTH SIDE ONLY - MULLIGAN DR.

BENCHMARK:
SANITARY SEWER MANHOLE RIM IN SPRINGCREST ROAD ON WEST PROPERTY LINE OF PINE CREEK SUB. FILING NO. 1
EL. 6620.34 U.S.G.S.

TRAFFIC REVIEW:
REVIEWED BY [signature]
TITLE for Traffic Eng.
DATE 10/21/92

THESE PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION.
Roland G. Obering - 8/14/92
ROLAND G. OBERING, P.E. & P.L.S., COLORADO 13226

PAVEMENT DESIGN INFORMATION:

Sta. 14+92.50 to Sta. 19+60 - 3" AC/4" Base, CBR=17
Sta. 19+60 to End of Project - 3" AC/6" Base, CBR=6

OR

5" Full Depth Asphalt Alternate for Entire Street.

Refer to Pavement Design Letter by CTL/Thompson, February 11, 1993 (Job No. CS-3268) for Final Design.

ENGINEER'S DRAINAGE STATEMENT:

THESE PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE CITY FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY THE NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.

Roland G. Obering - 8/14/92
ROLAND G. OBERING, P.E. & P.L.S. COLORADO 13226

MULLIGAN DRIVE CENTERLINE CURVE DATA

	RADIUS	DELTA	LENGTH	TANGENT
(A)	320.86'	17°47'56"	99.67'	50.24'
(B)	235.30'	28°36'39"	117.50'	60.00'
(C)	249.88'	42°35'55"	185.78'	97.42'
(D)	530.26'	31°01'36"	287.15	147.19'

PRE-EXCAVATION CHECKLIST

- ☐ GAS AND OTHER UTILITY LINES OF RECORD SHOWN ON PLANS.
- ☐ UTILITIES CENTRAL LOCATING CALLED AT LEAST 2 BUSINESS DAYS AHEAD.
- ☐ UTILITIES LOCATED AND MARKED
- EMPLOYEE BRIEFED ON MARKING AND COLOR CODES •
- ☐ EMPLOYEES TRAINED ON EXCAVATION AND SAFETY PROCEDURES FOR NATURAL GAS LINES.
- ☐ WHEN EXCAVATION APPROACHES GAS LINES, EMPLOYEES EXPOSE LINES BY CAREFULL PROBING AND HAND DIGGING.

• A.G.A/A.P.W.A. STANDARD UTILITY MARKING COLOR CODE

NATURAL GAS - YELLOW
ELECTRIC - RED
WATER - BLUE
WASTEWATER - GREEN

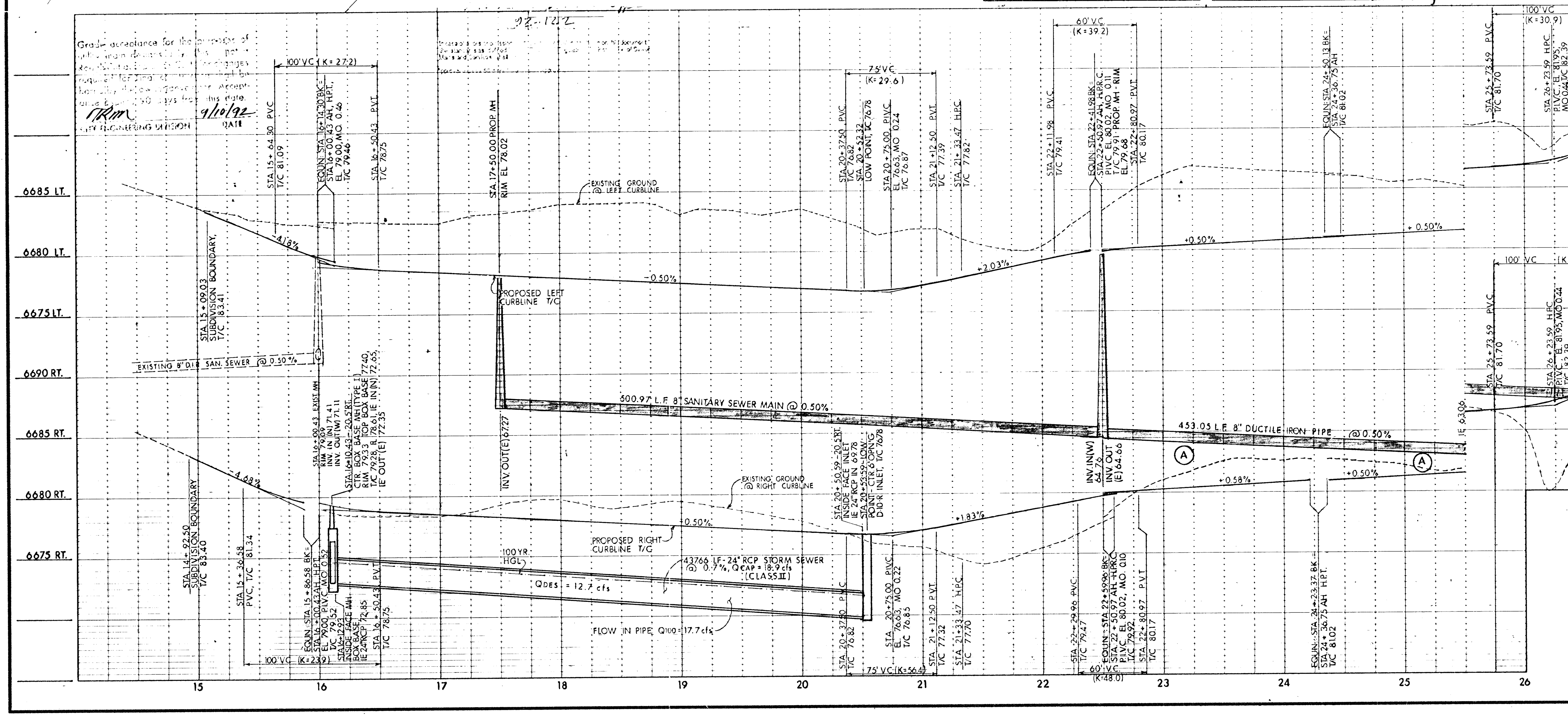
DEVELOPER'S STATEMENT:
ALL SANITARY SEWER CONSTRUCTION SHALL BE TO CITY OF COLORADO SPRINGS STANDARDS AND SPECIFICATIONS. MATERIALS SHALL BE PVC OR DIP AS NOTED.

SET MANHOLE RIMS (IN PAVEMENT AREAS) 0.3 FOOT BELOW FINISHED TOP OF PAVEMENT ELEVATION AT TIME OF CONSTRUCTION. RAISE TO TOP OF PAVEMENT ELEVATION AFTER PAVING.

ALL SANITARY SEWER MAINS AND MANHOLES WITHIN THE EASEMENTS SHALL BECOME THE PROPERTY OF, AND SHALL BE MAINTAINED BY THE CITY OF COLORADO SPRINGS.

ANY CHANGES OR ALTERATIONS EFFECTING THE GRADE ALIGNMENT, ELEVATION AND/OR DEPTH OF COVER OF SEWERS AND APPURTENANCES SHOWN ON THIS DRAWING SHALL BE THE RESPONSIBILITY OF THE DEVELOPER.

SIGNED: [signature] 8/19/92
OWNER/DEVELOPER DATE



2 - 10/9/92 ADD STORM SEWER DESIGN - TLW-CMB
1 - 9/10/92 REV. PER WASTEWATER COMMENTS - TLW/CMB
3 - ADD SOILS LETTER FOR CURB/GUTTER REVIEW - TLW-CMB 11/24/92

SHEET TITLE: MULLIGAN DRIVE PLAN & PROFILE
PROJECT: PINE CREEK SUB. FILING NO. 2

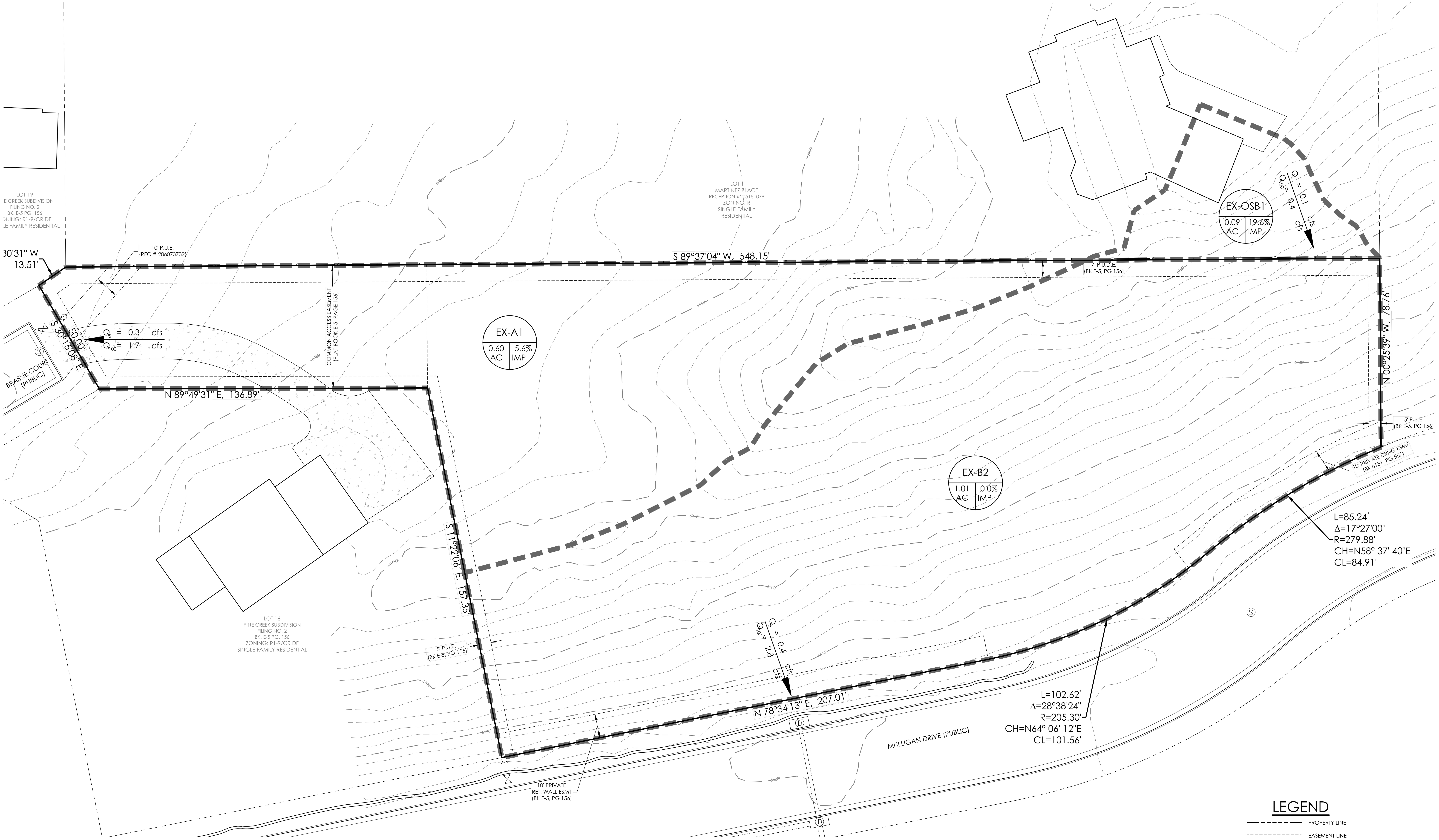
PREPARED BY:
Obering, Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors
1015 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-6200

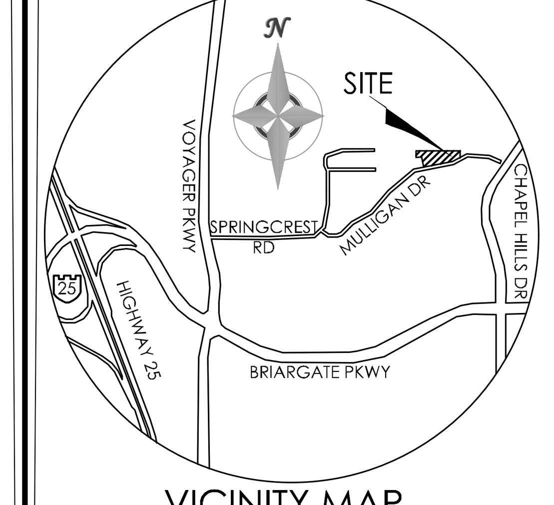
FIELD BOOK NO.
SCALE: 1"=50'H; 1"=5'V
DATE:
DESIGNED BY: TLW
CHECKED BY: RGO
DRAWN BY: CMB
PROJECT NO. 91025
SHEET NO. 1 OF 3 SHEETS

9210-10c

4 Drainage Maps

Existing Conditions Drainage Map	(Map Pocket)
Proposed Conditions Drainage Map	(Map Pocket)
Overall Basin Map (Modification of Pine Creek Subdivision Filing No. 2)	(Map Pocket)





VICINITY MAP

NOT TO SCALE

BENCHMARK

THE BENCHMARK FOR ELEVATIONS SHOWN ON THIS DRAWING IS CSU FIMS 2011 CONTOURS ELEVATION = (NAVD88).

BASIS OF BEARINGS:

5 0 10 20 40

1" = 20' 1:240

MVE INC.

ENGINEERS / SURVEYORS

1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

EXISTING DRAINAGE SUMMARY TABLE

DESIGN POINT / BASIN(S)		AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)
	EX-A1	0.60	8.3	0.3	1.7
	EX-OSB1	0.09	5.3	0.1	0.4
	EX-B2	1.01	6.3	0.4	2.8
(EX)OSB1 & B2		1.11	6.3	0.5	3.2

LEGEND

PROPERTY LINE

EASEMENT LINE

LOT LINE

BUILDING SETBACK LINE

EXISTING

5985 INDEX CONTOUR

84 INTERMEDIATE CONTOUR

X BARBED WIRE FENCE

TREE (EVERGREEN/DECID.)

RD ROOF DRAIN

DS DOWNSPOUT

PROPOSED

5985 INDEX CONTOUR

84 INTERMEDIATE CONTOUR

BASIN BOUNDARY

Q_5 = 19.0 cfs, Q_{100} = 60.0 cfs GENERAL FLOW/DIRECTION

SLOPE DIRECTION

A 0.30 AC 0% IMP BASIN LABEL AREA IN ACRES / PERCENT IMPERVIOUS

1 DESIGN POINT (DP)

DESIGNED BY
DRAWN BY
CHECKED BY ____ ______________
AS-BUILTS BY
CHECKED BY ____ ______________

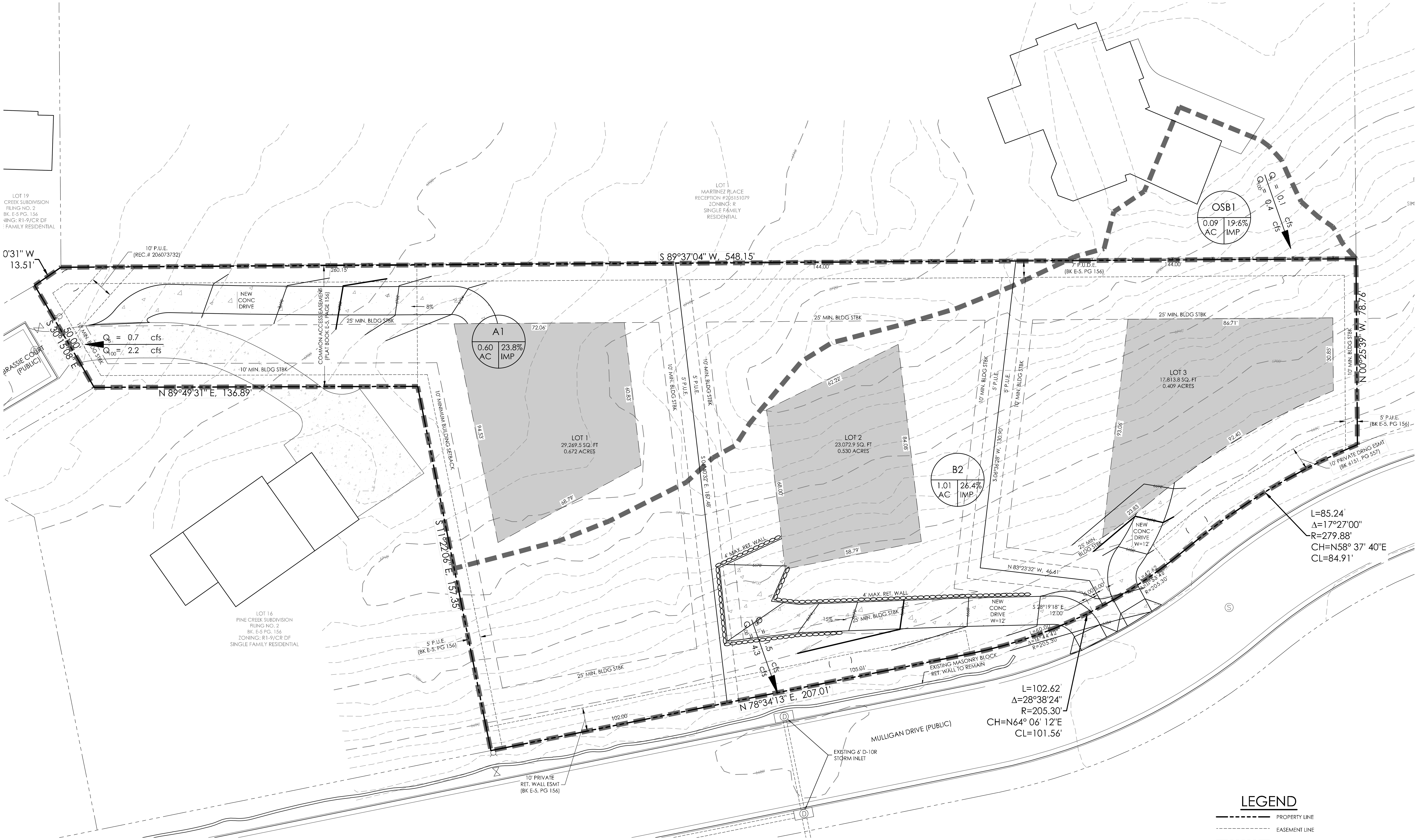
MULLIGAN PINES
SUBDIVISION

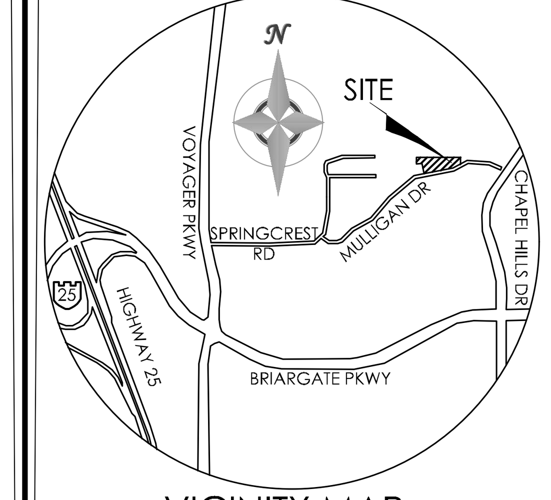
EXISTING
DRAINAGE MAP

MVE PROJECT 51478
MVE DRAWING -EX-DRN

JULY 24, 2020

SHEET 1 OF 1





VICINITY MAP
NOT TO SCALE

BENCHMARK
THE BENCHMARK FOR ELEVATIONS SHOWN ON THIS DRAWING IS CSU FIMS 2011 CONTOURS ELEVATION = (NAVD88).

BASIS OF BEARINGS:

1" = 20' 1:240

MVE, INC.
ENGINEERS / SURVEYORS
1903 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

LEGEND

- PROPERTY LINE
- EASEMENT LINE
- LOT LINE
- BUILDING SETBACK LINE

EXISTING
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- BARBED WIRE FENCE
- TREE (EVERGREEN/DECID.)
- ROOF DRAIN
- DOWNSPOUT

PROPOSED
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- BASIN BOUNDARY
- GENERAL FLOW/DIRECTION (Q_5 = 19.0 cfs, Q_{100} = 60.0 cfs)
- SLOPE DIRECTION
- BASIN LABEL AREA IN ACRES / PERCENT IMPERVIOUS
- DESIGN POINT (DP)

DEVELOPED DRAINAGE SUMMARY TABLE

DESIGN POINT / BASIN(S)		AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)
	A1	0.60	7.5	0.7	2.2
	OSB1	0.09	5.3	0.1	0.4
	B2	1.01	5.1	1.5	4.3
OSB1 & B2		1.11	5.1	1.6	4.7

DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

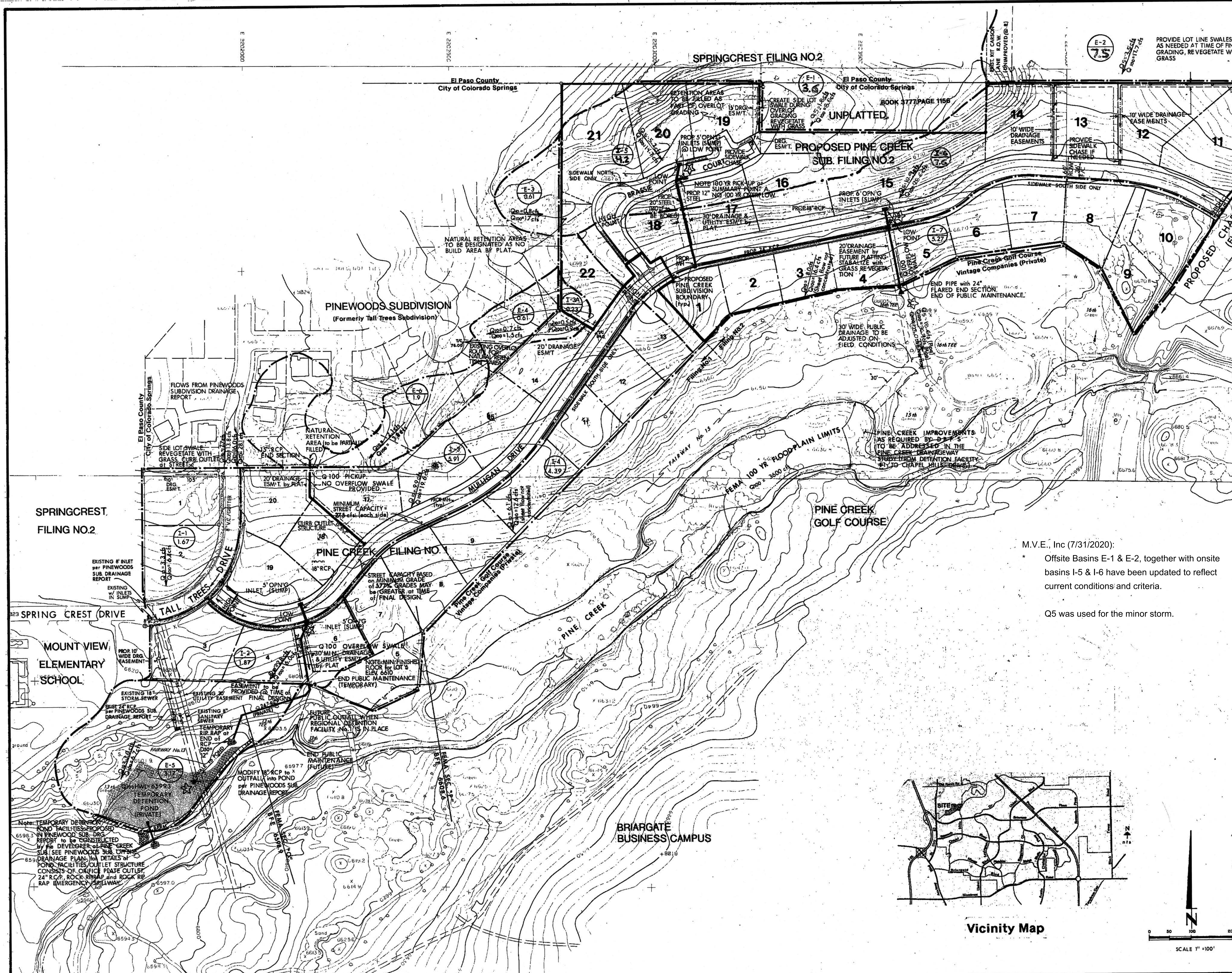
MULLIGAN PINES
SUBDIVISION

DEVELOPED
DRAINAGE MAP

MVE PROJECT 51478
MVE DRAWING -PP-DRN

JULY 24, 2020

SHEET 1 OF 1



M.V.E., Inc (7/31/2020):

* Offsite Basins E-1 & E-2, together with onsite basins I-5 & I-6 have been updated to reflect current conditions and criteria.

Q5 was used for the minor storm.

SUMMARY FLOWS

	Summary Point	Q_{10} cfs	Q_{100} cfs	
*	A	Q5 = 6.3	21.7	*
*	B	Q5 = 13.4	43.6	*
*	C	Q5 = 18.6	61.4	*
	D	12.8	24.7	
	E	18.6	37.4	

NOTE: SEE GRADING & EROSION CONTROL PLAN FOR EROSION PROTECTION REQUIREMENTS.

Legend

- FILING BOUNDARY of PINE CREEK SUB. FILING NO. 2
- LOT LINE
- EXISTING CONTOURS
- PLATTED BOUNDARY (FUTURE)
- SUB-BASIN DRAINAGE BOUNDARY
- SUB-BASIN DESIGNATION / SUB-BASIN ACREAGE
- SUMMARY FLOW DIRECTION and QUANTITY (Q_{10} YEAR / Q_{100} YEAR)
- SUMMARY POINT
- INDIVIDUAL BASIN FLOW QUANTITY (Q_{10} YEAR / Q_{100} YEAR)
- PROPOSED STORM SEWER (as noted)
- EXISTING STORM SEWER (as noted)
- FEMA 100 YR FLOODPLAIN LIMITS

NO.	DATE	REVISION	BY

DRAINAGE PLAN

PINE CREEK SUB. FILING NO. 2

SCALE: 1" = 100'
DATE: SEPT. 1992
DRAWN BY: CMB
CHECKED BY: SGB
PROJECT NO. 91025
1 OF 1 SHTS

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