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Final Drainage Report

19955 Wigwam Road

Project No. 61180

March 23, 2023

PCD File No.

Final Drainage Report

for

19955 Wigwam Road

Project No. 61180

March 23, 2023

prepared for

Wigwam Development CO LLC
6525 Mount Vernon Drive
Colorado Springs, CO 80909
719.896.0866

prepared by

MVE, Inc.
1903 Lelaray Street, Suite 200
Colorado Springs, CO 80909
719.635.5736

Statements and Acknowledgments

Engineer's Statement

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

_____ _____

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

Developer's Statement

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

_____ _____

John Taylor Date
Wigwam Development Co., LLC
6525 Mount Vernon Drive
Colorado Springs, CO 80909

El Paso County

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

_____ _____

Joshua Palmer, P.E., Date
County Engineer / ECM Administrator

Contents

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed 19955 Wigwam Road site. The report will discuss the recommended drainage improvements to the site and identify drainage requirements relative to the existing conditions and proposed project. This report has been prepared and submitted in accordance with the requirements of the El Paso County development approval process. An Appendix is included with this report with pertinent calculations and graphs used in the drainage analyses and design.

1 General Location and Description

1.1 Location

The proposed 19955 Wigwam Road site is located within a portion of the South ½ of the Northwest ¼ of Section 26, Township 17 South, Range 65 west of the 6th principal meridian in El Paso County, Colorado. The unplatted 7.74 ± acre site is situated east of Interstate 25 and Wigwam Road and located west of Industrial Ave on the east property line. The EPC Assessor's Schedule Number for the site is 57260-00-004 with the address of 19955 Wigwam Road. The adjacent parcels surrounding the site are unplatted. A **Vicinity Map** is included in the **Appendix**.

1.2 Description of Property

The 19955 Wigwam Road site is 7.74 ± acres and zoned I-3 (Heavy Industrial District). This site is primarily used for commercial vehicle parking and storage of building materials within the west ¾ of the site. The existing improvements on the site is an existing 625 SF building with attached septic system. Additionally, existing fencing surrounds the: west ¾ north property line, west property line, and west ¾ south property line.

Ground cover in the storage area is poor with little to no vegetation. There are existing berms along the north, west, and south property lines typical height of 1-2 feet. Additionally, there are several stockpiles of varying aggregate sizes throughout the storage area.

Ground cover in the east ¼ is undisturbed pasture/meadow conditions with fair to good ground cover featuring shrubs/native grasses.

The site slopes generally northwest to southeast with grades ranging from 1% to 10% within the storage area. The berms along the property line feature steep grades of 10% to >33%. No significant drainageways flow through the site and no significant drainage improvements or drainage facilities currently exist on the site.

1.3 Soils

According to the National Resource Conservation Service, there are two (2) soil types identified in the 19955 Wigwam Road site. The primary soil is Fluvaquentic Haplaquolls, nearly level (map unit 29) with a secondary soil, Manazanola silty clay loam, saline, 0 to 2 percent slopes (map unit MzA).

Fluvaquentic Haplaquolls, nearly level (map unit 29) is deep and poorly drained. Permeability is moderate, surface runoff is slow, the hazard of erosion is slight. Fluvaquentic Haplaquolls, nearly level is classified as being part of Hydrologic Soil Group D.

Manazanola silty clay loam, saline, 0 to 2 percent slopes (map unit MzA) is deep and well drained. Permeability is slow, surface runoff is slow, the hazard of erosion is moderate. Manazanola silty clay loam, saline, 0 to 2 percent slopes (map unit MzA) is classified as being part of Hydrologic Soil Group C.

A portion of the 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]

1.4 Flood Insurance

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRM), effective on December 7, 2018.[3] The proposed subdivision is included in Community Panel Numbered 08041C1170 G of the Flood Insurance Rate Maps for the El Paso County. No part of the site is shown to be included in a 100-year flood hazard area as determined by FEMA. A portion of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the **Appendix**.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The 19955 Wigwam Road site is located in the Midway Ranch Drainage Basin (FOFO0800) of the Fountain Creek Major Drainage Basin (FO). This basin drains to the adjacent Fountain Creek east of the site. The Midway Ranch Drainage Basin encompasses a part of the northwest portion of the Town of Wigwam and extends northwest from the site and generally drains southeasterly into Fountain Creek.

2.2 Other Drainage Reports

There are no found drainage reports/letters affecting 19955 Wigwam Road.

2.3 Sub-Basin Description

The existing drainage patterns of the 19955 Wigwam Road are described by three on-site drainage basins. All of these basins are previously disturbed or developed to a degree as described below. All existing basin delineations and data are depicted on the attached **Existing Drainage Map**.

2.3.1 Existing Drainage Patterns (Off-Site)

There are no offsite sub-basins that drain into this site.

2.3.2 Existing Drainage Patterns (On-Site)

Existing Sub-Basin EX-A (7.47± acres) represents the developed site containing the 625 SF building and storage area. This sub-basin features little to no vegetation on the west ¾ with ground cover as compacted bare earth. The east ¼ of this sub-basin is undeveloped pasture/meadow. This sub-basin features mild slopes of 1-5% eventually draining to the southeast corner of the site. This flow exits the site and continues southeasterly and eventually drains into Fountain Creek east of the site.

Existing Sub-Basin EX-B1 (0.06± acres) represents a small portion of the property that drains into the adjacent roadside ditch along Wigwam Road. This sub-basin features mild slopes of 1-3% with a steep gravel stockpile draining southwesterly offsite and continues southeasterly along said ditch.

1 WSS
2 OSD
3 FIRM

Existing Sub-Basin EX-B2 (0.24± acres) represents the south half of the existing berms on the south property line that draining directly into the adjacent south properties. This sub-basin features mild slopes of 1-5% from the south half of the existing berms.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for 19955 Wigwam Road has been prepared according to the report guidelines presented in the latest edition of *El Paso County Drainage Criteria Manual* (DCM)[4]. The County has also adopted portions of the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, especially concerning the calculation of rainfall runoff flow rates.[5] [6] The hydrologic analysis is based on a collection of data from the DCM, the NRCS Web Soil Survey[7], and existing topographic data by Polaris Surveying.

3.2 Hydrologic Criteria

For this Final Drainage Report, the Rational Method as described in the D*rainage Criteria Manual* has been used for all Storm Runoff calculations, as the development and all 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.[8]

The "Water Quality Control Volume procedure, Section 3.2.3 of the *Urban Drainage and Flood Control District Drainage Criteria Manual, Volume 3* (UDFCD)[9] [10]method was used for water quality volume calculations by the Urban Drainage and Flood Control District. Storm routing calculation through the proposed water quality basin was performed using triangular hydrographs based on the rational method peak discharges and times of concentrations with the aid of the detention design spreadsheet, "UD-Detention_v4.06", developed by the Urban Drainage and Flood Control District.[11]

4 Drainage Facility Design

4.1 General Concept

The intent of the drainage concept presented in this Final Drainage Report is to maintain the existing drainage patterns on the site while addressing water quality requirements for the site. Major and minor storm flows will continue to be safely conveyed through the site and downstream.

The existing and proposed drainage hydrologic conditions are described in more detail below. Input data and results for all calculations are included in the **Appendix**. Drainage maps for the hydrology are also included in the **Appendix**.

4 DCM Section 4.3 and Section 4.4
5 CS DCM Vol 1
6 CS DCM Vol 2
7 WSS
8 DCM
9 UDFCD V.2
10 UDFCDV.3
11 UDFCD

4.2 Specific Details

4.2.1 Existing Hydrologic Conditions

Existing Sub-Basin **EX-A** (7.47± acres) represents the storage area containing all existing improvements including the 625 SF building. This sub-basin features little to no vegetation on the west ¾ with ground cover as compacted bare earth. The east ¼ of this sub-basin is undeveloped pasture/meadow. This sub-basin features mild slopes of 1-5% eventually draining to the southeast corner of the site. Existing runoff discharges for this sub-basin are Q_5 = 12.2 cfs and Q_{100} = 27.6 cfs (existing flows) and is denoted as **Existing Design Point 4 (EX-DP4)**. This flow exits the site and continues southeasterly and eventually drains into Fountain Creek east of the site.

Existing Sub-Basin **EX-B1** (0.06± acres) represents a small portion of the property that drains into the adjacent roadside ditch along Wigwam Road. This sub-basin features mild slopes of 1-3% with a steep gravel stockpile draining southwesterly offsite and continues south along said ditch. Existing runoff discharges for this sub-basin are Q_5 = < 0.0 cfs and Q_{100} = 0.3 cfs (existing flows). These flows continue south along said ditch.

Existing Sub-Basin **EX-B2** (0.24± acres) represents the existing berms along the south property line that drains directly into the adjacent south properties. This sub-basin features mild slopes of 1-5% from the south half of the existing berms that drain immediately into the adjacent properties. Existing runoff discharges for this sub-basin are Q_5 = 0.2 cfs and Q_{100} = 0.9 cfs (existing flows).

The **Existing Drainage Map** depicts the existing topographic mapping, drainage basin delineations, drainage patterns, existing drives, drainage facilities, and runoff quantities with a data table including drainage areas and flow rates.

4.2.2 Proposed Hydrologic Conditions

Water quality treatment for the new disturbed and impervious areas on the site will be provided by a proposed Extended Detention Basin (EDB) which will capture, contain, treat and release the Water Quality Capture Volume (WQCV). Additionally, this EDB will provide detention to reduce the downstream effects of the existing and proposed site conditions.

Proposed sub-basin **A1** (3.10 ± acres) is comprised of the developed gravel area and will contain the existing improvements, half of the proposed vehicle storage building, and half of the masonry brick wall to the west. This sub-basin generally drains southeasterly along existing grades with proposed swales along the east and south portions of the sub-basin, draining into the proposed Extended Detention Basin. Developed runoff discharges for this sub-basin are Q_5 = 6.9 cfs and Q_{100} = 14.0 cfs (proposed flows). This runoff combines with additional flows from Design Point 1 (DP1) before entering the proposed Extended Detention Basin at **Design Point 2 (DP2)**.

Proposed sub-basin **A2** (2.02 ± acres) is comprised of the south half of the developed gravel area, some concrete pavement, half of the proposed vehicle storage building, and the masonry brick wall located south of the existing entrance to the site. This sub-basin generally drains southeasterly along existing grades with a proposed v-ditch along the south portion of the sub-basin. Developed runoff discharges for this sub-basin are Q_5 = 4.3 cfs and Q_{100} = 9.0 cfs (proposed flows). This runoff combines with flows from proposed sub-basin A3 at **Design Point 1 (DP1)**.

Proposed sub-basin **A3** (0.19 ± acres) is the landscaped area west of the masonry brick wall. Runoff within this sub-basin will drain within a shallow landscaped area along the front of the property with a small berm separating this landscaped area from the existing roadside ditch. No flows from this sub-basin will drain westerly offsite into the roadside ditch. This sub-basins will feature an average slope of 1% draining southeast along the masonry brick wall. Developed/existing runoff discharges for this sub-basin are Q_5 = 0.2 cfs and Q_{100} = 0.8 cfs (proposed flows) with no flows from this sub-basin to drain westerly offsite into said roadside ditch. This runoff drains at the southeast corner and into the adjacent sub-basin A2 and combines with runoff from A2 at **Design Point 1 (DP1).**

Proposed sub-basin **B1** (0.04 ± acres) is the westerly portion of a graded berm created from the proposed v-ditch that connects A3 and A2. This runoff will drain immediately west into the existing roadside ditch along Wigwam Road at grades of 4:1 along said berm. Existing runoff discharges for this sub-basin are Q_5 = 0.2 cfs and Q_{100} = 0.9 cfs (existing flows) with proposed runoff discharges of Q_5 = < 0.1 cfs and Q_{100} = 0.2 cfs (proposed flows). This results in a reduction of Q_5 = ~ 0.1 cfs and Q_{100} = 0.7 cfs affecting the drainage within the Wigwam Road Right of Way.

Proposed sub-basin **B2** (0.12 ± acres) is a portion of a proposed graded berm along the south property line that drains immediately south into the adjacent southeast property. Runoff will follow proposed grades of 3:1 to 4:1 along said berm. Existing runoff discharges for this sub-basin are Q_5 = 0.2 cfs and Q_{100} = 0.9 cfs (existing flows) with proposed runoff discharges of Q_5 = 0.1 cfs and Q_{100} = 0.5 cfs (proposed flows). This results in a reduction of Q_5 = 0.1 cfs and Q_{100} = 0.4 cfs affecting the south adjacent properties. This runoff is expected to continue easterly and drain into Industry Avenue ROW which continues southeasterly eventually into Fountain Creek.

Proposed sub-basin **C** (0.67 ± acres) is the bermed area and concrete drainage components for the proposed EDB. This sub-basin features 4:1 to 5:1 slopes along the side slopes of the EDB, shallow slopes along the floor ,concrete trickle channel, and outlet structure. Developed runoff discharges for this sub-basin are Q_5 = 0.7 cfs and Q_{100} = 2.8 cfs (proposed flows) draining into the EDB. This runoff combines with additional flows from Design Point 2 & at the proposed EDB outlet structure/box at **Design Point 3 (DP3)**.

Proposed sub-basin **D** (1.61 ± acres) is the undeveloped pasture/meadow and proposed berms that support the east V-ditch & EDB pond volume. Runoff within this area will follow existing grades of 1-3% with proposed berm grades of 5:1 draining easterly. The developed discharges for this sub-basin are Q_5 = 1.0 cfs and Q_{100} = 5.3 cfs (proposed flows). The majority of runoff travels directly east offsite via overland flow and into Industry Avenue and combines with the pond outlet flows from Design Point 3. These flows combine at **Design Point 4 (DP4)**.

Proposed **Design Point 1 (DP1)** (2.21 ± acres) comprises A2 and A3, located within the proposed drainage channel at the southeast corner of A2. This area will contain primarily gravel area with landscaped berms diverting flow into the proposed EDB. This design point contains sub-basins with minor grades of 1-5% with steeper slopes of greater than 4:1 around the earth/gravel stockpiles. The drainage channel has 4:1 side slopes with average longitudinal slopes of 1-2% dramatchining easterly. The developed discharges for this design point are Q_5 = 5.7 cfs and Q_{100} = 12.4 cfs (proposed flows) and combines with flows from A1 at **Design Point 2 (DP2)**.

Proposed **Design Point 2 (DP2)** (5.30 ± acres) comprises the area draining into the proposed EDB along the proposed V-ditchs to the south and east of the developed site. This area includes A1, A2, and A3 and this design point will be located in the center of the proposed EDB. The areas included in this design point have average slopes of 1-5% along the developed gravel area with 4:1 V-ditches and longitudinally graded 1-2%, all draining southeasterly into the EDB. The developed discharges for this design point are Q_5 = 11.3 cfs and Q_{100} = 23.5 cfs (proposed flows) and combines with flows from sub-basin C at **Design Point 3 (DP3)**.

Proposed **Design Point 3 (DP3)** (5.97 ± acres) comprises A1, A2, A3, and C, located at the outlet structure within the proposed EDB. This overall area that drains to the outlet structure contains all the gravel areas, buildings, and pavement. These areas feature mild slopes of 1-5% with 4:1 side sloped V-ditches that divert flow into the proposed EDB. Sub-basin C is the pond area and features 4:1 and 5:1 side slopes draining into the EDB. The developed discharges for this design point are Q_5 = 11.7 cfs and Q_{100} = 25.3 cfs (proposed flows) with an outflow design flowrate of Q_5 = 0.9 cfs and Q_{100} = 7.0 cfs (proposed flows). This runoff exits the pond via a proposed 18” HDPE outfall and discharges onto a riprap pad before becoming sheet flow. Proposed riprap calculations can be found in the appendix. This runoff combines with flows from proposed sub-basin D at **Design Point 4 (DP4)**.

Proposed **Design Point 4 (DP4)** (7.62 ± acres) comprises the pond outflow with proposed sub-basin D. This area is primarily pasture/meadow draining to the east and southeast with the pond outflow pipe draining to the southeast portion of the site. Existing runoff discharges for this design point are Q_5 = 11.9 cfs and Q_{100} = 27.0 cfs (existing flows) with proposed runoff discharges of Q_5 = 1.9 cfs and Q_{100} = 12.3 cfs (proposed flows). This reflects a reduction of Q_5 = 10.0 cfs and Q_{100} = 14.7 cfs for the drainage at the southeast portion of the site. This runoff continues southeasterly within the Industry Avenue ROW Dedication and eventually drains into Fountain Creek. It is expected that flows from proposed B1 & B2 sub-basins will combine with the flows from DP4 along the east property line of the adjacent southeast property.

4.3 Erosion Control

During future construction, best management practices (BMP's) for erosion control will be employed based on the previously referenced City of Colorado Springs Drainage Criteria Manual Volume 2 and the Erosion Control Plan for the site. During Construction, silt fencing, sediment control logs, vehicle tracking control, concrete washout area will be in place to minimize erosion from the site. Silt Fencing will be placed along the south and east portions of the disturbed areas. This will inhibit suspended sediment from leaving the site during construction. Silt fencing is to remain in place until the proposed berms are stabilized and vegetation is reestablished in the other disturbed areas which are to be reseeded. Vehicle tracking control will be placed at the access point in the private driveway connecting to Wigwam Road. BMP's will be utilized as deemed necessary by the contractor, engineer, owner, or County inspector and are not limited to the measures described above. The EDB will also serve as sediment traps until construction is compete.

4.4 Water Quality Enhancement Best Management Practices

The Extended Detention Basin described above will provide storage for the Water Quality Capture Volume (WQCV) for the site. A Grading and Erosion Control Plan for the construction of the site has been prepared in accordance with the provisions of the DCM. Placement of construction stormwater BMP's will as required by the plan will limit soil erosion and deposition by stormwater flowing over the site.

The El Paso County Engineering Criteria Manual (Appendix I, Section I.7.2) 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”. The Four Step Process is incorporated in this project and the elements are discussed below.

1) Runoff Reduction Practices are employed in this project. Impervious surfaces have been reduced as much as practically possible. The compacted road base for the storage area will not impact infiltration or increase the existing imperviousness of the compacted bare earth. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because all runoff from the storage areas passes through drainage channels before entering the EDB which provides a small portion of WQCV.
2) All drainage paths on the site are stabilized with appropriate landscape treatment. The EDB is intended to intercept flows from the developed areas. Additionally, the pond outfall will have rip rap protection.
3) The project contains no potentially hazardous uses. All developed areas drain into a proposed a WQCV BMP.
4) The site contains no storage of potentially harmful substances or use of potentially harmful substances. No Site Specific or Other Source Control BMP's are required.

5 Opinion of Probable Cost for Drainage Facilities

The following cost opinion is for the construction of the required private storm water appurtenances which are non reimbursable. There are no public storm water facilities required.

Opinion of Costs – On-Site Private Storm Water Facilities – Non Reimbursable

• 1,653 CY Earthwork @ $6/CY	= $ 9,918
• Outlet Structure, Trickle Channel, & Forebays	= $10,642
• 167 LF 18” HDPE Drain Pipe @ $35/LF	= $ 5,845
• 1 HDPE Flared End-section @ $210/EA	= $ 210
• 3.7 tons of VL Riprap @ $97/Ton	= $ 358
Sub – Total =	$26,973
10% Engineering Contingency =	$ 2,697
GRAND TOTAL =	$29,670

6 Drainage and Bridge Fees

This site is not being platted. No Drainage or Bridge Fees are due at this time.

7 Conclusion

This Final Drainage Report presents existing and proposed drainage conditions for the proposed 19955 Wigwam Road project. The development will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream. Water Quality treatment will be provided. The proposed project will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream properties.

References

NRCS Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed March, 2018).

NRCS Official Soil Series Descriptions. United States Department of Agriculture, Natural Resources Conservation Service ("http://soils.usda.gov/technical/classification/osd/index.html", accessed March, 2018).

Flood Insurance Rate Map. Federal Emergency Management Agency, National Flood Insurance Program (Washingon D.C.: FEMA, March 17, 1997).

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Detention Design Spreadsheet. Urban Drainage and Flood Control District ("http://www.udfcd.org/downloads/software/UD-Detention_v2.2.xls", accessed January 2010).

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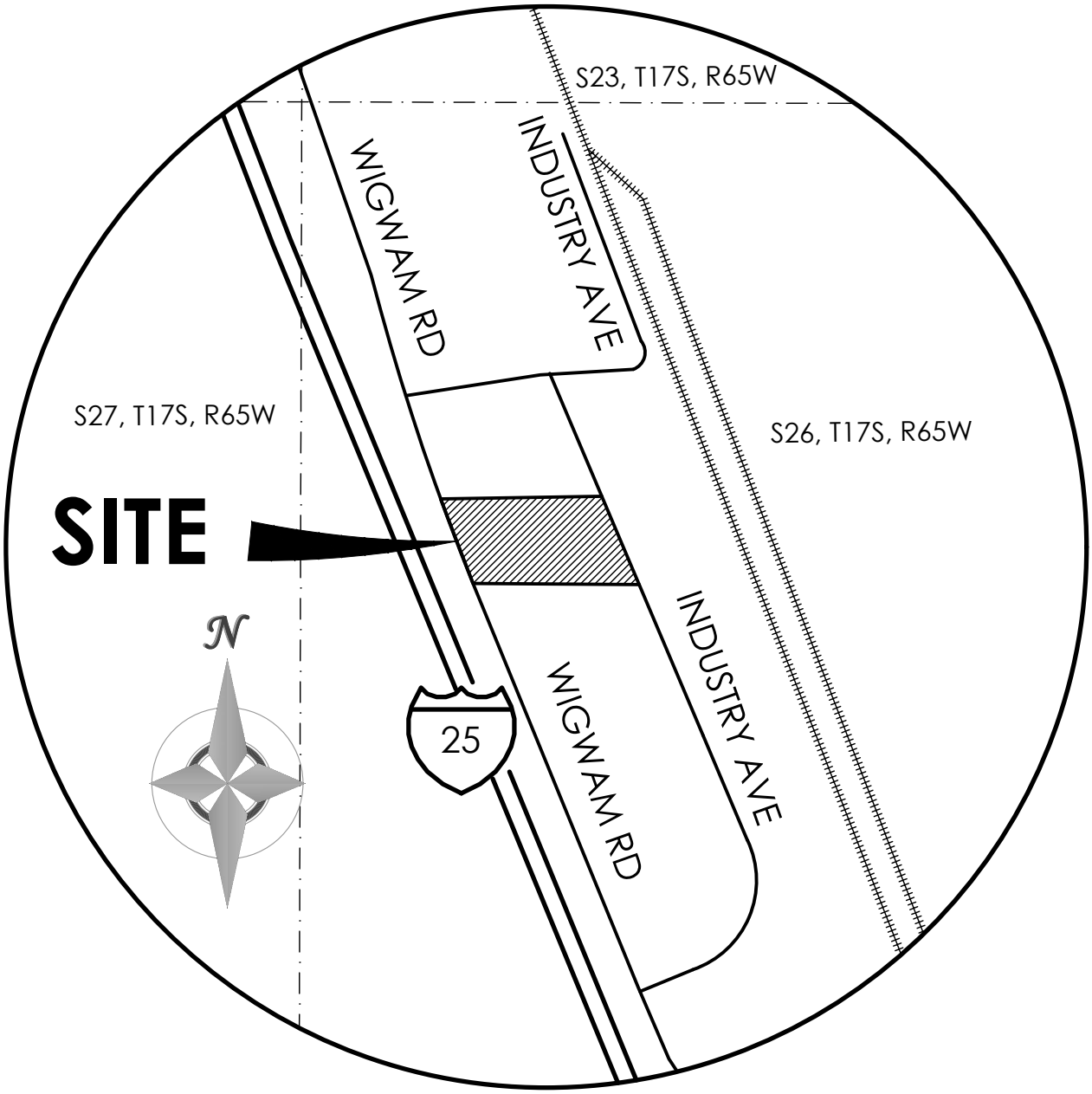
Drainage Criteria Manual (Volume 2). Urban Drainage and Flood Control District (Denver, Colorado: Urban Drainage and Flood Control District, Rev. April, 2008).

Appendices

8 General Maps and Supporting Data

Vicinity Map
Portions of Flood Insurance Rate Map
NRCS Soil Map and Tables
SCS Soil Type Descriptions
Hydrologic Soil Group Map and Tables



VICINITY MAP

NOT TO SCALE

National Flood Hazard Layer FIRMette

FEMA

104°38'45"W 38°32'49"N

104°38'8"W 38°32'21"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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 Cross Sections with 1% Annual Chance
- 17.5 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

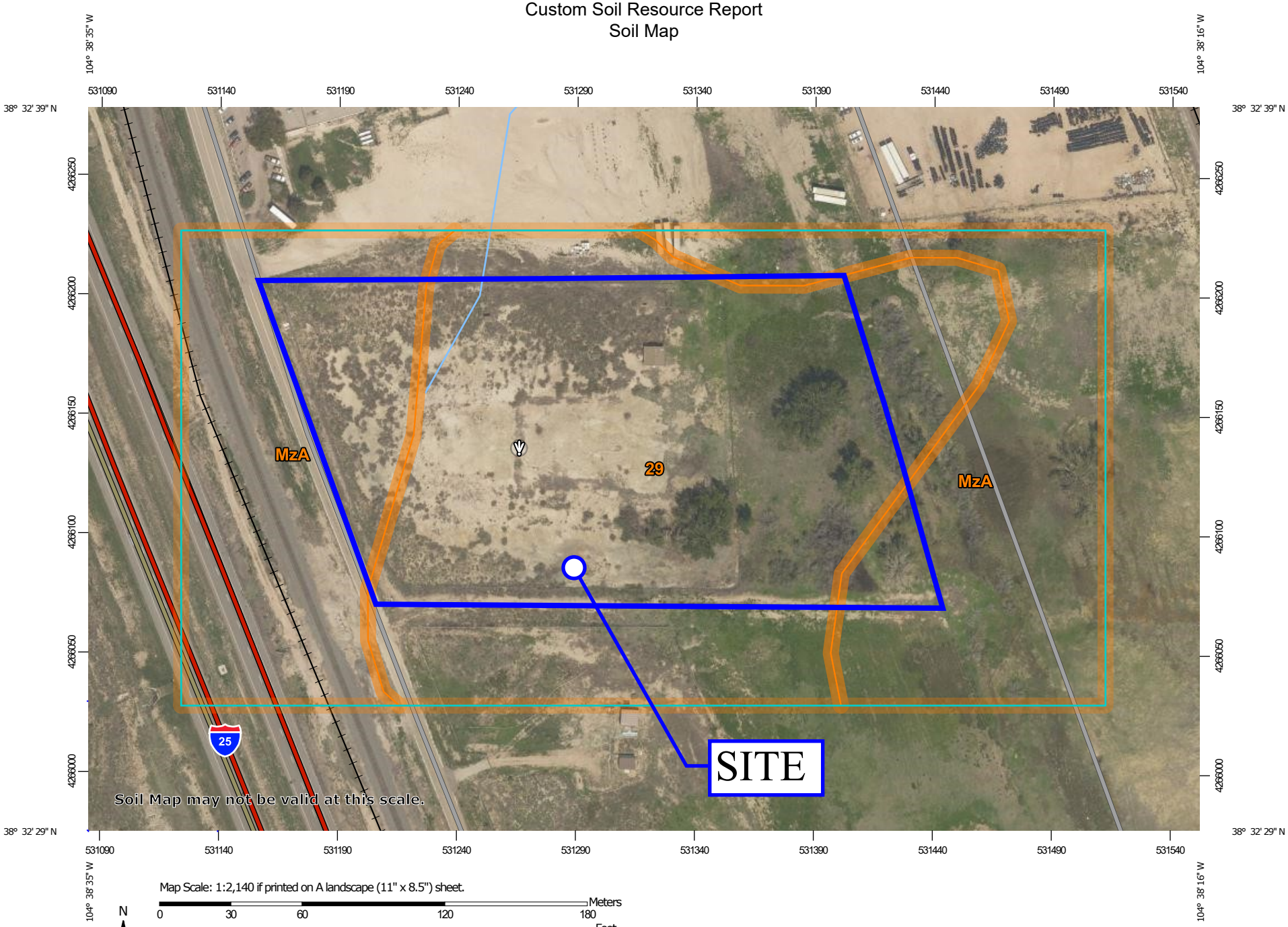
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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 1/12/2023 at 4:43 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.

Custom Soil Resource Report
Soil Map



Map Scale: 1:2,140 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 14, 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
29	Fluvaquentic Haplaquolls, nearly level	10.1	52.8%
MzA	Manzanola silty clay loam, saline, 0 to 2 percent slopes	9.0	47.2%
Totals for Area of Interest		**19.2**	**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

29—Fluvaquentic Haplaquolls, nearly level

Map Unit Setting

National map unit symbol: 3681
Elevation: 5,000 to 7,800 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Fluvaquentic Haplaquolls

Setting

Landform: Marshes, flood plains, swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: variable
C - 12 to 60 inches: stratified very gravelly sand to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: R067BY029CO - Sandy Meadow
Hydric soil rating: Yes

Minor Components

Haplaquolls

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

Other soils

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

MzA—Manzanola silty clay loam, saline, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2rgrg
Elevation: 3,900 to 6,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Manzanola and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manzanola

Setting

Landform: Terraces, interfluves, fan remnants, drainageways
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from shale

Typical profile

A - 0 to 4 inches: silty clay loam
Bt1 - 4 to 11 inches: silty clay loam
Bt2 - 11 to 26 inches: silty clay loam
Bk1 - 26 to 38 inches: silty clay loam
Bk2 - 38 to 79 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 14 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Moderately saline (8.0 to 15.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: R069XY037CO - Saline Overflow
Other vegetative classification: Saline Overflow (069XY037CO_1)
Hydric soil rating: No

Minor Components

Haversid

Percent of map unit: 5 percent
Landform: Terraces, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY037CO - Saline Overflow
Other vegetative classification: Loamy (G069XW017CO)
Hydric soil rating: No

Aguilar

Percent of map unit: 5 percent
Landform: Fan remnants
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY033CO - Salt Flat
Other vegetative classification: Salt Flat #33 (069AY033CO_2), Sodic, Sodic/Saline (G069XW027CO)
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group

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

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

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

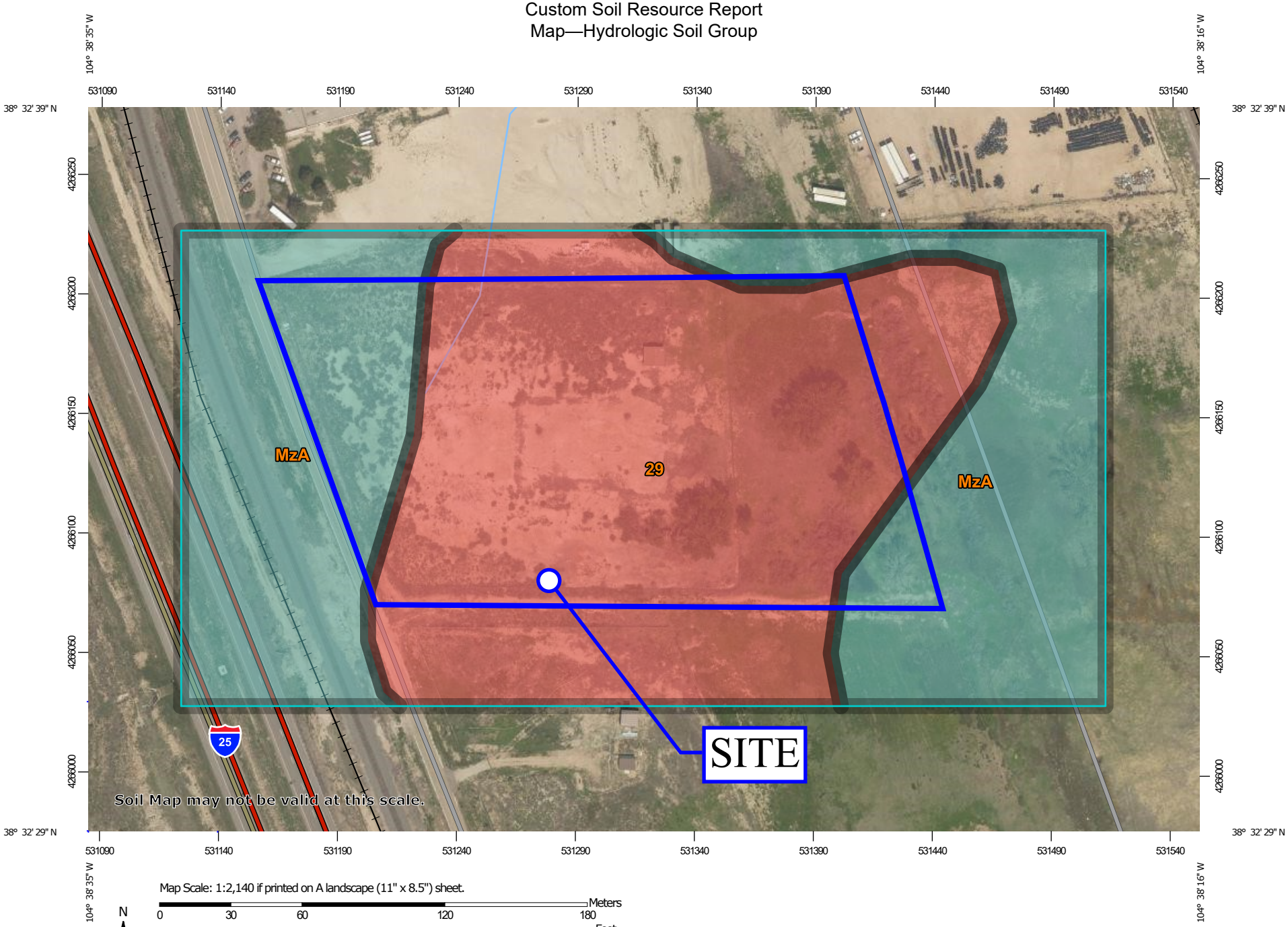
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:2,140 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 14, 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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
29	Fluvaquentic Haplaquolls, nearly level	D	10.1	52.8%
MzA	Manzanola silty clay loam, saline, 0 to 2 percent slopes	C	9.0	47.2%
Totals for Area of Interest			**19.2**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

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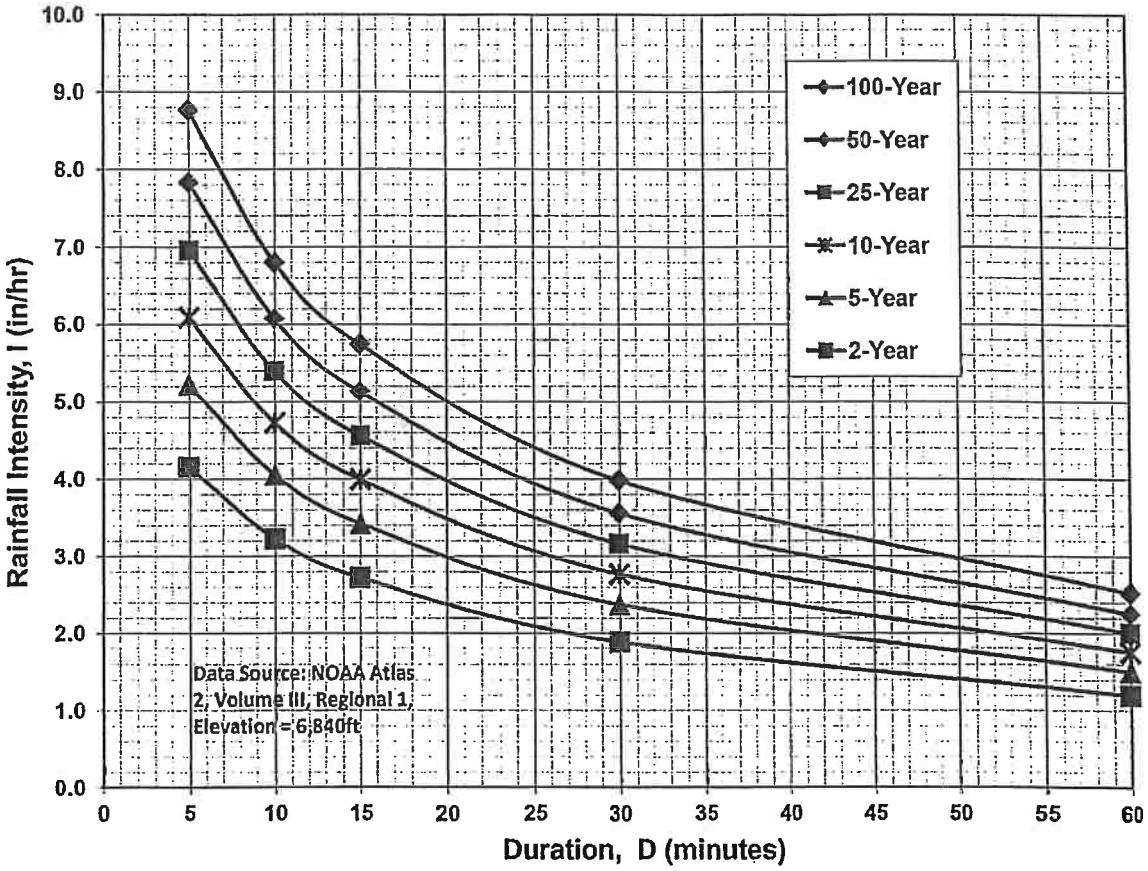
9 Hydrologic Calculations

Runoff Coefficients and Percent Imperviousness Table 6-6
Colorado Springs Rainfall Intensity Duration Frequency Table 6-5
Hydrologic Calculations Summary Form SF-1 for Existing & Developed Conditions
Hydrologic Calculations Summary 5-yr Form SF-2 for Existing & Developed Conditions
Hydrologic Calculations Summary 100-yr Form SF-2 for Existing & Developed Conditions

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.

Existing Imperviousness Calculations

Includes Basins EX-A EX-B1 EX-B2

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Light Areas	238,191	5.47	0.6	0.63	0.66	0.7	0.72	0.74	80%
Roofs	624	0.01	0.73	0.75	0.77	0.8	0.82	0.83	90%
Paved	112	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	98,018	2.25	0.04	0.15	0.25	0.37	0.44	0.5	0%
Landscaping	-	0.00	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**336,944**	**7.74**	**0.44**	**0.49**	**0.54**	**0.60**	**0.64**	**0.67**	**56.8%**

Notes

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

Proposed Imperviousness Calculations

Includes Basins A1 A2 B1 B2 C D A3

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	201,476	4.63	0.6	0.63	0.66	0.7	0.72	0.74	80%
Roofs	3,624	0.08	0.73	0.75	0.77	0.8	0.82	0.83	90%
Paved	3,607	0.08	0.89	0.9	0.92	0.94	0.95	0.96	100%
Landscaping	12,444	0.29	0.05	0.16	0.26	0.38	0.45	0.51	2%
Pasture/Meadow	115,794	2.66	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**336,944**	**7.74**	**0.39**	**0.45**	**0.51**	**0.58**	**0.62**	**0.65**	**49.9%**

Notes

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

Job No.: **61180** Date: **03/23/2023 15:45**

Project: **19955 Wigwam Road** Calcs By: **JO**

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)
Existing Conditions	7.74			56.8%														
EX-A	7.47	0.50	0.68	58.8%	187.48	1.1%	14.4	260.9	0.023	1.5	2.9	412.2	0.017	4.5	1.5	860.6	N/A	18.8
EX-B1	0.06	0.15	0.50	0.0%	5.00	20.0%	1.4	0.0	0.000	0.0	0.0	0.0	0.000	0.0	0.0	5.0	N/A	5.0
EX-B2	0.21	0.15	0.50	0.0%	34.01	5.9%	5.6	3.9	0.762	6.1	0.0	0.0	0.000	0.0	0.0	37.9	N/A	5.6
Proposed Conditions	7.74			49.9%														
A1	3.10	0.60	0.73	75.0%	57.61	1.7%	5.7	423.8	0.012	1.1	6.5	244.2	0.016	3.7	1.1	725.6	N/A	13.3
A2	2.02	0.57	0.71	70.6%	130.41	1.5%	9.4	258.8	0.015	1.2	3.5	54.1	0.044	5.4	0.2	443.3	N/A	13.0
A3	0.19	0.16	0.51	2.0%	13.94	7.2%	3.3	80.8	0.037	1.3	1.0	7.3	0.136	3.1	0.0	102.1	N/A	5.0
B1	0.04	0.16	0.51	2.0%	18.77	5.3%	4.2	0.0	0.000	0.0	0.0	0.0	0.000	0.0	0.0	18.8	N/A	5.0
B2	0.12	0.15	0.50	0.0%	46.70	6.4%	6.3	0.0	0.000	0.0	0.0	0.0	0.000	0.0	0.0	46.7	N/A	6.3
C	0.67	0.24	0.55	14.1%	75.97	6.6%	7.2	0.0	0.000	0.0	0.0	0.0	0.000	0.0	0.0	76.0	N/A	7.2
D	1.61	0.16	0.51	1.1%	64.37	3%	9.4	148.4	0.018	0.9	2.6	0	0.000	0.0	0.0	212.8	N/A	12.0

Job No.: **61180**
Project: **19955 Wigwam Road**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **03/23/2023 15:45**
Calcs By: **JO**
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)
Existing Conditions																						
EX-DP4	EX-A	7.47	0.50	18.8	3.76	3.18	11.94															
	EX-B1	0.06	0.15	5.0	0.01	5.17	0.05															
	EX-B2	0.21	0.15	5.6	0.03	5.00	0.16															
Proposed Conditions																					#####	#####
	A1	3.10	0.60	13.3	1.86	3.70	6.90															
	A2	2.02	0.57	13.0	1.16	3.73	4.33															
	A3	0.19	0.16	5.0	0.03	5.17	0.15															
	B1	0.04	0.16	5.0	0.01	5.17	0.03															
	B2	0.12	0.15	6.3	0.02	4.81	0.08															
	C	0.67	0.24	7.2	0.16	4.61	0.75															
	D	1.61	0.16	12.0	0.25	3.85	0.98															
Design Points																					#####	#####
DP1		2.21	0.54					6.3	1.19	4.81	5.7				5.75						#####	#####
	A2	2.02	0.57	13.0	1.16	3.73	4.33															
	A3	0.19	0.16	5.0	0.03	5.17	0.15															
DP2		5.30	0.58					13.3	3.06	3.70	11.3				11.31						#####	#####
	A1	3.10	0.60	13.3	1.86	3.70	6.90															
	A2	2.02	0.57	13.0	1.16	3.73	4.33															
	A3	0.19	0.16	5.0	0.03	5.17	0.15															
DP3		5.97	0.54					13.9	3.22	3.63	11.7				11.68						#DIV/0!	#DIV/0!
	A1	3.10	0.60	13.3	1.86	3.70	6.90															
	A2	2.02	0.57	13.0	1.16	3.73	4.33															
	A3	0.19	0.16	5.0	0.03	5.17	0.15															
	C	0.67	0.24	7.2	0.16	4.61	0.75															
DP4		1.61	0.16					12.0	0.25	3.85	1.9				1.9						#####	#####
	D	1.61	0.16	12.0	0.25	3.85	0.98															
	POND OUT	5.97					0.93															

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

Job No.: **61180**
Project: **19955 Wigwam Road**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **DCM**

Date: **03/23/2023 15:45**
Calcs By: **JO**
Checked By:

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

DP	Sub-Basin	Area (Acres)	C100	Direct Runoff t_c (min)	Direct Runoff CA (Acres)	Direct Runoff I100 (in/hr)	Direct Runoff Q100 (cfs)	Combined Runoff t_c (min)	Combined Runoff CA (Acres)	Combined Runoff I100 (in/hr)	Combined Runoff Q100 (cfs)	Streetflow Slope (%)	Streetflow Length (ft)	Streetflow Q (cfs)	Pipe Flow Q (cfs)	Pipe Flow Slope (%)	Pipe Flow Mnngs n	Pipe Flow Length (ft)	Pipe Flow D_{Pipe} (in)	Travel Time Length (ft)	Travel Time v_{0sc} (ft/s)	Travel Time t_t (min)
Existing Conditions																						
EX-DP4	EX-A	7.47	0.68	18.8	5.05	5.34	26.95															
	EX-B1	0.06	0.50	5.0	0.03	8.68	0.27															
	EX-B2	0.21	0.50	5.6	0.10	8.40	0.87															
Proposed Conditions																					#####	#####
	A1	3.10	0.73	13.3	2.25	6.22	14.00															
	A2	2.02	0.71	13.0	1.44	6.26	9.02															
	A3	0.19	0.51	5.0	0.10	8.68	0.82															
	B1	0.04	0.51	5.0	0.02	8.68	0.18															
	B2	0.12	0.50	6.3	0.06	8.08	0.47															
	C	0.67	0.55	7.2	0.37	7.74	2.84															
	D	1.61	0.51	12.0	0.81	6.47	5.25															
Design Points																					#####	#####
DP1		2.21	0.70					6.3	1.54	8.08	12.4				12.40						#####	#####
	A2	2.02	0.71	13.0	1.44	6.26	9.02															
	A3	0.19	0.51	5.0	0.10	8.68	0.82															
DP2		5.30	0.71					13.3	3.79	6.22	23.5				23.54						#####	#####
	A1	3.10	0.73	13.3	2.25	6.22	14.00															
	A2	2.02	0.71	13.0	1.44	6.26	9.02															
	A3	0.19	0.51	5.0	0.10	8.68	0.82															
DP3		5.97	0.70					13.9	4.15	6.10	25.3				25.30						#DIV/0!	#DIV/0!
	A1	3.10	0.73	13.3	2.25	6.22	14.00															
	A2	2.02	0.71	13.0	1.44	6.26	9.02															
	A3	0.19	0.51	5.0	0.10	8.68	0.82															
	C	0.67	0.55	7.2	0.37	7.74	2.84															
DP4		1.61	0.51					12.0	0.81	6.47	12.3				12.26						#####	#####
	D	1.61	0.51	12.0	0.81	6.47	5.25															
	POND OUT	5.97					7.03															

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

Sub-Basin Existing Conditions Runoff Calculations (EX-A/EX-DP4)

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	624	0.01	0.73	0.75	0.77	0.8	0.82	0.83	90%
Paved	112	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Light Areas	238,191	5.47	0.6	0.63	0.66	0.7	0.72	0.74	80%
Pasture/Meadow	86,270	1.98	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**325,197**	**7.47**	**0.45**	**0.50**	**0.55**	**0.61**	**0.65**	**0.68**	**58.8%**

325197

Basin Travel Time

Shallow Channel Ground Cover: Nearly bare ground

$L_{max,Overland}$: 300 ft — C_v: 10

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	861	15	0.017	-	-	-	
Initial Time	187	2	0.011	-	14.4	N/A	DCM Eq. 6-8
Shallow Channel	261	6	0.023	1.5	2.9	-	DCM Eq. 6-9
Channelized	412	7	0.017	4.5	1.5	-	V-Ditch
				t_c	**18.8**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.54	3.18	3.71	4.24	4.77	5.34
Runoff (cfs)	8.6	**11.9**	15.3	19.4	23.0	**27.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	8.6	**11.9**	15.3	19.4	23.0	**27.0**

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 Existing Conditions Runoff Calculations (EX-B1)

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	2,741	0.06	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**2,741**	**0.06**	**0.04**	**0.15**	**0.25**	**0.37**	**0.44**	**0.50**	**0.0%**
	2741								

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	5	1	0.200	-	-	-	
Initial Time	5	1	0.200	-	1.4	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**5.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	4.12	5.17	6.03	6.89	7.75	8.68
Runoff (cfs)	0.0	**0.0**	0.1	0.2	0.2	**0.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.0	**0.0**	0.1	0.2	0.2	**0.3**

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 Existing Conditions Runoff Calculations (EX-B2)

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	9,007	0.21	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**9,007**	**0.21**	**0.04**	**0.15**	**0.25**	**0.37**	**0.44**	**0.50**	**0.0%**
	9007	-							

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	38	5	0.132	-	-	-	
Initial Time	34	2	0.059	-	5.6	N/A	DCM Eq. 6-8
Shallow Channel	4	3	0.762	6.1	0.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**5.6**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.99	5.00	5.84	6.67	7.50	8.40
Runoff (cfs)	0.0	**0.2**	0.3	0.5	0.7	**0.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.0	**0.2**	0.3	0.5	0.7	**0.9**

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

Sub-Basin A1 Runoff Calculations

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	2,124	0.05	0.73	0.75	0.77	0.8	0.82	0.83	90%
Paved	1,268	0.03	0.89	0.9	0.92	0.94	0.95	0.96	100%
Gravel	122,334	2.81	0.6	0.63	0.66	0.7	0.72	0.74	80%
Landscaping	2,514	0.06	0.05	0.16	0.26	0.38	0.45	0.51	2%
Pasture/Meadow	6,634	0.15	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**134,873**	**3.10**	**0.57**	**0.60**	**0.64**	**0.68**	**0.70**	**0.73**	**75.0%**
	134873	-							

Basin Travel Time

Shallow Channel Ground Cover: Nearly bare ground

$L_{max,Overland}$ 300 ft C_v 10

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	726	10	0.013	-	-	-	
Initial Time	58	1	0.017	-	5.7	N/A	DCM Eq. 6-8
Shallow Channel	424	5	0.012	1.1	6.5	-	DCM Eq. 6-9
Channelized	244	4	0.016	3.7	1.1	-	V-Ditch
				t_c	**13.3**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.96	3.70	4.32	4.94	5.55	6.22
Runoff (cfs)	5.2	**6.9**	8.5	10.4	12.1	**14.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	5.2	**6.9**	8.5	10.4	12.1	**14.0**
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 A2 Runoff Calculations

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	1,500	0.03	0.73	0.75	0.77	0.8	0.82	0.83	90%
Paved	100	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Gravel	75,859	1.74	0.6	0.63	0.66	0.7	0.72	0.74	80%
Pasture/Meadow	10,517	0.24	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**87,976**	**2.02**	**0.54**	**0.57**	**0.61**	**0.66**	**0.69**	**0.71**	**70.6%**
	87976								

Basin Travel Time

Shallow Channel Ground Cover: Nearly bare ground

$L_{max,Overland}$: 300 ft C_v: 10

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	443	8	0.019	-	-	-	
Initial Time	130	2	0.015	-	9.4	N/A	DCM Eq. 6-8
Shallow Channel	259	4	0.015	1.2	3.5	-	DCM Eq. 6-9
Channelized	54	2	0.044	5.4	0.2	-	V-Ditch
				t_c	**13.0 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.98	3.73	4.35	4.98	5.60	6.26
Runoff (cfs)	3.2	**4.3**	5.4	6.7	7.8	**9.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	3.2	**4.3**	5.4	6.7	7.8	**9.0**
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 A3 Runoff Calculations

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Landscaping	8,116	0.19	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**8,116**	**0.19**	**0.05**	**0.16**	**0.26**	**0.38**	**0.45**	**0.51**	**2.0%**
	8116								

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	102	5	0.049	-	-	-	
Initial Time	14	1	0.072	-	3.3	N/A	DCM Eq. 6-8
Shallow Channel	81	3	0.037	1.3	1.0	-	DCM Eq. 6-9
Channelized	7	1	0.136	3.1	0.0	-	V-Ditch
				t_c	**5.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	4.12	5.17	6.03	6.89	7.75	8.68
Runoff (cfs)	0.0	**0.2**	0.3	0.5	0.7	**0.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.0	**0.2**	0.3	0.5	0.7	**0.8**
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 B1 Runoff Calculations

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Landscaping	1,813	0.04	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**1,813**	**0.04**	**0.05**	**0.16**	**0.26**	**0.38**	**0.45**	**0.51**	**2.0%**
	1813								

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	19	1	0.053	-	-	-	
Initial Time	18.8	1.0	0.053	-	4.2	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**5.0 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	4.12	5.17	6.03	6.89	7.75	8.68
Runoff (cfs)	0.0	**0.0**	0.1	0.1	0.1	**0.2**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.0	**0.0**	0.1	0.1	0.1	**0.2**

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

Sub-Basin B2 Runoff Calculations

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	5,056	0.12	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**5,056**	**0.12**	**0.04**	**0.15**	**0.25**	**0.37**	**0.44**	**0.50**	**0.0%**
	5056								

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	46.7	3.0	0.064	-	-	-	
Initial Time	46.7	3.0	0.064	-	6.3	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**6.3**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.84	4.81	5.61	6.42	7.22	8.08
Runoff (cfs)	0.0	**0.1**	0.2	0.3	0.4	**0.5**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.0	**0.1**	0.2	0.3	0.4	**0.5**

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 C Runoff Calculations

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	24,308	0.56	0.04	0.15	0.25	0.37	0.44	0.5	0%
Paved	1,472	0.03	0.89	0.9	0.92	0.94	0.95	0.96	100%
Gravel	3,283	0.08	0.6	0.63	0.66	0.7	0.72	0.74	80%
Combined	**29,064**	**0.67**	**0.15**	**0.24**	**0.33**	**0.44**	**0.50**	**0.55**	**14.1%**
	29064								

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	76.0	5.0	0.066	-	-	-	
Initial Time	76.0	5.0	0.066	-	7.2	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**7.2**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.68	4.61	5.38	6.15	6.92	7.74
Runoff (cfs)	0.4	**0.7**	1.2	1.8	2.3	**2.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.4	**0.7**	1.2	1.8	2.3	**2.8**
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 D Runoff Calculations

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	69,279	1.59	0.04	0.15	0.25	0.37	0.44	0.5	0%
Paved	767	0.02	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**70,046**	**1.61**	**0.05**	**0.16**	**0.26**	**0.38**	**0.45**	**0.51**	**1.1%**
	70046								

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	212.8	4.7	0.022	-	-	-	
Initial Time	64.4	2.0	0.031	-	9.4	N/A	DCM Eq. 6-8
Shallow Channel	148.4	2.7	0.018	0.9	2.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**12.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.08	3.85	4.50	5.14	5.78	6.47
Runoff (cfs)	0.2	**1.0**	1.9	3.1	4.1	**5.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**1.0**	1.9	3.1	4.1	**5.3**

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

Combined Sub-Basin Runoff Calculations (DP1)

Includes Basins A2 A3

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	75,859	1.74	0.6	0.63	0.66	0.7	0.72	0.74	80%
Landscaping	8,116	0.19	0.05	0.16	0.26	0.38	0.45	0.51	2%
Pasture/Meadow	10,517	0.24	0.04	0.15	0.25	0.37	0.44	0.5	0%
Paved	100	0.00	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	1,500	0.03	0.73	0.75	0.77	0.8	0.82	0.83	90%
Combined	**96,092**	**2.21**	**0.49**	**0.54**	**0.58**	**0.64**	**0.67**	**0.70**	**64.8%**

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	A3	-	102	5		-	-	-	5.0
Channelized-1	V-Ditch	1	356	7.5	12.4	0	4	4.4	1.3
Channelized-2									
Channelized-3									
Total			458	12					

1 = Man-made, Smooth, Straight

t_c (min) **6.3**

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)	3.84	4.81	5.61	6.41	7.22	8.08
Site Runoff (cfs)	4.18	**5.73**	7.22	9.04	10.64	**12.40**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**5.7**	-	-	-	**12.4**
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.

Combined Sub-Basin Runoff Calculations (DP2)

Includes Basins A1 A2 A3

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	198,193	4.55	0.6	0.63	0.66	0.7	0.72	0.74	80%
Landscaping	10,630	0.24	0.05	0.16	0.26	0.38	0.45	0.51	2%
Pasture/Meadow	17,151	0.39	0.04	0.15	0.25	0.37	0.44	0.5	0%
Paved	1,368	0.03	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	3,624	0.08	0.73	0.75	0.77	0.8	0.82	0.83	90%
Combined	**230,966**	**5.30**	**0.54**	**0.58**	**0.61**	**0.66**	**0.69**	**0.71**	**70.7%**

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	A1	-	725.6	9.8		-	-	-	13.3
Channelized-1									
Channelized-2									
Channelized-3									
Total			725.6	9.8					
								t_c (min)	**13.3**

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)	2.96	3.70	4.32	4.94	5.55	6.22
Site Runoff (cfs)	8.41	**11.31**	14.07	17.37	20.31	**23.54**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**11.3**	-	-	-	**23.5**
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 (DP3)

Includes Basins A1 A2 A3 C

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	201,476	4.63	0.6	0.63	0.66	0.7	0.72	0.74	80%
Landscaping	10,630	0.24	0.05	0.16	0.26	0.38	0.45	0.51	2%
Pasture/Meadow	41,459	0.95	0.04	0.15	0.25	0.37	0.44	0.5	0%
Paved	2,840	0.07	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	3,624	0.08	0.73	0.75	0.77	0.8	0.82	0.83	90%
Combined	**260,029**	**5.97**	**0.49**	**0.54**	**0.58**	**0.64**	**0.67**	**0.70**	**64.4%**

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	A1	-	725.6	9.8		-	-	-	13.3
Channelized-1	C&G	1	117.0	1.0	25.4	3	0	3.2	0.6
Channelized-2									
Channelized-3									
Total			842.6	10.8					

1 = Man-made, Smooth, Straight

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	4.85	5.45	6.10
Site Runoff (cfs)	8.55	**11.69**	14.75	18.47	21.75	**25.35**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**11.7**	-	-	-	**25.3**
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

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

Combined Sub-Basin Runoff Calculations (DP4)

Includes Basins D

Job No.:	**61180**	Date:	**03/23/2023 15:45**
Project:	**19955 Wigwam Road**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**D**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	69,279	1.59	0.04	0.15	0.25	0.37	0.44	0.5	0%
Paved	767	0.02	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**70,046**	**1.61**	**0.05**	**0.16**	**0.26**	**0.38**	**0.45**	**0.51**	**1.1%**

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	D	-	212.8	4.7	-	-	-	-	12.0
Channelized-1						2	4		
Channelized-2									
Channelized-3									
Total			213	5					
								t_c (min)	**12.0**

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

Contributing Basins/Areas: Pond Outfall

Q_{Minor} 0.93 (cfs) - 5-year Storm

Q_{Major} 7.03 (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.08	3.85	4.50	5.14	5.78	6.47
Site Runoff (cfs)	0.24	**0.98**	1.86	3.11	4.14	**5.25**
OffSite Runoff (cfs)	-	**0.93**	-	-	-	**7.03**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**1.9**	-	-	-	**12.3**
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

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

10 Hydraulic Calculations

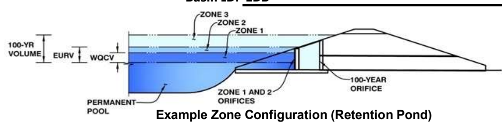
Extended Detention Basin Sizing Calculations
Outfall Calculation
Ditch Capacity Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: 61180-19955 Wigwam Road

Basin ID: EDB



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	5.97	acres		
Watershed Length =	725	ft		
Watershed Length to Centroid =	363	ft		
Watershed Slope =	0.013	ft/ft		
Watershed Imperviousness =	64.60%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.126	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.373	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.394	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.541	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.664	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.800	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.927	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.076	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.25 in.) =	1.451	acre-feet	3.25	inches
Approximate 2-yr Detention Volume =	0.333	acre-feet		
Approximate 5-yr Detention Volume =	0.472	acre-feet		
Approximate 10-yr Detention Volume =	0.540	acre-feet		
Approximate 25-yr Detention Volume =	0.576	acre-feet		
Approximate 50-yr Detention Volume =	0.593	acre-feet		
Approximate 100-yr Detention Volume =	0.649	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.126	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.247	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.276	acre-feet
Total Detention Basin Volume =	0.649	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
Trickle Channel 5222.96'	--	0.33	--	--	--	10	0.000	3	0.000
	--	0.37	--	--	--	308	0.007	7	0.000
	--	0.87	--	--	--	1,159	0.027	368	0.008
	--	1.37	--	--	--	3,639	0.084	1,551	0.036
	--	1.87	--	--	--	7,215	0.166	4,240	0.097
	--	2.37	--	--	--	11,316	0.260	8,845	0.203
	--	2.87	--	--	--	17,413	0.400	15,987	0.367
	--	3.37	--	--	--	19,072	0.438	25,097	0.576
Spillway 5226.5'	--	3.87	--	--	--	20,964	0.481	35,093	0.806
	--	4.37	--	--	--	23,273	0.534	46,137	1.059
	--	4.87	--	--	--	25,680	0.590	58,359	1.340
Top of Berm 5228'	--	5.37	--	--	--	28,161	0.646	71,802	1.648
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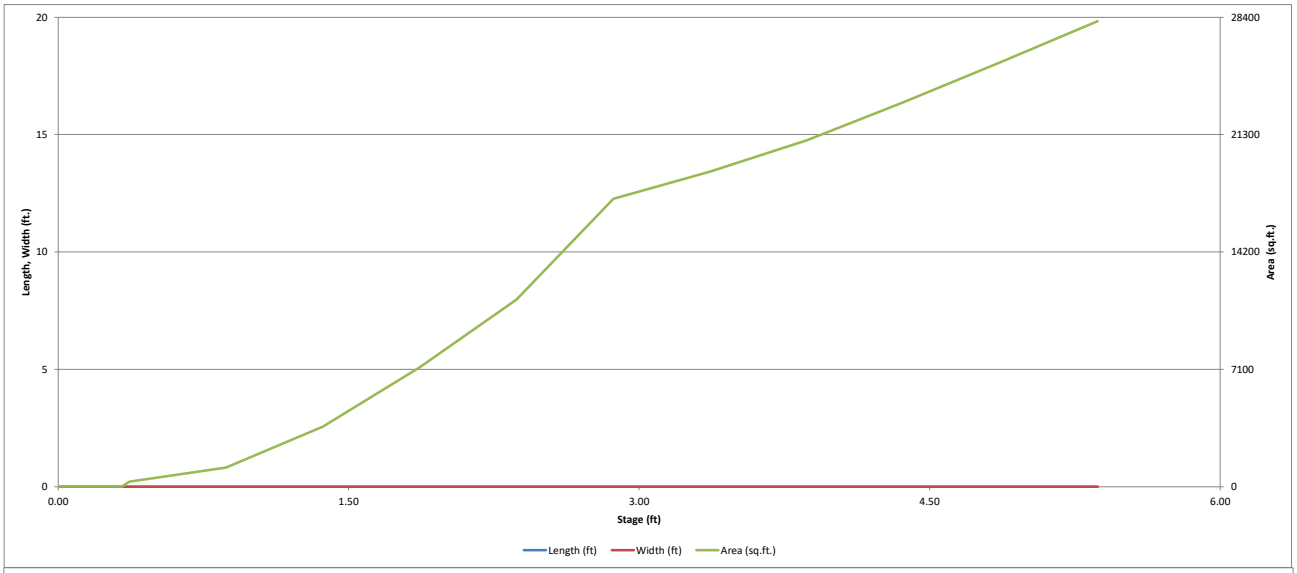
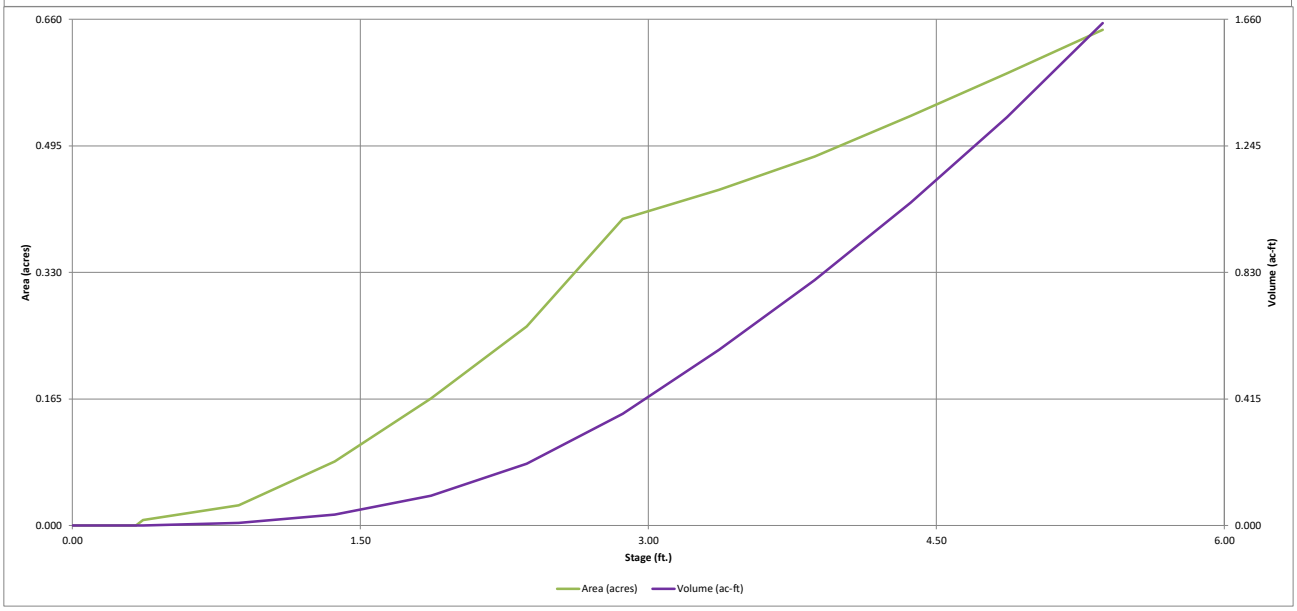
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



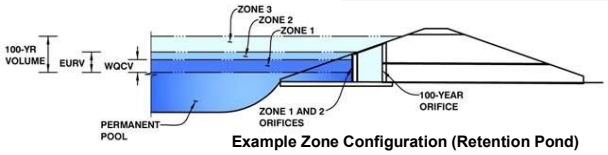


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **61180-19955 Wigwam Road**

Basin ID: **EDB**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.02	0.126	Orifice Plate
Zone 2 (EURV)	2.88	0.247	Orifice Plate
Zone 3 (100-year)	3.53	0.276	Weir&Pipe (Restrict)
Total (all zones)		0.649	

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

Underdrain Orifice Invert Depth = [ ] ft (distance below the filtration media surface)

Underdrain Orifice Diameter = [ ] inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = [ ] ft^2

Underdrain Orifice Centroid = [ ] feet

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

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = 2.88 ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = 12.00 inches

Orifice Plate: Orifice Area per Row = N/A sq. inches

Calculated Parameters for Plate

WQ Orifice Area per Row = N/A ft^2

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.000	1.000	2.000					
Orifice Area (sq. inches)	0.645	0.645	1.289					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.00	N/A	feet
Overflow Weir Slope Length =	2.92	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.50	N/A	
Overflow Grate Open Area w/o Debris =	5.92	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.96	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	8.25		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.79	N/A	ft^2
Outlet Orifice Centroid =	0.40	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.49	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= 3.87 ft (relative to basin bottom at Stage = 0 ft)

Spillway Crest Length = 20.00 feet

Spillway End Slopes = 4.00 H:V

Freeboard above Max Water Surface = 1.08 feet

Calculated Parameters for Spillway

Spillway Design Flow Depth= 0.42 feet

Stage at Top of Freeboard = 5.37 feet

Basin Area at Top of Freeboard = 0.65 acres

Basin Volume at Top of Freeboard = 1.65 acre-ft

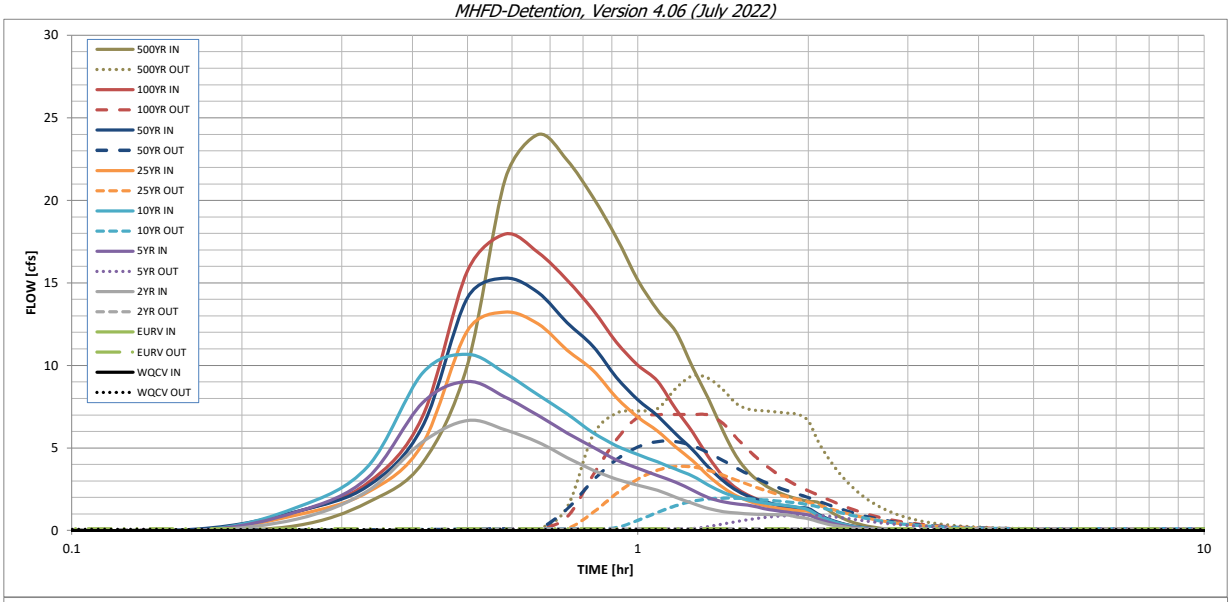
Routed Hydrograph Results

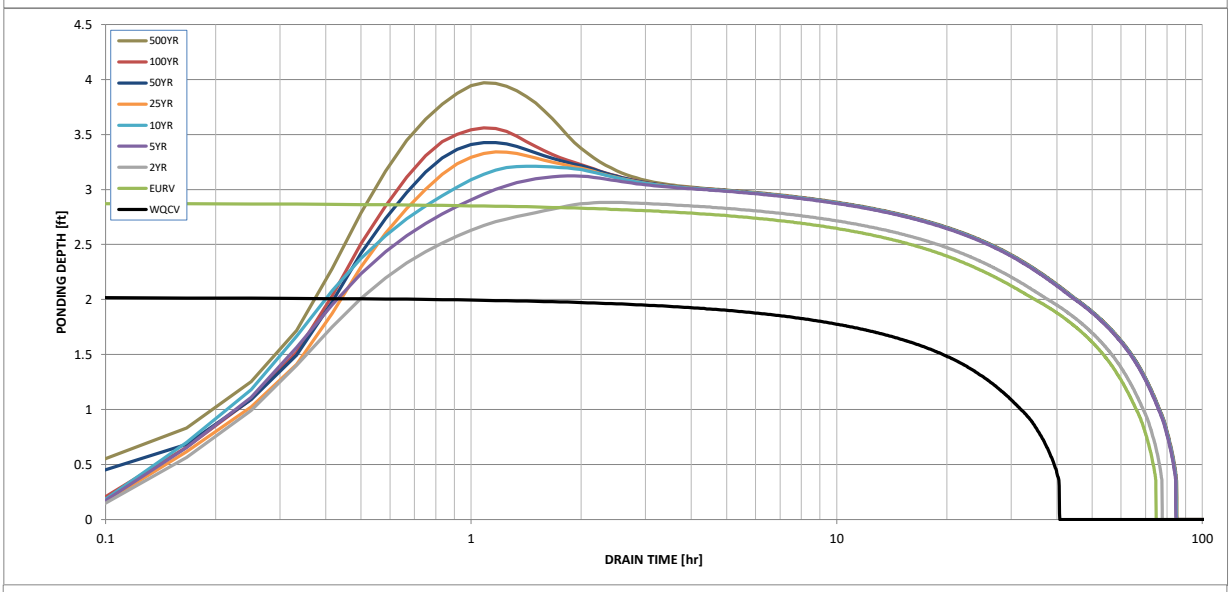
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

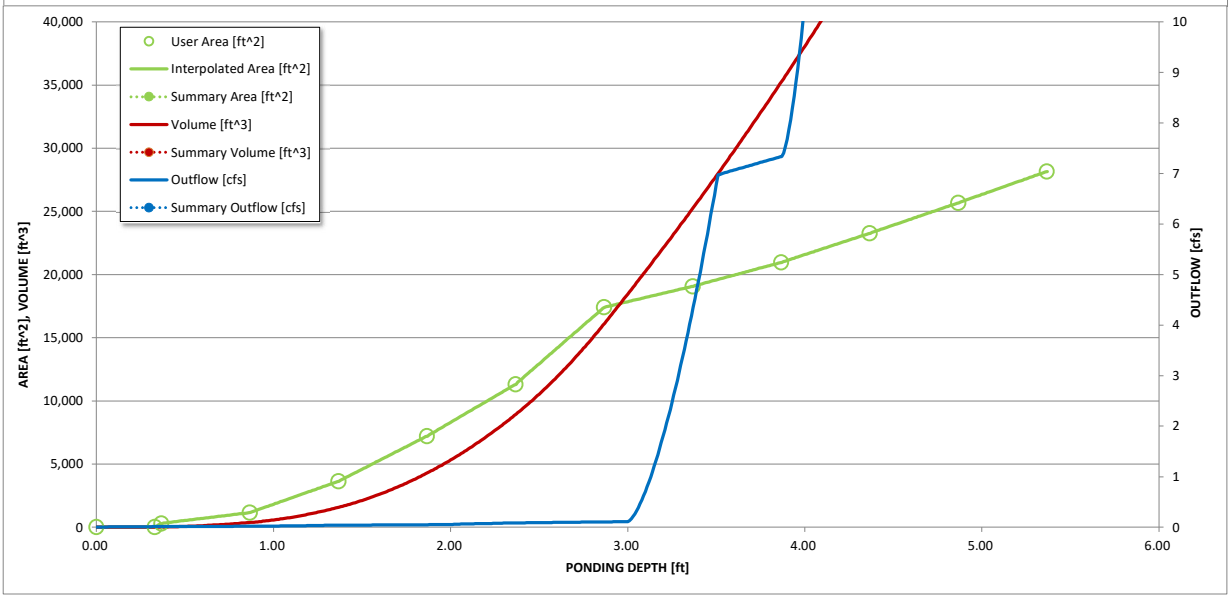
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.25
CUHP Runoff Volume (acre-ft) =	0.126	0.373	0.394	0.541	0.664	0.800	0.927	1.076	1.451
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.394	0.541	0.664	0.800	0.927	1.076	1.451
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.2	2.4	3.3	5.1	6.3	8.0	11.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.20	0.40	0.55	0.86	1.06	1.33	1.92
Peak Inflow Q (cfs) =	N/A	N/A	6.7	9.0	10.7	13.2	15.3	18.0	24.0
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.9	2.0	3.9	5.4	7.0	9.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.8	0.9	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.6	0.9	1.2	1.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	67	70	75	73	72	70	69	66
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	75	81	80	79	79	78	76
Maximum Ponding Depth (ft) =	2.02	2.88	2.88	3.12	3.21	3.34	3.43	3.56	3.97
Area at Maximum Ponding Depth (acres) =	0.19	0.40	0.40	0.42	0.43	0.44	0.44	0.45	0.49
Maximum Volume Stored (acre-ft) =	0.126	0.375	0.375	0.473	0.511	0.567	0.603	0.665	0.859

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.01	0.29
	0:15:00	0.00	0.00	0.69	1.13	1.40	0.94	1.16	1.14	1.70
	0:20:00	0.00	0.00	2.40	3.19	3.86	2.31	2.68	2.88	4.08
	0:25:00	0.00	0.00	5.35	7.73	9.53	5.23	6.29	6.89	10.03
	0:30:00	0.00	0.00	6.66	9.02	10.68	12.11	14.11	15.73	21.29
	0:35:00	0.00	0.00	6.09	8.08	9.52	13.23	15.28	17.95	23.99
	0:40:00	0.00	0.00	5.35	6.96	8.21	12.50	14.41	16.84	22.43
	0:45:00	0.00	0.00	4.42	5.91	7.06	10.93	12.59	15.17	20.19
	0:50:00	0.00	0.00	3.66	5.04	5.93	9.70	11.16	13.36	17.75
	0:55:00	0.00	0.00	3.11	4.28	5.14	8.05	9.27	11.41	15.18
	1:00:00	0.00	0.00	2.74	3.76	4.60	6.87	7.92	10.01	13.34
	1:05:00	0.00	0.00	2.44	3.33	4.15	6.02	6.96	9.04	12.05
	1:10:00	0.00	0.00	2.01	2.92	3.70	5.05	5.85	7.36	9.85
	1:15:00	0.00	0.00	1.63	2.44	3.29	4.21	4.88	5.93	7.97
	1:20:00	0.00	0.00	1.33	1.99	2.75	3.31	3.83	4.44	5.96
	1:25:00	0.00	0.00	1.14	1.73	2.30	2.58	2.99	3.25	4.38
	1:30:00	0.00	0.00	1.05	1.60	2.01	2.06	2.39	2.51	3.40
	1:35:00	0.00	0.00	1.00	1.51	1.82	1.73	2.01	2.06	2.80
	1:40:00	0.00	0.00	0.97	1.34	1.68	1.52	1.76	1.76	2.39
	1:45:00	0.00	0.00	0.95	1.20	1.58	1.37	1.59	1.55	2.11
	1:50:00	0.00	0.00	0.94	1.11	1.51	1.27	1.47	1.41	1.92
	1:55:00	0.00	0.00	0.81	1.03	1.41	1.20	1.39	1.31	1.78
	2:00:00	0.00	0.00	0.72	0.95	1.26	1.15	1.34	1.24	1.69
	2:05:00	0.00	0.00	0.53	0.70	0.92	0.85	0.98	0.91	1.24
	2:10:00	0.00	0.00	0.39	0.50	0.66	0.61	0.71	0.66	0.90
	2:15:00	0.00	0.00	0.28	0.36	0.47	0.44	0.51	0.48	0.65
	2:20:00	0.00	0.00	0.20	0.25	0.33	0.31	0.36	0.34	0.46
	2:25:00	0.00	0.00	0.14	0.17	0.23	0.22	0.25	0.24	0.32
	2:30:00	0.00	0.00	0.09	0.12	0.16	0.15	0.17	0.16	0.22
	2:35:00	0.00	0.00	0.06	0.08	0.10	0.10	0.12	0.11	0.15
	2:40:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.09
	2:45:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.03	0.05
	2:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 13-12c. Emergency Spillway Protection

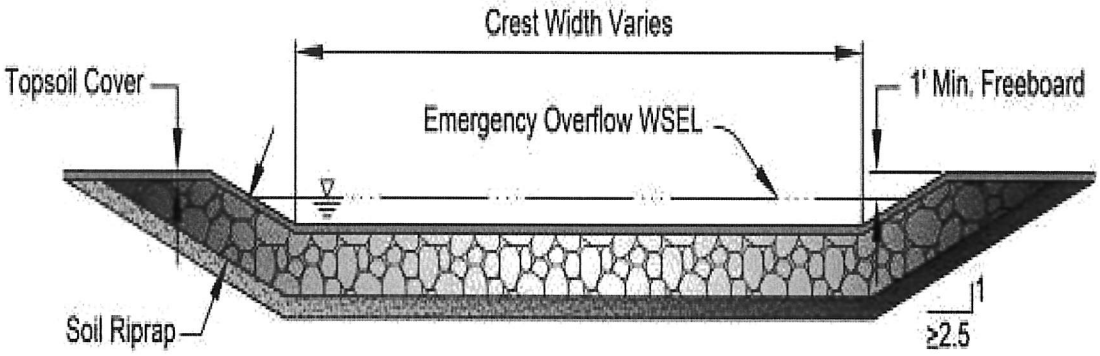
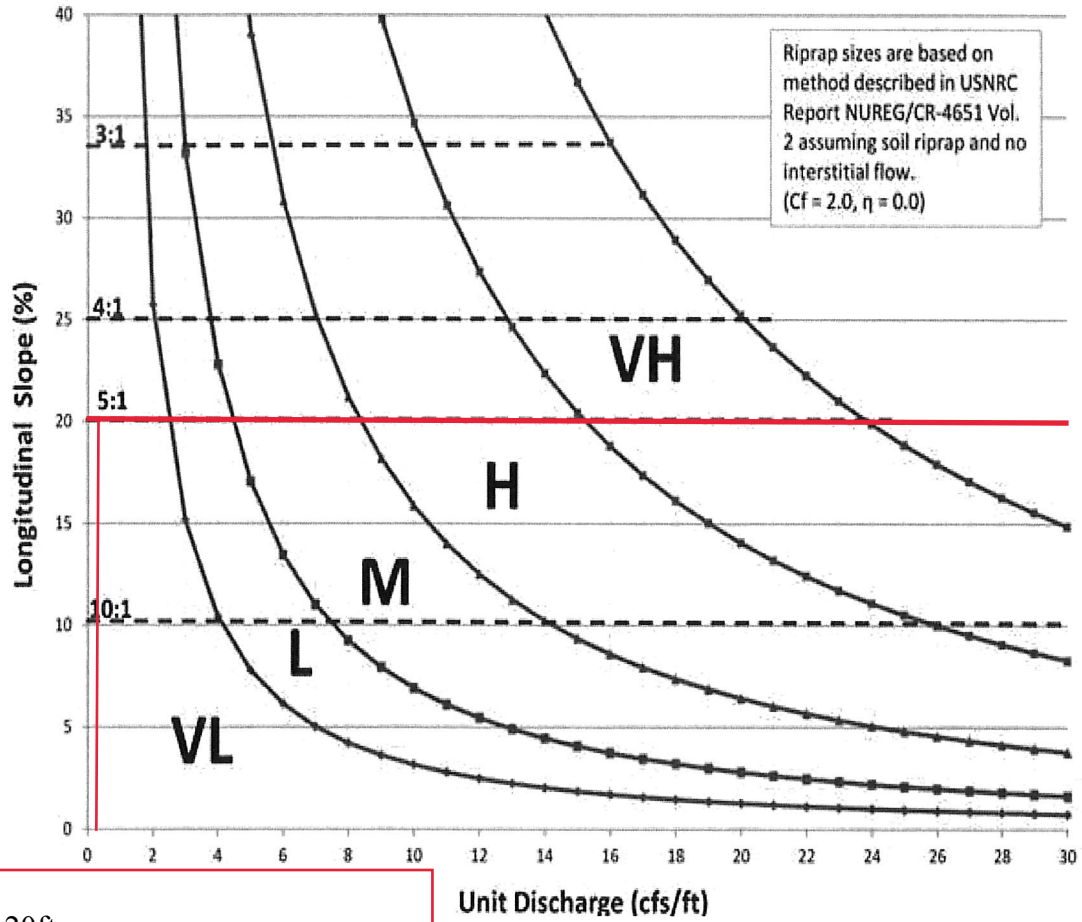


Figure 13-12d. Riprap Types for Emergency Spillway Protection



Q = 5.723 cfs
Crest Width = 20ft
Therefore, Unit Discharge (q) =0.29
Longitudial Slope of Emerg Spillway = 20.5%

Use VL sized Riprap (d_{50}=6")

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 23 2023

61180-A1 East Swale Draining To EDB

Triangular

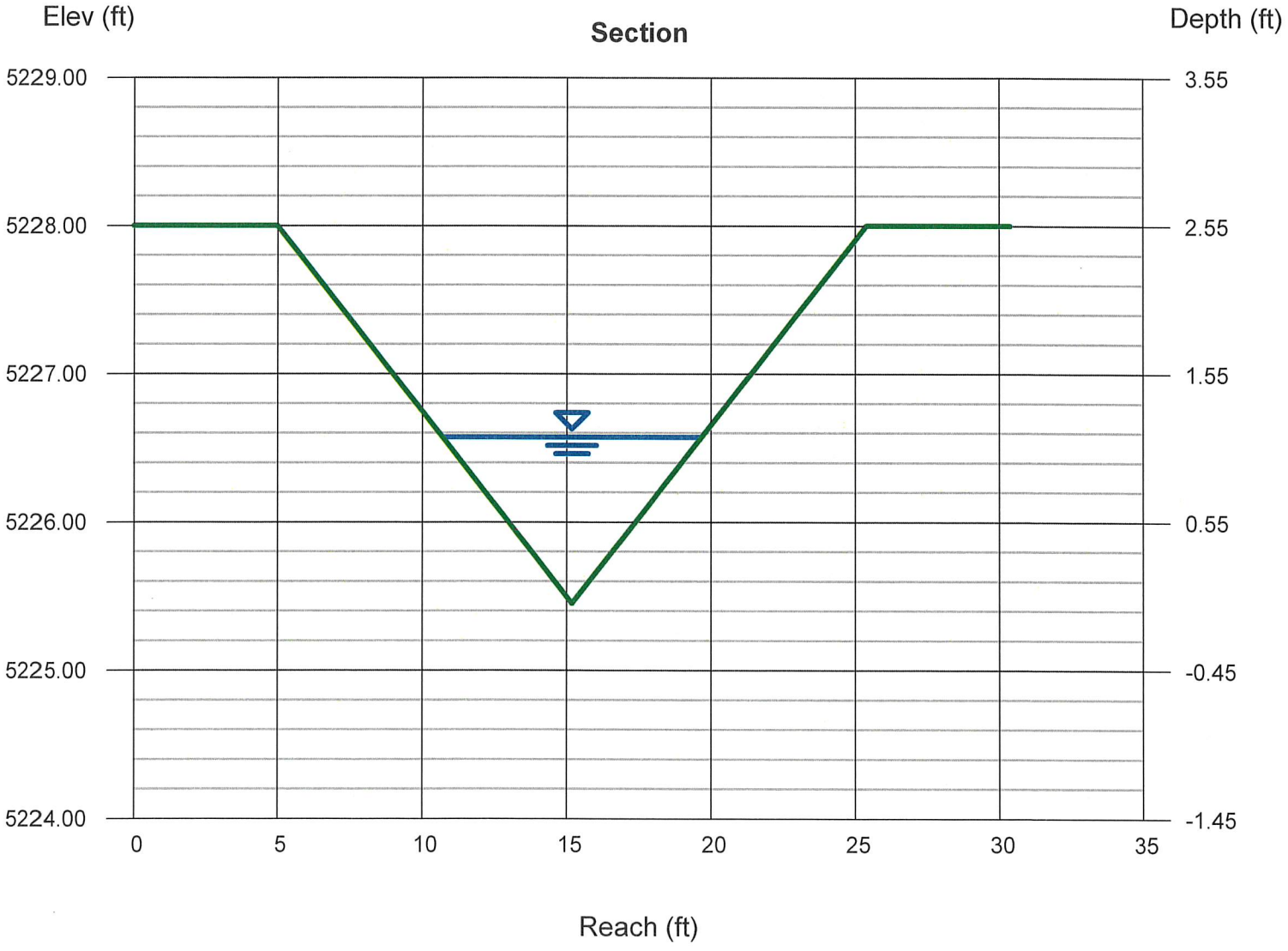
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.55
Invert Elev (ft)	= 5225.45
Slope (%)	= 0.98
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 14.00

Highlighted

Depth (ft)	= 1.12
Q (cfs)	= 14.00
Area (sqft)	= 5.02
Velocity (ft/s)	= 2.79
Wetted Perim (ft)	= 9.24
Crit Depth, Yc (ft)	= 0.95
Top Width (ft)	= 8.96
EGL (ft)	= 1.24



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 23 2023

61180-A3 Landscaped Area Draining into A2

Triangular

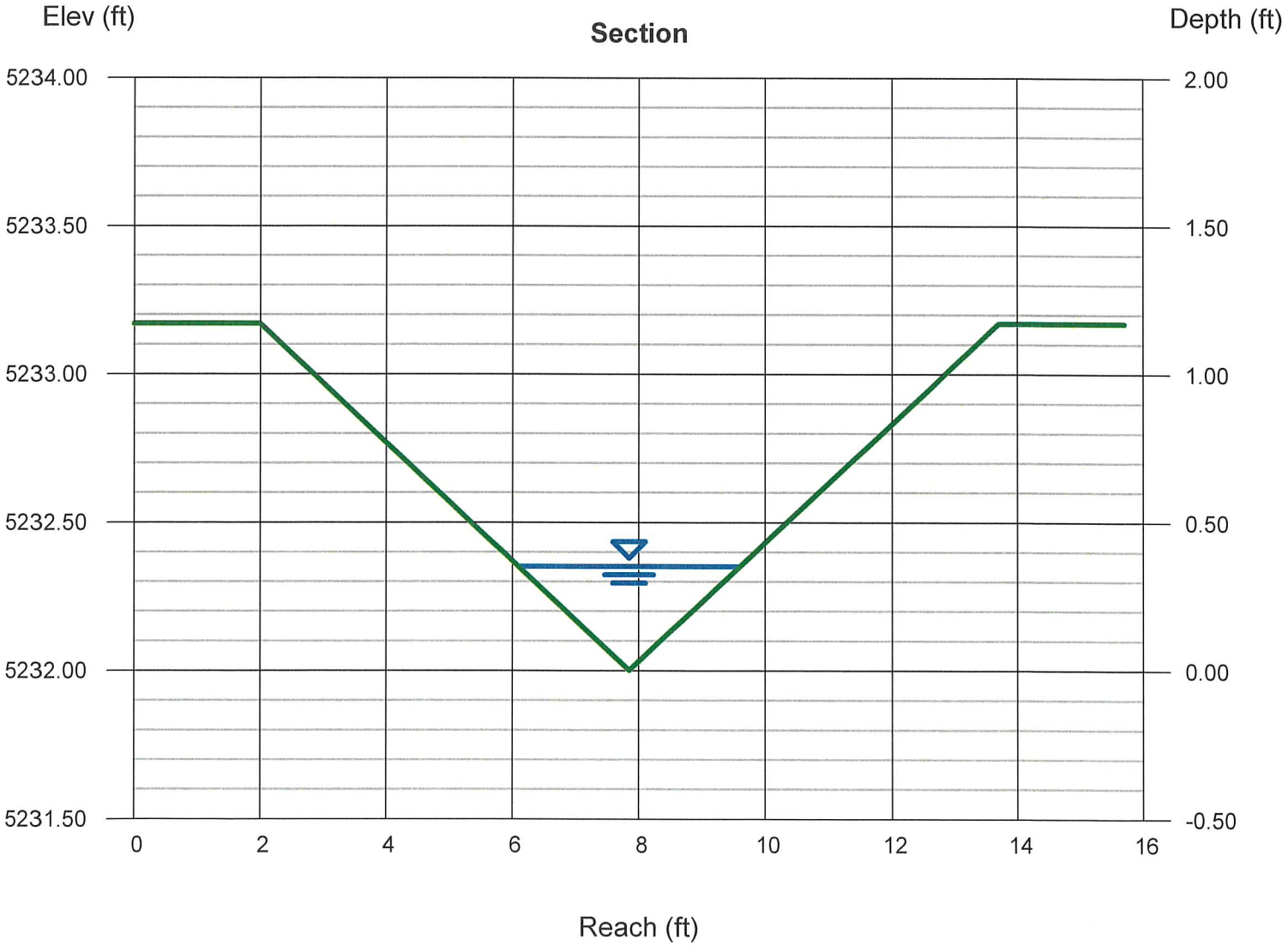
Side Slopes (z:1)	= 5.00, 5.00
Total Depth (ft)	= 1.17
Invert Elev (ft)	= 5232.00
Slope (%)	= 1.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.80

Highlighted

Depth (ft)	= 0.35
Q (cfs)	= 0.800
Area (sqft)	= 0.61
Velocity (ft/s)	= 1.31
Wetted Perim (ft)	= 3.57
Crit Depth, Yc (ft)	= 0.28
Top Width (ft)	= 3.50
EGL (ft)	= 0.38



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 23 2023

61180-A2 South V-Ditch Draining Into EDB

Triangular

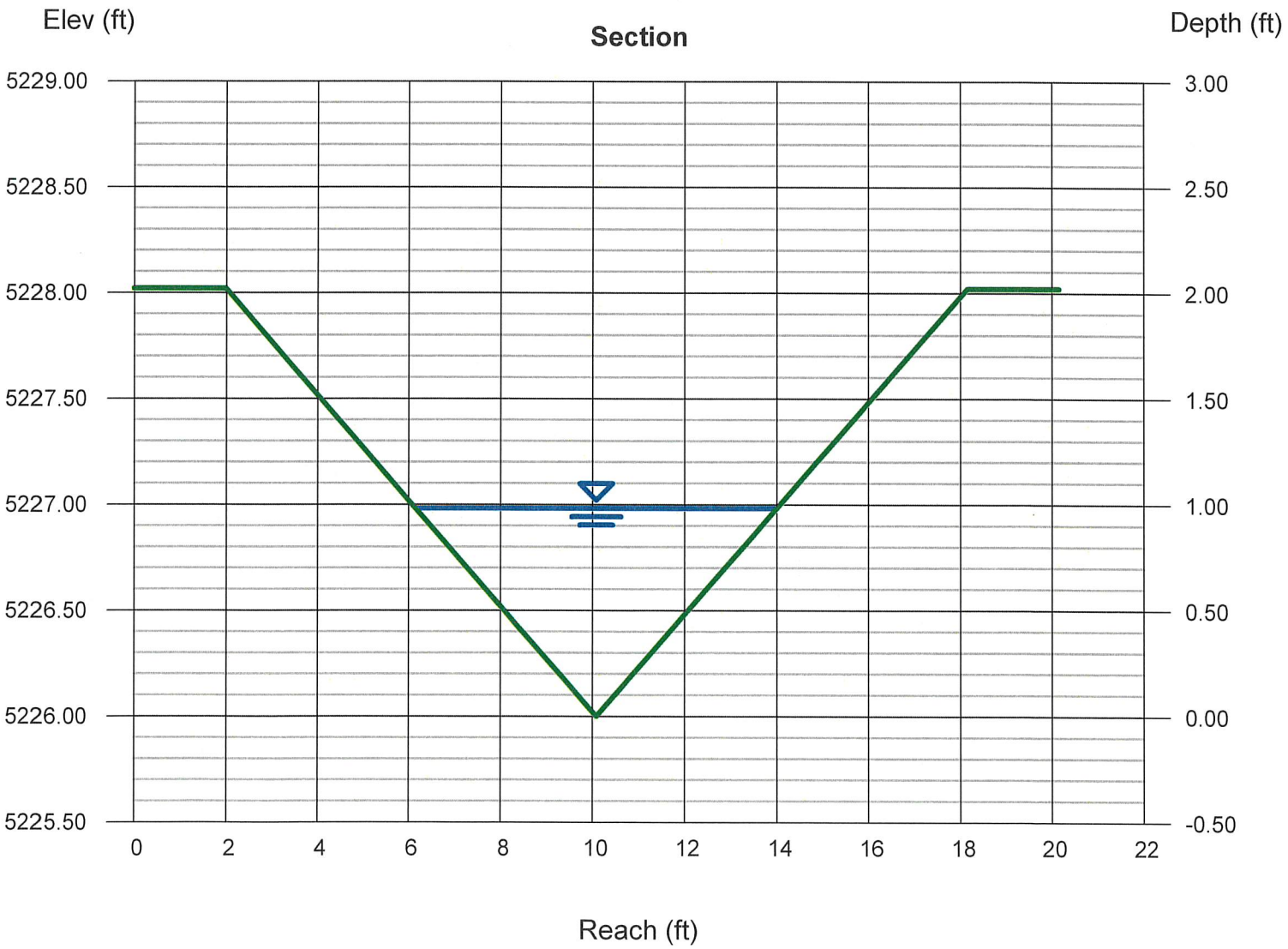
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.02
Invert Elev (ft)	= 5226.00
Slope (%)	= 1.59
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 12.40

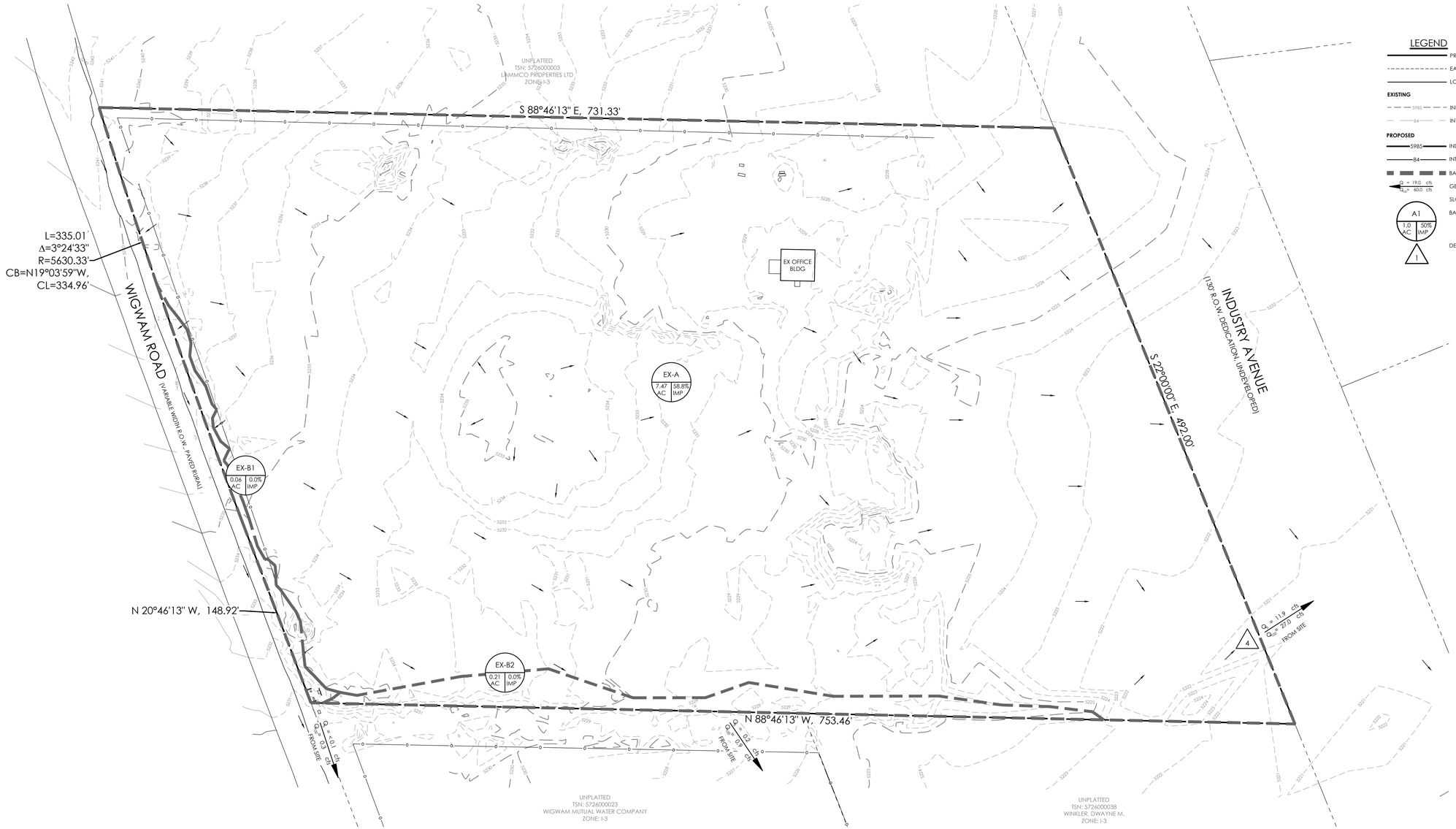
Highlighted

Depth (ft)	= 0.98
Q (cfs)	= 12.40
Area (sqft)	= 3.84
Velocity (ft/s)	= 3.23
Wetted Perim (ft)	= 8.08
Crit Depth, Yc (ft)	= 0.91
Top Width (ft)	= 7.84
EGL (ft)	= 1.14



11 Report Maps

Existing Condition Hydraulic Analysis Map (Map Pocket)
Proposed Condition Hydraulic Analysis Map (Map Pocket)



LEGEND

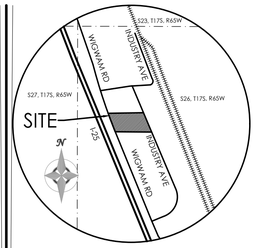
- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

EXISTING

- 5985 INDEX CONTOUR
- 84 INTERMEDIATE CONTOUR

PROPOSED

- 5985 INDEX CONTOUR
- 84 INTERMEDIATE CONTOUR
- BASIN BOUNDARY
- Q5 = 19.0 cfs, Q100 = 60.0 cfs — GENERAL FLOW/DIRECTION
- SLOPE DIRECTION AND GRADE
- A1 | 1.0 AC | 50% IMP — BASIN LABEL: AREA IN ACRES, PERCENT IMPERVIOUS
- 1 — DESIGN POINT



VICINITY MAP

NOT TO SCALE

BENCHMARK

N

10 0 20 40 80

1" = 40' 1:480

FLOODPLAIN STATEMENT

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAPS (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBER 08041C1170G, EFFECTIVE DECEMBER 7, 2018.

EXISTING DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
EX-DP4	EX-A	7.47	18.8	11.9	27.0	RATIONAL
	EX-B1	0.06	5.0	< 0.1	0.3	RATIONAL
	EX-B2	0.21	5.6	0.2	0.9	RATIONAL

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

REVISIONS

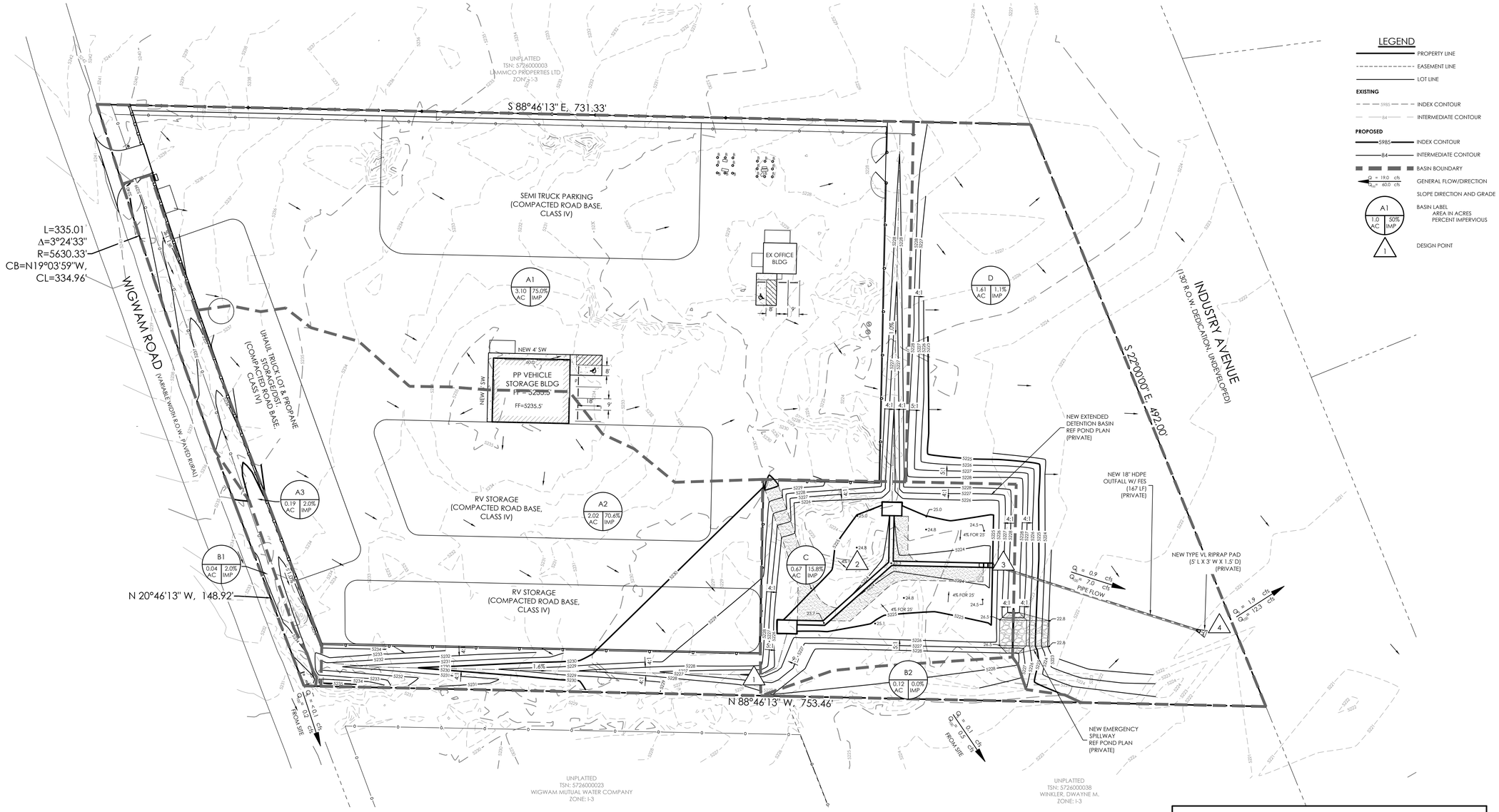
DESIGNED BY
DRAWN BY JO
CHECKED BY
AS-BUILTS BY
CHECKED BY

19955 WIGWAM ROAD

EXISTING DRAINAGE MAP

MVE PROJECT **61180**
MVE DRAWING **EX-DRN**

MARCH 23, 2023
SHEET 1 OF 1



LEGEND

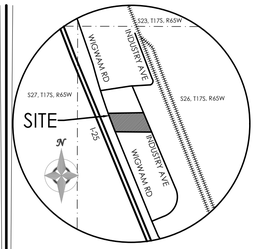
- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

EXISTING

- 5985 — INDEX CONTOUR
- 84 — INTERMEDIATE CONTOUR

PROPOSED

- 5985 — INDEX CONTOUR
- 84 — INTERMEDIATE CONTOUR
- BASIN BOUNDARY
- Q = 19.0 cfs, Q100 = 60.0 cfs — GENERAL FLOW/DIRECTION
- SLOPE DIRECTION AND GRADE
- A1 | 1.0 AC | 50% IMP — BASIN LABEL: AREA IN ACRES, PERCENT IMPERVIOUS
- 1 — DESIGN POINT



VICINITY MAP

NOT TO SCALE

BENCHMARK

1" = 40' 1:480

PROPOSED DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
	A1	3.10	13.3	6.9	14.0	RATIONAL
	A2	2.02	13.0	4.3	9.0	RATIONAL
	A3	0.19	5.0	0.2	0.8	RATIONAL
	B1	0.04	5.0	< 0.1	0.2	RATIONAL
	B2	0.12	6.3	0.1	0.5	RATIONAL
	C	0.67	7.2	0.8	2.9	RATIONAL
	D	1.61	12.0	1.0	5.3	RATIONAL
DP1	A2, A3	2.21	6.3	5.7	12.4	RATIONAL
DP2	A1, A2, A3	5.30	13.3	11.3	23.5	RATIONAL
DP3	A1, A2, A3, C	5.97	13.9	11.7	25.4	RATIONAL
	POND OUT	5.97		0.9	7.0	MHFD-DETENT
DP4	POND OUT, D	7.58	12.0	1.9	12.3	RATIONAL

FLOODPLAIN STATEMENT

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAPS (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBERS 08041C1170G, EFFECTIVE DECEMBER 7, 2018.

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REVISIONS

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

19955 WIGWAM ROAD

PROPOSED DRAINAGE MAP

MVE PROJECT **61180**
MVE DRAWING **PP-DRN**

MARCH 23, 2023
SHEET 1 OF 1