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Master Development Drainage Plan / Preliminary Drainage Report

Southmoor Ridge Development

Project No. 61186

February 15, 2024

Master Development Drainage Plan / Preliminary Drainage Report

For The

Southmoor Ridge Development

Project No. 61186

February 15, 2024

prepared for

DHN Develoment, LLC
2335 CoralBell Grove, #101
Colorado Springs, CO 80910
719-244-9851

prepared by

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Statements and Acknowledgments

Engineer's Statement

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

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

Developer's Statement

DHN Develoment, LLC hereby certifies that the drainage facilities for Southmoor Ridge Development shall be constructed according to the design presented in this report. I understand that the City of Fountain does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Fountain pursuant to City of Fountain Zoning Code and Subdivision Code; and cannot, on behalf of Southmoor Ridge Development, guarantee that final drainage design review will absolve DHN Develoment, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Darcy Nicklasson, Manager	Date

DHN Develoment, LLC
2335 CoralBell Grove, #101
Colorado Springs, CO 80910

City of Fountain Statement

Filed in accordance with the City of Fountain Zoning Code and Subdivision Code, as amended.

For the City Engineer	Date

City of Fountain

Conditions:

Master Development Drainage Plan / Preliminary Drainage Report

The purpose of this Master Development Drainage Plan / Preliminary Drainage Report is to identify drainage patterns and quantities within the proposed Southmoor Ridge Development. This drainage study includes four (4) on-site parcels and two (2) off-site parcels with a collective area of 23± acres. The report will identify specific solutions to problems on-site and off-site resulting from future development. The report and included maps present results of hydrologic and drainage facilities analyses. The report will discuss the recommended drainage improvements to the site and identify drainage requirements relative to the proposed project. This report has been prepared and submitted in accordance with the requirements of the City of Fountain development approval process. An Appendix is included with this report with pertinent calculations and graphs used in the drainage analyses and conceptual design.

1 General Location and Description

1.1 Location

The Southmoor Ridge Development site is located within a portion of the North ½ of the Northwest ¼ of Section 24, and the Southwest ¼ of the Southwest ¼ of Section 13 within Township 15 South, Range 66 West of the 6th principal meridian in the City of Fountain in El Paso County, Colorado. The general location of the site is east of Southmoor Drive, west of US Highway 85/87 and both north and south of the westerly extension of Fontaine Boulevard. The Southmoor Ridge Development site consists of four (4) parcels:

EPC Tax ID	Description	Location	Acreage	Use
6513314015	Lot 2, Fountain Commons Subdivision Filing no. 3	Southmoor Dr.	1.01 acres	Vacant Commercial Lot
6513300021	Unplatted	Southmoor Dr.	6.5 acres	Vacant Land
6524200052	Unplatted	Southmoor Dr.	4.64 acres	Vacant Land
6524200053	Unplatted	Southmoor Dr.	4.29 acres	Vacant Land

This area around the site consists of Commercial Lots to the Northwest, a single family residential parcel to the south, and commercial buildings to the center-east. Fountain Commons Subdivision Filing No. 3 is located north of the subject site. The Mart Subdivision Filings No. 1 & 2, Lovitt Subdivision, and Meadow Village Subdivision Filings Nos. 1-2 are located to the center east. A Vicinity Map is included in the Appendix.

1.2 Description of Property

The Southmoor Ridge Development site is 16.44± acres and is primarily Vacant Land distributed 73% north of the right-of-way for the extension of Fontaine Boulevard and 27% south of the extension. The subject site is zoned Planned Unit Development District (PUD). The site is covered with native grass and weeds in good condition, and clusters of coniferous and deciduous trees. All storm runoff flows south from the subject site and the property is located in the Carson Street Drainage Basin.

According to the National Resource Conservation Service, there are three (3) soil types in the Southmoor Ridge Development site. Nunn Clay Loam, 0 to 3 percent slopes (Map Unit 59) is the primary soil (69.7%) found onsite with Yoder gravelly sandy loam, 1 to 8 percent slopes (Map Unit 109) (28.2%) and Schamber-Razor Complex, 8 to 50 percent slopes (Map Unit 82) (2.2%) as secondary soils.

Nunn Clay Loam, 0 to 3 percent slopes (Map Unit 59) is found at the northern and southeasterly portions of the site. The soil is deep and well drained. Permeability is moderately slow, surface runoff is slow to medium, and the hazard of erosion is slight. Nunn Clay Loam, 0 to 3 percent slopes (Map Unit 59) is classified under Hydrologic Soil Group C.

Yoder gravelly sandy loam, 1 to 8 percent slopes (Map Unit 109) is found at the southerly portion of the site. The soil is deep and well drained. Permeability is moderately rapid, surface runoff is slow to medium, and the hazard of erosion is slight. Yoder gravelly sandy loam, 1 to 8 percent slopes (Map Unit 109) is classified under Hydrologic Soil Group A.

Schamber-Razor Complex, 8 to 50 percent slopes (Map Unit 82) is found at the southwesterly portion of the site and is the smallest type of soil onsite with respect to area. The soil is deep and well drained. Permeability is rapid, surface runoff is medium to rapid, and the hazard of erosion is moderate. Yoder gravelly sandy loam, 1 to 8 percent slopes (Map Unit 109) is classified under Hydrologic Soil Group A.

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]

A Preliminary Subsurface Soils Investigation (PSSI) was also prepared by Entech Engineering, Inc. dated June 29, 2022.[3] This report was followed by an Infiltration Rate Testing Summary by Entech Engineering, Inc. dated October 26, 2022.[4] The PSSI contains soil classifications for three soil types found in the investigation and preliminary geotechnical recommendations for construction on the site. The soils types found include Soil Type 1: very clayey sand, clean sand and silty to slightly silty sand; Soil Type 2: sandy silt and sandy clay; and Soil Type 3: claystone and shale. Soil Type 1 is the upper 13' to 20' in the majority of the test borings performed. The infiltration rate testing was performed using the alternative Infiltration Testing Protocol contained in the City of Colorado Springs Policy Clarification dated January 9, 2017 titled Infiltration Testing Using Percolation Test Method. The Infiltration Rate Testing Summary indicates Infiltration rates of the on-site soils range from 2.0 in/hr to 3.3 inc/hr. Because the findings of the PSSI and the Infiltration Testing are key to the drainage concept presented herein, a copy of the two documents are included in the appendix of this report.

The current Flood Insurance Study of the region includes Flood Insurance Rate Map (FIRM), effective on December 7, 2018.[5] The subject property is found within Community Panel No. 08041C0951G of the Flood Insurance Rate Maps for El Paso County. According to FEMA, This property is located Zone X with the description: "0.2 pct Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile". The subject site is located between two regulatory floodways to the northeast and

1 WSS
2 OSD
3 PSSI
4 Infiltr
5 FIRM

west. A portion of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the **Appendix**.

Sanitary and storm sewer lines, overhead electric and gas lines bisect the property from east to west. Some of these facilities are in existing easements. Utilities shall be relocated as necessary for the development and easements will be created where required.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The Southmoor Ridge Development site is located within the Carson Street Drainage Basin (FOFO2700) of the Fountain Creek Major Drainage Basin. This drainage basin is currently unstudied. The Carson Street Drainage Basin covers an area of approximately 0.5 square miles and drains to Fountain Creek. The Carson Street Drainage Basin encompasses a part of the northwest portion of the City of Fountain with the north of the basin extending to Plaza Boulevard to the north, Widefield Boulevard to the east, Southmoor Drive to the west, and Mesa Ridge Parkway to the south. This drainage basin drains southeasterly from the site into the adjacent properties to the south. There they continue to flow southeasterly to Carson Blvd then southwest into Fountain Creek.

2.2 Other Drainage Reports

No other drainage reports prepared by others were found for this site or the adjacent properties. A draft Master Development Drainage Plan for the Southmoor Ridge Development, dated August 24, 2023 by MVE, Inc., was supplied to the City of Fountain for preliminary consideration. In response, the city issued a letter of acceptance of the Full Infiltration Basin concept provided that final drainage report is submitted and reviewed and that a facility having enough storage volume to contain at least two consecutive 100-year rainfall events is constructed. A copy of this letter is included in the **Appendix.** This report describes proposed stormwater facilities that meet and exceed the requirements set forth in the city's letter.

2.3 Sub-Basin Description

The existing drainage patterns of the Southmoor Ridge Development site are described by various sub-basins making up two Design Points on the site. All existing sub-basin delineations and data are depicted on the attached **Existing Drainage Map**.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Master Development Drainage Plan / Preliminary Drainage Report for Southmoor Ridge Development has been prepared according to the report guidelines presented in the latest edition of the City of Colorado Springs Drainage Criteria Manual (DCM) Volumes 1 and 2 as adopted by the City of Fountain.[6] [7] The hydrologic analysis is based on a collection of data from the DCM, the NRCS Web Soil Survey[8], and existing topographic data by Compass Surveying and Mapping, LLC and by USGS.

3.2 Hydrologic Criteria

For this Master Development Drainage Plan / Preliminary Drainage Report, the Rational Method as described in the *Drainage Criteria Manual* has been used for all Storm Runoff calculations, as the development and all sub-basins are less than 130 acres in area.[9] "Colorado Springs Rainfall

6 DCM
7 CS DCM Vol 2
8 WSS
9 DCM

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 in the DCM Volume 1[10].

4 Drainage Facility Design

4.1 General Concept

The intent of this Master Development Drainage Plan / Preliminary Drainage Report is to determine existing and proposed runoff conditions for all on-site and off-site sub-basins to create a concept drainage facility plan. This site lies near the upstream end of the Carson Street Drainage Basin and is separated from the primary drainage path / storm system of said basin by several large residential properties. There are no nearby storm facilities available to discharge this developments developed runoff. Due to the inability to connect to a downstream discharge facility, this development will rely on a Full Infiltration Basin for the release of stormwater runoff. The drainage concept is to create multiple private Full Spectrum Extended Detention Basins (FS-EDBs) that will release the developed flows at the historic rate into a proposed private stormwater system. All developed flows from the site will pass through these FS-EDB's then flow into a proposed private Full Infiltration Basin.

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**.

4.2 Specific Details

4.2.1 Existing Hydrologic Conditions

The Southmoor Ridge Development study area is approximately 23 acres in size, including the street rights-of-way and offsite basins. The existing drainage conditions for the site consists of two offsite sub-basins and five onsite sub-basins. The site primarily consists of meadow/pasture with minor slopes of 0.5-2%. The primary Hydrologic Soil Group for the sub-basin is "C" unless otherwise specified.

Existing offsite sub-basin, **OS1** (3.14± acres), is located center-east of the subject site. This area is mostly developed with commercial buildings, landscaping, paved areas, and the north half of the existing 60' ROW Fontaine Boulevard. This sub-basin has mild slopes of 1-2%. The sub-basin generates peak storm runoff discharges of Q5 = 12.4 cfs and Q100 = 22.7 cfs (existing flow) which drains overland south into Fontaine Boulevard. This runoff continues west via the existing curb and gutter to a point where the pavement ends for the mentioned ROW within on-site sub-basin EX-MID-C.

Existing offsite sub-basin, **OS2** (2.40 ± acres), is located south-east of the subject site. This area is mostly developed with commercial buildings, a single family residence, barns and sheds, landscaping, paved areas, some pasture/meadow, and the south half of the 60' ROW Fontaine Boulevard. This sub-basin has slopes of 0.5-2%. The sub-basin generates peak storm runoff discharges of Q5 = 4.5 cfs and Q100 = 12.5 cfs (existing flow) which drains southwest onto the property into on-site sub-basin EX-SOU-C.

Existing onsite sub-basin, **EX-NORTH** (7.53 ± acres), is the northerly portion of the subject site. This area is undeveloped pasture/meadow with large bushes, clusters of deciduous trees, and several dirt paths. This sub-basin has slopes of 0.5 to 1% draining to the southeast. This sub-basin generates peak storm runoff discharges of Q5 = 4.1 cfs and Q100 = 23.1 cfs (existing flow) which drains

10 DCM

southeast with channelized flow at the southeast corner of the subject sub-basin. This runoff continues southeast as channelized flow and enters adjacent on-site sub-basin EX-MID-C.

Existing onsite sub-basin, **EX-MID-A** (1.66 ± acres), is located center-west within the subject site. This sub-basin has the primary soil group: Yoder gravelly sandy loam, 1 to 8 percent slopes (Map Unit 109) with Hydrologic Soil Group "A". This area is mostly undeveloped pasture/meadow with large bushes, clusters of deciduous trees, and several dirt paths. There is a series of man-made berms found in the western portion of the site which drain southerly. This sub-basin has slopes of 1-2% draining to the southeast. This sub-basin generates peak storm runoff discharges of Q5 = 0.5 cfs and Q100 = 3.7 cfs (existing flow) which drains southeast with channelized flow at the southeast corner of the subject sub-basin. This runoff continues southeast as channelized flow and enters adjacent on-site sub-basin EX-MID-C.

Existing onsite sub-basin, **EX-MID-C** (3.36 ± acres), is the center-east portion of the subject site. This sub-basin is delineated from EX-MID-A to differentiate the large contrast in soil types across the MID basin per the NRCS. This area is undeveloped pasture/meadow with large bushes, clusters of deciduous trees, and several dirt paths. This sub-basin has slopes of 1-2% draining to the south. This sub-basin generates peak storm runoff discharges of Q5 = 2.0 cfs and Q100 = 11.1 cfs (existing flow) which drains southeast with channelized flow at the southeast corner of the subject sub-basin. This sub-basin also accepts flows from on-site sub-basins: EX-NORTH, EX-MID-A, EX-MID-C, and the offsite sub-basin OS1 and combines at Existing Design Point 1 (EX-DP1). This runoff continues southerly as channelized flow and enters adjacent on-site sub-basin EX-SOUTH-C.

Existing onsite sub-basin, **EX-SOUTH-A** (3.98 ± acres), is located south-west within the subject site. This sub-basin has the primary soil classification: Yoder gravelly sandy loam, 1 to 8 percent slopes (Map Unit 109) with Hydrologic Soil Group "A". This area is a partially developed rural residential site with paved and dirt roads, barns and corrals. The residential structures are dilapidated and uninhabitable. This sub-basin has slopes of 0.5-1.5%. This sub-basin generates peak storm runoff discharges of Q5 = 1.9 cfs and Q100 = 9.6 cfs (existing flow) which drains overland to the southeast with channelized flow at the southeast corner of the subject sub-basin. This runoff continues southeast overland enters adjacent on-site sub-basin EX-SOUTH-C.

Existing onsite sub-basin, **EX-SOUTH-C** (0.82 ± acres), is the southeast portion within the subject site. This sub-basin is delineated from EX-SOUTH-A to differentiate the large contrast in soil types across the MID basin per the NRCS. This area is mostly undeveloped pasture/meadow with large bushes, clusters of deciduous trees, and livestock fencing. This sub-basin has slopes of 0.5-1.5%. This sub-basin generates peak storm runoff discharges of Q5 = 0.5 cfs and Q100 = 2.8 cfs (existing flow) which drains south with channelized flow at the southeast corner of the subject sub-basin. This sub-basin also accepts flows from all mentioned on-site and off-site sub-basins and combines at Existing Design Point 2 (EX-DP2). The sub-basin has no discharge point. The southerly neighbor has installed berms which prevent drainage from continuing south. Storm flows pond in the southeast corner of the site and infiltrate into the ground over a short period of time.

Existing Design Point, **EX-DP1** (15.69 ± acres), is located in the southeast corner of the on-site sub-basin EX-MID-C. This design point accepts flows from: EX-OS1, EX-NORTH, EX-MID-A, and EX-MID-C. This design point has runoff discharges of Q5 = 15.1 cfs and Q100 = 50.7 cfs (existing flow). These flows exits the mentioned sub-basin and continue southeasterly to Existing Design Point 2 (EX-DP2).

Existing Design Point, **EX-DP2** (22.89 ± acres), is located in the southeast corner of the on-site sub-basin EX-SOU-C. This design point accepts from all sub-basins. This design point has runoff discharges of Q5 = 18.6 cfs and Q100 = 64.4 cfs (existing flow). As mentioned above, these flows do not exit the site in an overland fashion since earth berms placed on the southerly property force the runoff to remain at the southeast corner of the site and infiltrate into the ground over a short period of time.

The included Hydrology Maps (Existing On-Site & Off-Site) 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 Developed Hydrologic Conditions

The developed hydrologic conditions are based upon the preliminary site development plan. The sub-basins are described below. Runoff for each sub-basin has been calculated and detention pond sizing is based on the preliminary site development plan. The locations of inlets and storm drain lines are shown in order to portray the expected stormwater routing but have not been sized in this report.

Developed offsite sub-basin, **OS1** (3.14 ± acres), is located center-east from the subject site. This existing area is mostly developed with commercial buildings, landscaping, paved areas, and the north half of the existing 60' ROW Fontaine Boulevard with an imperviousness of 95.1%. Therefore, the developed conditions for this sub-basin will remain the same as existing conditions. This sub-basin has mild slopes of 1-2%. The sub-basin generates peak storm runoff discharges of Q5 = 12.4 cfs and Q100 = 22.7 cfs (existing/developed flow) which drains overland into Fontaine Boulevard. This runoff continues west via the existing curb and gutter to a point where the pavement ends for the mentioned ROW within on-site sub-basin MID-C.

Developed offsite sub-basin, **OS2** (2.40 ± acres), is located south-east from the subject site. This existing area features commercial buildings, a single family residence, landscaping, paved areas, some pasture/meadow, and the south half of the existing 60' ROW Fontaine Boulevard. To simulate developed conditions for a combined commercial & residential areas, a composite imperviousness of 80% was derived based on area. This sub-basin has slopes of 0.5-2%. This sub-basin generates peak storm runoff discharges of Q5 = 4.5 cfs and Q100 = 12.5 cfs (existing flow) and developed flows of Q5 = 7.8 cfs and Q100 = 15.4 cfs (developed flow). This results in a negligible increase of flows of Q5 = 3.3 cfs and Q100 = 2.9 cfs. This future developed runoff is assumed to flow into Fontaine Boulevard and continue west via the existing curb and gutter to a proposed private curb inlet in a sump condition at the low point of Fontaine Blvd. Flows from that inlet enter a storm system conveying runoff to the proposed private FS-EDB Pond C.

Developed onsite sub-basin, **A1** (1.92 ± acres), is the northwest portion of the subject site. This sub-basin has slopes of 1% draining to the southeast. This area contains two multi-family apartment buildings, paved drives, sidewalk and landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 5.2 cfs and Q100 = 10.8 cfs (developed flow). Runoff from roofs and landscape areas shall be routed to the paved drives and flow to the southeast to a proposed private curb inlet which collects the flows and conveys them to the FS-EDB Pond A. Emergency overflow from the inlet would continue southeast into sub-basin A2. The inlet and conveyance pipes shall be sized in the future Final Drainage Report (FDR).

Developed onsite sub-basin, **A2** (1.46 ± acres), is the west central portion of the subject site. This sub-basin has slopes of 1% draining to the southeast. This area contains proposed clubhouse, common amenities, townhome buildings, paved drives, sidewalk and landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 4.8 cfs and Q100 = 9.7 cfs (developed flow). Runoff from roofs and landscape areas shall be routed to the paved drives and flow to the southeast to a proposed private curb inlet which collects the flows and conveys them to the FS-EDB Pond A. Emergency overflow from the inlet would continue southeast into sub-basin A4 and directly into the FS-EDB Pond A. The inlet and conveyance pipes shall be sized in the future Final Drainage Report (FDR).

Developed onsite sub-basin, **A3** (1.61 ± acres), is the north central portion of the subject site. This sub-basin has slopes of 1% draining to the southeast. This area contains the west half of two multi-family apartment buildings, paved drives, sidewalk and landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 5.3 cfs and Q100 = 10.3 cfs (developed flow). Runoff from roofs and landscape areas shall be routed to the paved drives and flow to the southeast to a proposed private curb inlet which collects the flows and conveys them to the FS-EDB Pond A. Emergency overflow from the inlet would continue southeast into sub-basin A4 and directly into the FS-EDB Pond A. The inlet and conveyance pipes shall be sized in the future Final Drainage Report (FDR).

Developed onsite sub-basin, **A4** / **Pond A** (0.46 ± acres), is located in the central portion of the site. This sub-basin contains the private FS-EDB and surrounding landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 0.6 cfs and Q100 = 2.3 cfs (developed flow). The private FS-EDB Pond A accepts flows from sub-basins A1, A2 & A3. This pond collects peak storm runoff discharges of Q5 = 14.1 cfs and Q100 = 30.1 cfs (proposed flow) being Design Point 4. The proposed private FS-EDB will provide water quality and detention before being released slowly into an outfall pipe draining to the Full Infiltration Basin in sub-basin D. The expected outflows for this FS-EDB are Q5 = 1.0 cfs and Q100 = 5.1 cfs. Emergency overflow from Pond A will travel east to a low point in the paved drive.

Developed onsite sub-basin, **B1** (2.76 ± acres), is the northeast portion of the subject site. This sub-basin has slopes of 1% draining to the southeast. This area contains the east half of two multi-family apartment buildings, garages, storage buildings, paved drives, sidewalk and landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 6.0 cfs and Q100 = 14.0 cfs (developed flow). Runoff from roofs and landscape areas shall be routed to the paved drives and flow to the southeast to a proposed private curb inlet in the low point of the drive which collects the flows and conveys them to the FS-EDB Pond B. Emergency overflow from the inlet would continue southeast into sub-basin B2 and directly into the FS-EDB Pond B. The inlet and conveyance pipes shall be sized in the future Final Drainage Report (FDR).

Developed onsite sub-basin, **B2** / **Pond B** (0.39 ± acres), is located in the east central portion of the site. This sub-basin contains the private FS-EDB and surrounding landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 0.6 cfs and Q100 = 2.0 cfs (developed flow). The private FS-EDB Pond B accepts flows from sub-basins B1. This pond collects peak storm runoff discharges of Q5 = 6.0 cfs and Q100 = 15.0 cfs (proposed flow) being Design Point 6. The proposed private FS-EDB will provide water quality and detention before being released slowly into an outfall pipe draining to the Full Infiltration Basin in sub-basin D. The expected outflows for this FS-EDB are Q5 = 0.1 cfs and Q100 = 2.6 cfs. Emergency overflow from Pond A will travel east to a low point in the paved drive.

Developed onsite sub-basin, **C1** (3.15 ± acres), is the central portion of the subject site. This sub-basin has slopes of 1% draining to the southeast. This area contains townhome buildings, paved drives, sidewalk, landscaping and the north half of the proposed Fontaine Blvd. This sub-basin generates peak storm runoff discharges of Q5 = 8.1 cfs and Q100 = 16.8 cfs (developed flow). Runoff from roofs and landscape areas shall be routed to the paved drives and flow to the southeast to a proposed public curb inlet in the low point of the proposed Fontain Blvd which collects the flows and conveys them to the FS-EDB Pond C. Emergency overflow from the inlet would continue south across Fontaine Blvd. The inlet and conveyance pipes shall be sized in the future Final Drainage Report (FDR).

Developed onsite sub-basin, **C2** (0.44 ± acres), is the central portion of the subject site. This sub-basin has slopes of 1% draining to the southeast. This area contains the south half of the proposed Fontaine Blvd. This sub-basin generates peak storm runoff discharges of Q5 = 1.9 cfs and Q100 = 3.4 cfs (developed flow). Runoff flows to the east to a proposed public curb inlet in the low point of the proposed Fontain Blvd which collects the flows and conveys them to the FS-EDB Pond C. Emergency overflow from the inlet would continue south directly into the proposed Full Infiltration Basin in sub-basin D. The inlet and conveyance pipes shall be sized in the future Final Drainage Report (FDR).

Developed onsite sub-basin, **C3** (1.24 ± acres), is the southwest portion of the subject site. This sub-basin has slopes of 1% draining to the east. This area contains townhome buildings, paved drives, sidewalk, and landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 3.2 cfs and Q100 = 7.1 cfs (developed flow). Runoff from roofs and landscape areas shall be routed to the paved drives and flow to the east to a proposed private curb inlet and conveys them to the FS-EDB Pond C. Emergency overflow from the inlet would continue east directly into the FS-EDB Pond C. The inlet and conveyance pipes shall be sized in the future Final Drainage Report (FDR).

Developed onsite sub-basin, **C4** / **Pond C** (1.54 ± acres), is located in the south central portion of the site. This sub-basin contains the private FS-EDB and surrounding landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 1.8 cfs and Q100 = 6.5 cfs (developed flow). The private FS-EDB Pond C accepts flows from sub-basins OS1, OS2, C1, C2, and C3. This pond collects peak storm runoff discharges of Q5 = 29.9 cfs and Q100 = 62.6 cfs (proposed flow) being Design Point 10. The proposed private FS-EDB will provide water quality and detention before being released slowly into an outfall pipe draining to the Full Infiltration Basin in sub-basin D. The expected outflows for this FS-EDB are Q5 = 2.8 cfs and Q100 = 16.1 cfs. Emergency overflow from Pond C will travel east directly into the proposed Full Infiltration Basin.

Developed onsite sub-basin, **E** (0.96 ± acres), is the west portion of the subject site. This sub-basin slopes to the west. This area contains the sidewalk and landscaping that flows west to Southmoor Drive from the site. This sub-basin generates peak storm runoff discharges of Q5 = 0.7 cfs and Q100 = 2.8 cfs (developed flow). This area is 5% of the total development and stormwater runoff can not reasonably be captured and routed to a treatment/detention facility.

Developed onsite sub-basin, **D / Full Infiltration Basin** (1.44 ± acres), is located in the southeast portion of the site. This sub-basin contains the private Full Infiltration Basin and surrounding landscaping. This sub-basin generates peak storm runoff discharges of Q5 = 1.2 cfs and Q100 = 6.1 cfs (developed flow). The private Full Infiltration Basin accepts flows from the three FS-EDBs. Detailed discussion of this facility is below.

The **Full Infiltration Basin** accepts all outflows from the FS-EDBs. The max inflow rate for this basin is 23.6 cfs in the 100 year storm as specified in the release rate for Ponds A, B & C. The size of this infiltration basin is based on a infiltration surface area of 19,100 square feet. Entech Engineering Inc. performed soil infiltration tests on site for the location of proposed Full Infiltration Basin. According to their report, this infiltration basin will have an infiltration rate of 2.149 inch/hr.[11] The soil infiltration report can be found in the **Appendix.**

The Full Infiltration Basin calculations were based on the outflow hydrographs of each of the three FS-EDBs. The outflow hydrographs are included in the **Appendix.**

Infiltration is expected to occur in each of the FS-EDBs but that rate of infiltration was not applied to a reduction of runoff volume in the FS-EDBs, thus applying an additional conservative factor in the system design.

The infiltration flowrate was determined by converting the infiltration rate from Entech's report from inch/hr to ft/sec and multiplying the floor area of the infiltration basin to obtain a constant infiltration flowrate in cubic feet per second. This infiltration flowrate does not consider the affects of pressure head or additional infiltration at the pond side slopes, thus applying an additional conservative factor in the system design.

To determine the stage-storage relationship for the Full Infiltration Basin, the outflow rates for all three FS-EDBs at 5 minute intervals were added together and converted into a volume. The constant outflow of the infiltration basin was determined by a basin bottom of 19,100 SF with a infiltration rate of 2.149 inch/hour, yielding a constant infiltration flowrate of 1.0 cfs. The constant outflow volume was subtracted from the total volume entering the basin at each 5 minute interval to obtain a net change in volume for each interval. That change in volume was applied to each 5 minute interval to develop the stage-storage relationship of the Full Infiltration Basin and determined the highest volume required. Infiltration is expected to occur on the side slopes of the basin, but this rate of infiltration was not accounted for in the required volume calculations. The stage-storage curve yielded a minimum pond size (maximum storage volume) of 90,134 cubic feet (2.069 acre-feet). Per the letter from the City of Fountain requiring the Full Infiltration Basin to hold two 100yr events, the required pond size is 180,268 cubic feet (4.138 acre-feet).

The proposed Full Infiltration Basin has a bottom area of 19,100 sf, 4 to 1 side slopes and a design depth of 6.5 feet. The resulting basin is capable of holding 183,310 cubic feet, thus meeting the required volume.

Given the placement and bottom elevation of the Full Infiltration Basin, there is 4.5 feet of freeboard above the water surface of two 100yr events before any runoff could physically leave the site onto the adjacent property to the south. This freeboard provides an additional volume of 202,300 cubic feet. The total volume of the Full Infiltration Basin is 385,610 cubic feet, approximately 430% of the required volume.

11 ENTECH

The infiltration basin will utilize existing site soils in the bed and side slopes. There is no anticipated need for excavation and replacement of the existing site soils to facilitate proper operation of the infiltration basin. The Full Infiltration Basin is designed with a wide and flat emergency spillway, acting as a level spreader along the southern boundary line. Existing map contours indicate that the south boundary is the natural outflow point for all the site parcels.

Each of the extended Full Spectrum Extended Detention Basins will fully comply with the requirements of CRS 37-92-602(8). The Full Infiltration Basin will fully drain the 100yr event in under 43 hours, thus also complying with CRS 37-92-602(8).

The included Hydrology Maps (Developed On-Site & Off-Site) depicts the location of the private Full Spectrum Extended Detention Basins and Full Infiltration Basin.

4.3 Erosion Control

During future construction, Control Measures (CM'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[12]. During Construction, silt fencing, & sediment control logs will be in place to minimize erosion from the site. CM's will be utilized as deemed necessary by the contractor, engineer, owner, or city inspector and are not limited to the measures described above.

4.4 Water Quality Enhancement Control Measures

The City of Colorado Springs Drainage Criteria Manual Volume 2 (DCM v2) requires the consideration of a “Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long term source controls”.[13] Per DCM v2, this Four Step Process applies to projects that disturb more than 1 acre, as is the case with this project. The Four Step Process is incorporated in the project and the elements are discussed below.

1) **Employ Runoff Reduction Practices:** Runoff reduction practices will be accomplished by allowing the majority of the impervious areas to sheet into planned infiltration areas (RPA's) that direct and route the flows into the proposed private full spectrum extended detention basin's (FS-EDB). Details of these RPAs and associated calculations will be provided in the Final Drainage Report. The design of these RPAs must comply with Step 1 Criteria at the time of the writing of the FDR's, including showing a minimum of a 10% reduction in the Water Quality Capture Volume (WQCV) utilizing volume reduction calculations and an associated green infrastructure exhibit. The associates Site Plan for the project provides ample space for the required RPA's

2) **Implement Control Measures That Provide a Water Quality Capture Volume with Slow Release:** The project site drains to multiple private Full Spectrum Extended Detention Basins (FS-EDBs) throughout the site. These basins provide water quality and detention before slowly discharging into an full infiltration basin. These basins will be constructed in accordance with City of Fountain drainage criteria.

3) **Stabilize Drainage Ways:** There are no significant existing drainageways on the site. All open areas will be stabilized with appropriate landscape treatment.

4) **Implement Site Specific and Other Source Control Measures:** The site contains no storage of potentially harmful substances. No Site Specific or other Source Control/Construction Control Measures (CCM's) are required as there are no potentially harmful substances for all proposed lots.

   A Grading, Erosion and Storm Water Quality Control Plan will be prepared at the time of Construction Drawing preparation and submitted to the City of Fountain for review and approval prior to construction. The plan will be prepared in accordance with the provisions of the City of Colorado Springs Drainage Criteria Manual Volume 2.

12 CS DCM Vol 2
13 CS DCM Vol 2

5 Drainage and Bridge Fees

The City of Fountain does not participate in the City of Colorado Springs / El Paso County Drainage Basin Fee Program. No Drainage or Bridge Fees will be payable with the development of this site.

6 Conclusion

This Master Development Drainage Plan / Preliminary Drainage Report presents existing and proposed drainage conditions for the proposed Southmoor Ridge Development site. The development will have negligible and inconsequential effects on the existing site drainage and will not exit the site as concentrated flow. The site runoff and storm drain and appurtenances mentioned in this report will not adversely affect the down stream and surrounding developments.

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).

Infiltration Rates (Percolation Test Method), Southmoor Drive, Parcel Nos. 6513314015, 6513300021, 6524200052, and 6524200053, Fountain, Colorado. Entech Engineering, Inc. (Colorado Springs, Colorado: , October 26, 2022).

Preliminary Subsurface Soils Investigation, Southmoor Properties, Fountain, Colorado. Entech Engineers, Inc. (Colorado Springs, Colorado: , June 29, 2022).

Flood Insurance Rate Map. Federal Emergency Management Agency, National Flood Insurance Program (Washingon D.C.: FEMA, December 7, 2018).

NCSS Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed May, 2017).

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

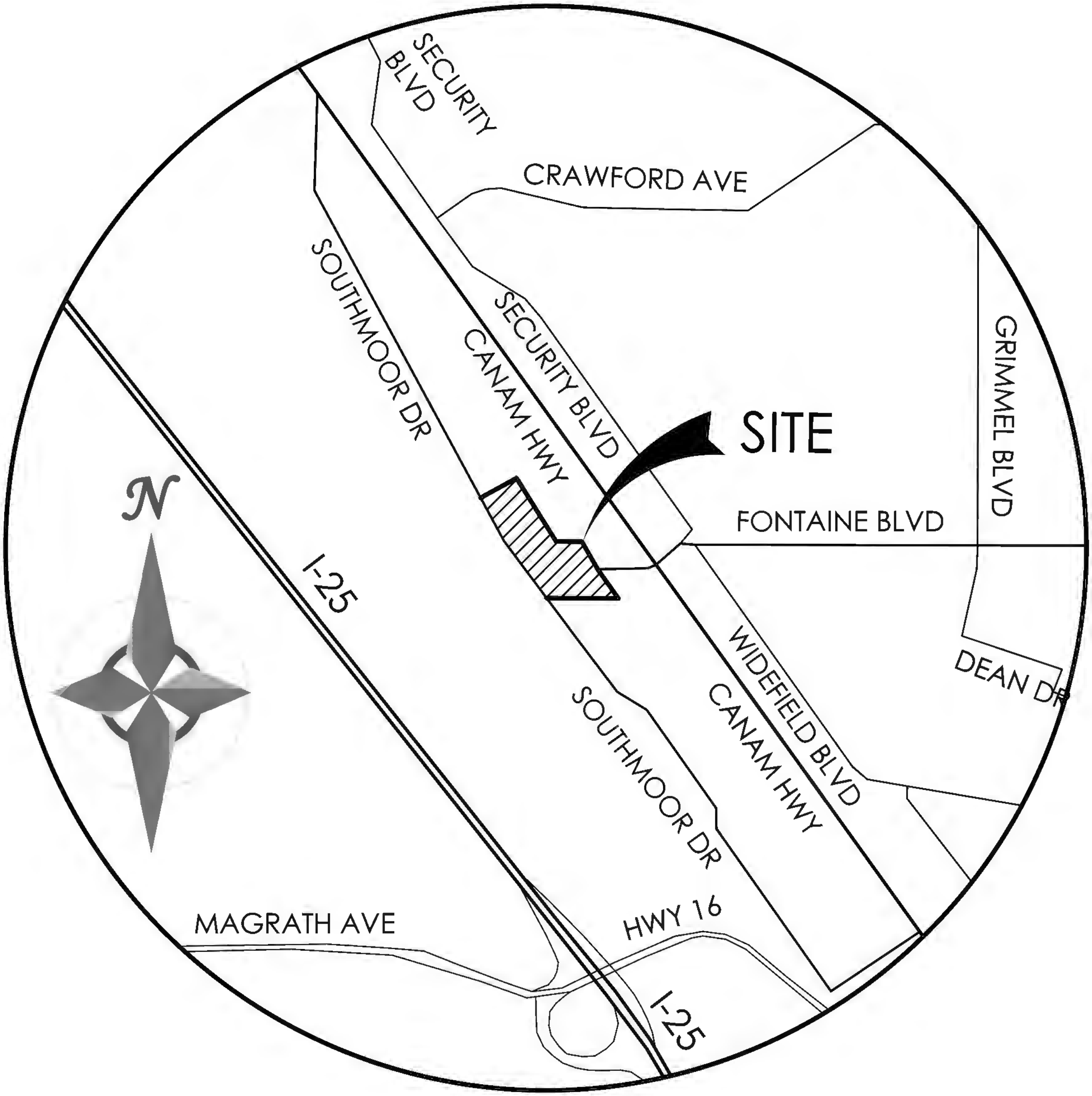
City of Colorado Springs Drainage Criteria Manual Volume 1. City of Colorado Springs Engineering Division with Matrix Design Group and Wright Water Engineers (Colorado Springs, Colorado: , May 2014).

Infiltration Rates (Percolation Test Method) Southmoor Drive, Pacel Nos. 6513314015, 6513300021, 6524200052, and 6524200053. Entech Engineering, Inc. (: , 2022).

Appendices

7 General Maps and Supporting Data

Vicinity Map
Portions of Flood Insurance Rate Map
Portion of Drainage Area Identification Study Map
NRCS Soil Map and Tables
SCS Soil Type Descriptions
Hydrologic Soil Group Map and Tables
Southmoor Ridge Drainage Concept Letter from the City of Fountain



VICINITY MAP

NOT TO SCALE

National Flood Hazard Layer FIRMette

FEMA

104°44'27"W 38°44'28"N

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

1:6,000

104°43'49"W 38°44'N

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
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 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 10/14/2022 at 10:34 AM 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 (Southmoor Ridge)

Map Scale: 1:3,680 if printed on A landscape (11" x 8.5") sheet.

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 (Southmoor Ridge)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
59	Nunn clay loam, 0 to 3 percent slopes	13.9	69.7%
82	Schamber-Razor complex, 8 to 50 percent slopes	0.4	2.2%
109	Yoder gravelly sandy loam, 1 to 8 percent slopes	5.6	28.2%
Totals for Area of Interest		**19.9**	**100.0%**

Map Unit Descriptions (Southmoor Ridge)

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

59—Nunn clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3693
Elevation: 5,400 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

A - 0 to 12 inches: clay loam
Bt - 12 to 26 inches: clay loam
BC - 26 to 30 inches: clay loam
Bk - 30 to 58 inches: sandy clay loam
C - 58 to 72 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
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: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: R069XY042CO - Clayey Plains
Other vegetative classification: CLAYEY PLAINS (069AY042CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

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

82—Schamber-Razor complex, 8 to 50 percent slopes

Map Unit Setting

National map unit symbol: 369y
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Schamber and similar soils: 55 percent
Razor and similar soils: 43 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Schamber

Setting

Landform: Breaks
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite and/or colluvium derived from granite and/or eolian deposits derived from granite

Typical profile

A - 0 to 5 inches: gravelly loam
AC - 5 to 15 inches: very gravelly loam
C - 15 to 60 inches: very gravelly sand

Properties and qualities

Slope: 8 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R069XY064CO - Gravel Breaks
Hydric soil rating: No

Description of Razor

Setting

Landform: Breaks
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 3 inches: clay loam
Bw - 3 to 9 inches: clay loam
Bk - 9 to 31 inches: clay
Cr - 31 to 35 inches: weathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
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: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R069XY047CO - Alkaline Plains
Other vegetative classification: ALKALINE PLAINS (069AY047CO)
Hydric soil rating: No

Minor Components

Other soils

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

Pleasant

Percent of map unit: 1 percent

Landform: Depressions
Hydric soil rating: Yes

109—Yoder gravelly sandy loam, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: 367c
Elevation: 6,200 to 6,900 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Yoder and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Yoder

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Noncalcareous alluvium derived from arkose

Typical profile

A - 0 to 6 inches: gravelly sandy loam
Bt - 6 to 12 inches: gravelly sandy clay loam
2C - 12 to 60 inches: very gravelly loamy coarse sand

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 5 percent
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 (Southmoor Ridge)

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.

tices help to maintain vigor and growth of plants. Fencing and properly locating livestock watering facilities also help to control grazing.

Windbreaks and environmental plantings generally are well suited to these soils. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure establishment and survival. Trees that are best suited to these soils are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited to these soils are skunkbush sumac, lilac, Siberian peashrub, and American plum.

These soils are best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many non-game species can be developed by establishing areas for nesting and escape cover. Rangeland widlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitations of the Neville soil for urban use are its limited ability to support a load, moderate shrink-swell potential, and frost action potential. The main limitations of the Rednun soil are slow permeability, shrink-swell potential, and frost action potential. Special designs for buildings and roads are needed to overcome these limitations. Community sewage systems may be required because septic tank absorption fields do not function properly where permeability is slow. Capability subclass IVe.

59—Nunn clay loam, 0 to 3 percent slopes. This deep, well drained soil is on terraces, fans, and uplands. It formed in mixed alluvium. Elevation ranges from about 5,400 to 6,500 feet. The average annual precipitation is about 14 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is grayish brown clay loam about 12 inches thick. The subsoil is grayish brown heavy clay loam about 18 inches thick. The substratum to a depth of 72 inches is light olive brown sandy clay loam in the upper part and light brownish gray clay in the lower part. Visible lime occurs as soft masses and streaks throughout the substratum.

Included with this soil in mapping are small areas of Manzanola clay loam, 0 to 1 percent slopes; Manzanola clay loam, 1 to 3 percent slopes; Sampson loam, 0 to 3 percent slopes; and Ustic Torrifluvents, loamy.

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

About 70 percent of the acreage of this soil is in dryland and irrigated crops. Wheat is the main dryland crop, and corn and alfalfa are the main irrigated crops. The remaining acreage is used as rangeland.

This soil is suited to the production of native vegetation suitable for grazing. The native vegetation is mainly western wheatgrass, blue grama, alkali sacaton, needleandthread, and side-oats grama. Galleta and fourwing saltbush are also present where this soil occurs in the southern part of the survey area. The presence of princesplume, two-groove milkvetch, and Fremont goldenweed indicates that selenium-bearing plants are in the stand.

Good grazing management is essential to maintain the desirable grasses. Deferment of grazing early in spring helps to maintain the vigor of cool-season grasses. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings generally are well suited to this soil. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by providing nesting areas and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided for in plans for habitat development; this is especially true for intensively farmed areas. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitations of this soil for urban use are slow permeability, low strength, and shrink-swell potential. Buildings and roads must be designed to overcome the limitations of low bearing strength and shrink-swell potential. Septic tank absorption fields do not function properly because of the slow permeability. Capability subclasses IIIc, nonirrigated, and IIe, irrigated.

60—Olney sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in calcareous sandy sediment on uplands. Elevation ranges from 5,200 to 6,000 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is grayish brown sandy loam about 6 inches thick. The subsoil, about 21 inches thick, is brown sandy clay loam in the upper 7 inches and pale brown sandy clay loam grading to sandy loam in the lower 14 inches. The substratum to a depth of 60 inches is very pale brown sandy loam that grades to loamy sand. The lower part of the subsoil and the substratum have visible lime in the form of soft masses and seams.

Included with this soil in mapping are small areas of Olney and Vona soils, eroded; Vona sandy loam, 1 to 3 percent slopes; and soils that are similar to this Olney soil in the upper 40 inches but that are very dark brown and loamy below a depth of 40 inches. Also included are material is reddish brown heavy fine sandy loam about 6 inches thick over light reddish brown loam that extends to a depth of 60 inches or more.

Permeability of the Neville soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies have developed along drainageways and trails.

These soils are used as rangeland, for wildlife habitat, and for military maneuvers.

These soils produce mainly midgrasses, dominantly western wheatgrass. Needlegrasses, big bluestem, sideoats grama, blue grama, and native bluegrasses make up a high percentage of the total production. If the range has deteriorated, blue grama, junegrass, and native bluegrasses increase. Sleepygrass and annuals replace these grasses if the range has seriously deteriorated. Death of livestock that eat poisonous plants increases as the range deteriorates.

Proper range management helps to maintain the vigor and production of plants. Proper location of livestock watering facilities helps to control grazing. Seeding is a good practice if the range is in poor condition. Seeding of the native vegetation is desirable, but the range can also be seeded with tame species of grasses such as Nordan crested wheatgrass, Russian wildrye, pubescent wheatgrass, or intermediate wheatgrass.

Windbreaks and environmental plantings generally are well suited to these soils. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

These soils are suited to wildlife habitat. They are best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided for in plans for habitat development. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitations for construction on these soils are low bearing strength, shrink-swell potential, and frost action potential. Special designs for buildings and roads are needed. Access roads must have adequate cut-slope grade, and drains should be provided to control surface runoff and keep soil losses to a minimum. Capability subclass IVe.

82—Schamber-Razor complex, 8 to 50 percent slopes. These gently rolling to steep soils are on eroded breaks and remnants of granite outwash over shale. Elevation ranges from 5,500 to 6,500 feet. The average annual precipitation is about 13 inches, and the average annual air temperature is about 49 degrees F.

The Schamber soil makes up about 40 percent of the complex, the Razor soil about 30 percent, and other soils about 30 percent.

Included with these soils in mapping are areas of Chaseville-Midway complex; Kim loam, 1 to 8 percent slopes; Razor stony clay loam, 5 to 15 percent slopes; and Heldt clay loam, 0 to 3 percent slopes.

The Schamber soil is deep and well drained. It formed in eolian material mixed with alluvium and colluvium derived from granite. Typically, the surface layer is grayish brown gravelly loam about 5 inches thick. The underlying material is brown very gravelly loam about 9 inches thick over light yellowish brown very gravelly sand that extends to a depth of 60 inches or more.

Permeability of the Schamber soil is rapid. The effective rooting depth is 60 inches or more, and available water capacity is low to moderate. Surface runoff is medium to rapid, and the hazard of erosion is moderate.

The Razor soil is moderately deep and well drained. It formed in residuum derived from calcareous shale. Slope is 8 to 15 percent. Typically, the surface layer is light brownish gray clay loam about 3 inches thick. The subsoil is grayish brown heavy clay loam or clay about 15 inches thick. The substratum is grayish brown clay that grades to calcareous shale at a depth of about 31 inches. Visible lime is in the lower part of the subsoil and in the substratum.

Permeability of the Razor soil is slow. The effective rooting depth is 20 to 40 inches. Available water capacity is moderate. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high.

The soils in this complex are used as native rangeland, for wildlife habitat, and as military impact areas.

These soils are suited to the production of native vegetation suitable for grazing. Native vegetation on the Schamber soil is western wheatgrass, blue grama, sideoats grama, and little bluestem. The common shrubs are skunkbush sumac, fourwing saltbush, and buckwheat. Native vegetation on the Razor soil is alkali sacaton, western wheatgrass, galleta, and lesser amounts of blue grama. Fourwing saltbush is a common shrub. The presence of princesplume, two-groove milkvetch, and Fremont goldenweed indicates that selenium-bearing plants are in the stand.

These soils are very difficult to revegetate, and it is especially important that livestock grazing be carefully managed. Fencing and properly locating livestock watering facilities help to control grazing. Where the plant cover has been depleted, especially on the Razor soil, pitting aids in the recovery of the native vegetation.

Windbreaks and environmental plantings are suited to this soil. Low available water capacity is the main limitation for the establishment of tree and shrub plantings. Summer fallow a year in advance and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac and lilac.

These soils are poorly suited to wildlife habitat. They are typically used as habitat for rangeland wildlife, such as scaled quail and antelope. Livestock grazing must be very carefully managed if wildlife is to satisfy most of its habitat requirements.

The main limitation for construction on the Schamber soil is steep slopes. Because of rapid permeability, there is a hazard of pollution if this soil is used for septic tank absorption fields. The high content of coarse fragments may cause problems with excavations, mainly because cut banks cave in. Special designs for buildings and roads are necessary to offset the limitation of slope. The Razor soil is limited by depth to shale, slow permeability, limited ability to support a load, shrink-swell potential, and slope. Both soils are limited by frost-action potential. Special designs for buildings and roads are needed to overcome these limitations. Capability subclass VIIe.

83—**Stapleton sandy loam, 3 to 8 percent slopes.** This deep, noncalcareous, well drained soil formed in sandy alluvium derived from arkosic bedrock on uplands. Elevation ranges from 6,500 to 7,300 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 11 inches thick. The subsoil is grayish brown gravelly sandy loam about 6 inches thick. The substratum extends to a depth of 60 inches or more. It is pale brown gravelly sandy loam in the upper part and grades to gravelly loamy sand in the lower part.

Included with this soil in mapping are small areas of Louviers silty clay loam, 3 to 18 percent slopes; Blakeland loamy sand, 1 to 9 percent slopes; Columbine gravelly sandy loam, 0 to 3 percent slopes; and Fluvaquentic Haplaquolls, nearly level. Also included are areas where arkose beds of sandstone and shale are at a depth of 0 to 40 inches. Included areas make up about 20 percent of the mapped acreage.

Permeability of this Stapleton soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

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

Native vegetation is mainly western wheatgrass, sideoats grama, needleandthread, and little bluestem. The predominant shrub on this soil is true mountainmahogany. Yucca occurs in some areas.

Deferred grazing late in summer and in fall improves the condition of the range. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the principal limitation for the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitation of this soil for urban use is frost-action potential. Special design of roads and streets is necessary to minimize frost heave damage. Special practices must be provided to minimize water erosion and soil blowing on construction sites where vegetation has been removed. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Capability subclass IVe.

84—**Stapleton sandy loam, 8 to 15 percent slopes.** This deep, noncalcareous, well drained soil formed in sandy alluvium derived from arkosic bedrock on uplands. Elevation ranges from 6,500 to 7,300 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 11 inches thick. The subsoil is grayish brown gravelly sandy loam about 6 inches thick. The substratum extends to a depth of 60 inches or more. It is pale brown gravelly sandy loam in the upper part and grades to gravelly loamy sand in the lower part.

Included with this soil in mapping are small areas of Bresser sandy loam, 5 to 9 percent slopes; Louviers silty clay loam, 3 to 18 percent slopes; Truckton sandy loam, 3 to 9 percent slopes; Yoder gravelly sandy loam, 1 to 8 percent slopes; and small outcrops of arkose beds of sandstone and shale.

Permeability of this Stapleton soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used as range, for wildlife habitat, and as homesites.

Native vegetation is mainly western wheatgrass, sideoats grama, needleandthread, and little bluestem. The dominant shrub on this soil is true mountainmahogany. Yucca is present in some places.

Deferred grazing late in summer and early in fall improves the condition of the range. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. Soil blowing is the main limitation for the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and planting and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil is best suited to habitat for openland wildlife, such as pheasant, mourning dove, and cottontail. Development of wildlife habitat, including tree, shrub, and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, excellent wildlife habitat could be developed that would benefit many kinds of openland wildlife.

The main limitations of this soil for urban uses are potential frost action and limited ability to support a load. Dwellings or roads can be designed to offset these limitations. Capability subclass IVe.

108—Wiley silt loam, 3 to 9 percent slopes. This deep, well drained soil formed in calcareous, silty eolian material. Elevation ranges from 5,200 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost free period is about 145 days.

Typically, the surface layer is pale brown silt loam about 5 inches thick. The subsoil is very pale brown heavy silt loam about 18 inches thick. The substratum is very pale brown silt loam to a depth of 60 inches. Visible soft masses of lime are in the lower part of the subsoil and in the substratum.

Included with this soil in mapping are small areas of Fort Collins loam, 3 to 8 percent slopes; Stoneham sandy loam, 3 to 8 percent slopes; Keith silt loam, 0 to 3 percent slopes; and Satanta loam, 3 to 5 percent slopes.

Permeability of this Wiley soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium, the hazard of erosion is moderate, and the hazard of soil blowing is high.

Almost all areas of this soil are used as rangeland and for wildlife habitat.

This soil is well suited to the production of native vegetation suitable for grazing. Native vegetation is mainly blue grama, western wheatgrass, sand dropseed, and galleta.

Fencing and properly locating livestock watering facilities help to control grazing. Deferment of grazing may be necessary to maintain a needed balance between livestock use and forage production. In areas where the plant cover has been depleted, pitting can be used to help the natural vegetation recover. Chemical control practices may be needed in disturbed areas where dense stands of pricklypear occur. Ample amounts of litter and forage should be left on the soil because of the high hazard of soil blowing.

Windbreaks and environmental plantings generally are well suited to this soil. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil is best suited to habitat for openland wildlife, such as pheasant, mourning dove, and cottontail. Wildlife habitat development, including tree and shrub plantings as well as grass plantings to serve as nesting areas, should be successful without irrigation during most years. If this soil is irrigated, excellent habitat that would benefit many kinds of openland wildlife could be established.

The main limitations of this soil for urban uses are potential frost action and limited ability to support a load. Dwellings and roads can be designed to offset these limitations. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff and thus keep soil losses to a minimum. Capability subclass VIe.

109—Yoder gravelly sandy loam, 1 to 8 percent slopes. This deep, well drained, gravelly soil formed in noncalcareous alluvium derived from arkosic deposits on uplands. Elevation ranges from 6,200 to 6,900 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown gravelly sandy loam about 6 inches thick. The subsoil is brown gravelly sandy clay loam about 6 inches thick. The substratum is very gravelly loamy coarse sand to a depth of 60 inches.

Included with this soil in mapping are small areas of Bresser sandy loam, 0 to 3 percent slopes; Bresser sandy loam, 3 to 5 percent slopes; Louviers silty clay loam, 3 to 18 percent slopes; and Truckton sandy loam, 3 to 9 percent slopes.

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

Most areas of this soil are used for rangeland and wildlife habitat, but a few small areas where slopes are less than 3 percent are cultivated.

The native vegetation is mainly western wheatgrass, side-oats grama, needleandthread, and little bluestem. The most prominent shrub on this soil is true mountain-mahogany.

Properly locating livestock watering facilities helps to control grazing of livestock.

Windbreaks and environmental plantings are suited to this soil. Low available water capacity is the main limitation for the establishment of tree and shrub plantings. Summer fallow a year in advance and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Supplemental irrigation may also be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac and lilac.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitation of this soil for excavations is the high gravel content, which causes cut banks to cave in. Excavations for underground utilities need to be designed to overcome this limitation. Capability subclass VIe.

110—Yoder gravelly sandy loam, 8 to 25 percent slopes. This deep, well drained, gravelly soil formed in noncalcareous alluvium derived from arkosic deposits on uplands. Elevation ranges from 6,200 to 6,900 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown gravelly sandy loam about 6 inches thick. The subsoil is brown gravelly sandy clay loam about 6 inches thick. The substratum is very gravelly loamy coarse sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Louviers silty clay loam, 3 to 18 percent slopes, and Truckton-Bresser complex, 5 to 20 percent slopes.

Permeability of this Yoder soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is medium to rapid, and the hazard of erosion is moderate. Some gullies have developed along drainageways, and there is some soil slippage on the steeper slopes.

This soil is used as rangeland and for wildlife habitat.

The native vegetation is mainly western wheatgrass, side-oats grama, needleandthread, and little bluestem. The most prominent shrub on this soil is true mountain-mahogany.

Vegetation is very difficult to reestablish on this soil if the native vegetation is destroyed. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are suited to this soil. Low available water capacity is the main limitation for the establishment of tree and shrub plantings. Summer fallow a year in advance and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Supplemental irrigation may also be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac and lilac.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitation of this soil for homesites is slope. The high gravel content can cause some excavation problems, such as unstable cut banks. Special designs for buildings and roads are required to overcome this limitation. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff and keep soil losses to a minimum. Capability subclass VIe.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

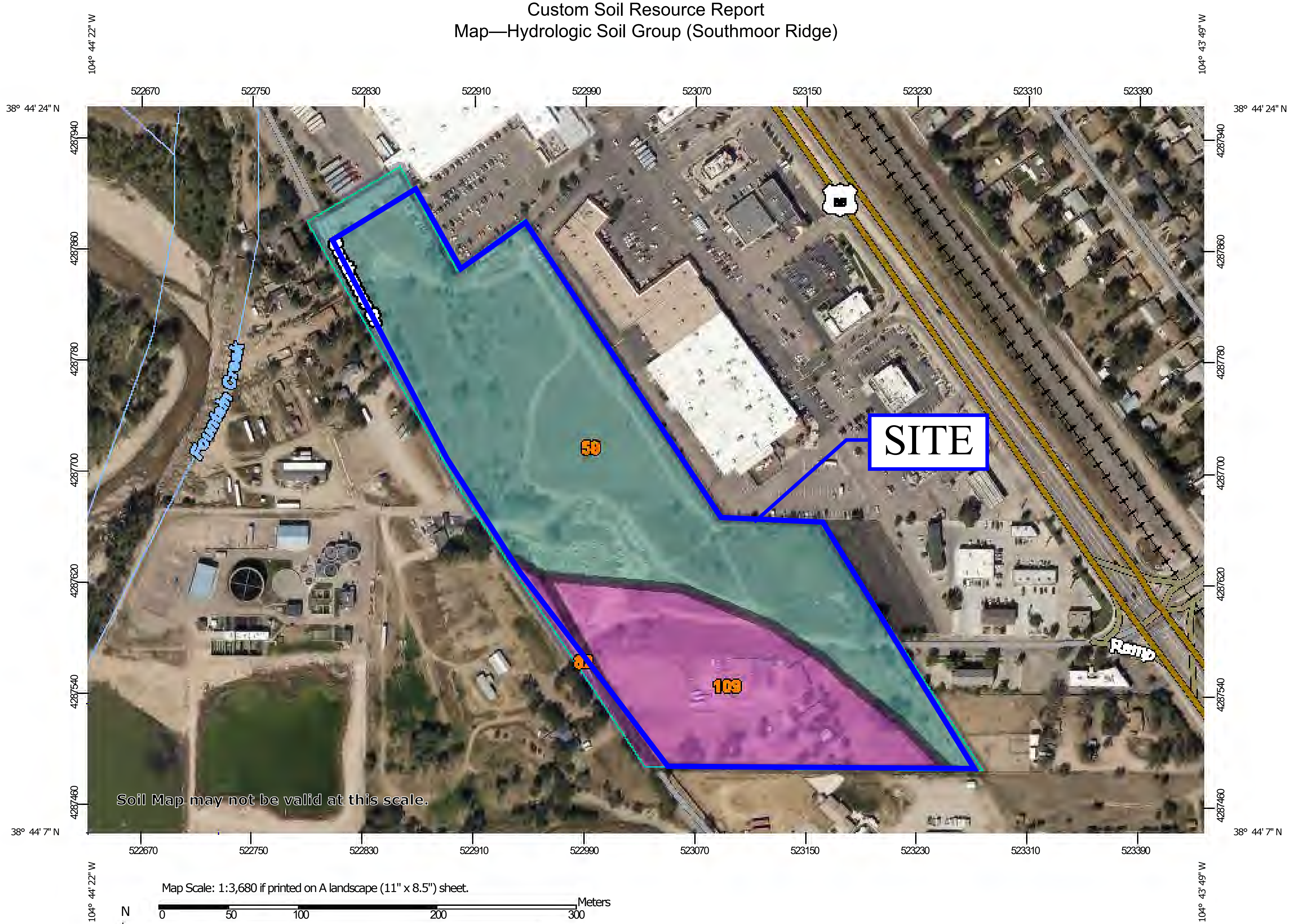
Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland; as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities; and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Map—Hydrologic Soil Group (Southmoor Ridge)



Map Scale: 1:3,680 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 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 (Southmoor Ridge)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
59	Nunn clay loam, 0 to 3 percent slopes	C	13.9	69.7%
82	Schamber-Razor complex, 8 to 50 percent slopes	A	0.4	2.2%
109	Yoder gravelly sandy loam, 1 to 8 percent slopes	A	5.6	28.2%
Totals for Area of Interest			**19.9**	**100.0%**

Rating Options—Hydrologic Soil Group (Southmoor Ridge)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

8 Subsurface Soils Investigation and Infiltration Rate Testing

Preliminary Subsurface Soils Investigation (PSSI)
Infiltration Rate Testing Summary

ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

June 29, 2022

Front Row Properties
1378 Promontory Bluff View
Colorado Springs, CO 80921

Attn: Ron Waldthausen

Re: Preliminary Subsurface Soil Investigation
Southmoor Properties
Fountain, Colorado

Dear Mr. Waldthausen:

As requested, personnel of Entech Engineering, Inc. have drilled twelve test borings to evaluate the site soil conditions for the anticipated development. This letter presents the results of our soils investigation, laboratory testing, and preliminary foundation recommendations.

SITE CONDITIONS:

The site development has not been determined and will likely consist of commercial and/or residential development with associated site improvements. Adjacent properties consist of commercial shopping center to the north and east, and a mix of rural residential and commercial properties to the west. The location of the site is shown in the vicinity map, Figure, 1. The site is gradually sloping to the southeast. At the time of our site investigation stables and out buildings were located in the southern portion of the site, and the remaining portion of the site was undeveloped. Vegetation consists of field grasses and weeds, with scattered trees in portions of the site, and fill piles were observed in the western portion of the site.

FIELD INVESTIGATION AND LABORATORY TESTING PROGRAM:

Subsurface conditions on the site were explored by drilling twelve test borings across the site. The test borings were drilled at the approximate locations shown on the Site Map/Test Boring Location Map, Figure 2. The borings were drilled to approximately 20 feet below the existing ground surface (bgs). The drilling was performed using a truck-mounted, continuous flight auger-drilling rig supplied and operated by Entech. Boring logs descriptive of the subsurface conditions encountered during drilling are presented in Appendix A. At the conclusion of drilling, observations for groundwater levels were made in the open boreholes.

Soil samples were obtained from the borings utilizing the Standard Penetration Test (ASTM D-1586) using 2-inch O.D. split-barrel and California samplers. Results of the Standard Penetration Test (SPT) are included on the boring logs in terms of N-values expressed in blows per foot (bpf). Soil samples recovered from the borings were visually classified and recorded on the boring logs. The soil classifications were later verified utilizing laboratory testing and grouped by soil type. The soil type numbers are included on the boring logs and in the provided chart. It should be understood that the soil descriptions shown on the boring logs may vary between boring location and sample depth. It should also be noted that the lines of stratigraphic separation shown on the boring logs represent approximate boundaries between soil types and the actual stratigraphic transitions may be more gradual and vary with location.

Moisture content testing (ASTM D-2216) was performed on the samples recovered from the borings, and the results are shown on the boring logs. Grain-Size Analysis Testing (ASTM D-422) was performed on selected samples to assist in classifying the materials encountered in the borings. Volume change testing was performed on selected samples using Swell/Consolidation (ASTM D-4546) tests in order to evaluate potential expansion/compression characteristics of the soil. Sulfate testing was performed on selected samples to evaluate potential for below grade concrete degradation due to sulfate attack. The Laboratory Testing Results are summarized on Table 1 and are presented in Appendix B.

SUBSURFACE CONDITIONS:

Three soil and rock types were encountered during drilling. The soils consisted of Type 1: very clayey sand, clean sand, and silty to slightly silty sand (SC, SW, SM, SM-SW), Type 2: sandy silt and sandy clay (ML, CL). The soils were classified using the Unified Soil Classification System (USCS).

Soil Type 1 classified as very clayey sand, clean sand, and silty to slightly silty sand (SC, SW, SM, SM-SW). The sand was encountered in all test borings from the existing ground surface to depths of 13 to 18 feet bgs, and to the termination of Test Boring Nos. 6, and 8 – 10 (20 feet). Standard Penetration Testing resulted in SPT N-values of 2 to 41 bpf, indicating very loose to dense states. The majority of the sands were encountered at medium dense states. Moisture contents of 1 to 9 percent were measured, indicating dry to moist conditions. Grain size testing resulted in 5 to 49 percent of the soil passing the No. 200 sieve. Atterberg Limits Testing on a sample of the very clayey sand resulted in a liquid limit of 26 and plastic index of 10. Sulfate testing on a sample of very clayey sand resulted in less than 0.1 percent sulfate by weight, indicating a low potential for below grade concrete degradation.

Soil Type 2 is classified as sandy silt and sandy clay (ML, CL). The silt and clay were encountered in five the test borings at depths of 13 to 19 feet bgs, extending to depths ranging from 17 to 19 feet, and the termination of Test Boring Nos. 4, 5, and 12 (20 feet bgs). Standard Penetration Testing resulted in an SPT N-value of 19 to 45 bpf, indicating stiff to very stiff consistencies. Moisture contents of 11 to 22 percent were measured, indicating moist conditions. Grain size testing resulted in 70 to 99 percent of the soil passing the No. 200 sieve. Atterberg Limits Testing resulted in a liquid limit of 49 and a plastic index of 21. Swell/Consolidation Testing resulted in volume changes of 0.7 to 1.7 percent, indicating a low to moderate expansion potential. Sulfate testing on the clay resulted in less than 0.1 percent sulfate by weight, indicating a low potential for below grade concrete degradation.

Soil Type 3 is classified as claystone and shale (CL, ML). The claystone and shale were encountered in four the test borings at depths of 13 to 19 feet bgs, extending to the termination of the test borings (20 feet bgs). Standard Penetration Testing resulted in an SPT N-value of 28 to greater than 50 bpf, indicating stiff to hard consistencies. Moisture contents of 13 to 17 percent were measured, indicating moist conditions. Grain size testing resulted in 88 to 97 percent of the soil passing the No. 200 sieve. Atterberg Limits Testing on the shale resulted in liquid limits of 40 and 44 and plastic indexes of 14 to 16. Swell/Consolidation Testing resulted in a volume change of 0.8 percent, indicating a low expansion potential. Sulfate testing on the shale resulted in 0.00 to 0.02 percent sulfate by weight, indicating a low potential for below grade concrete degradation.

Depth to groundwater was measured in each of the borings at the conclusion and subsequent to drilling. Groundwater was encountered in Test Boring No. 2 at 15.5 feet, groundwater was not encountered in the remaining test borings were which drilled to depths of 20 feet bgs. It is anticipated groundwater will not affect construction on the site. Development of this site and adjacent properties, as well as seasonal precipitation changes, and changes in runoff may affect groundwater elevations.

GEOTECHNICAL EVALUATION AND RECOMMENDATIONS:

The following discussion is based on the subsurface conditions encountered in the borings drilled for the planned development. If subsurface conditions different from those described herein are encountered during construction or if the project elements change from those described, Entech Engineering, Inc. should be notified so that the evaluation and recommendations presented can be reviewed and revised if necessary.

The site is to be developed with commercial and/or residential structures and associated site improvements. Very loose to loose soils were encountered in several of the borings in the upper profile. Fill piles were observed on the site, however, fill was not encountered in the testing borings. If uncontrolled fill is encountered beneath foundations mitigation will be required. Loose soils or uncontrolled fill encountered within the building areas must be completely removed and recompacted. To provide a uniform bearing pad, at a minimum, it is recommended that the loose soils be penetrated or moisture-conditioned, and recompacted below the building(s). Prior to placing the structural fill, the subgrade should be scarified, moisture-conditioned, and compacted. Fill placed in building areas should be compacted according to the "Structural Fill" paragraph. Preliminary design considerations are discussed in the following sections. Additional subsurface soil investigation is recommended once development plans are prepared. The extent of overexcavation/recompaction will be determined at the time of the open excavation observations.

Expansive soils were encountered in the borings, however, are sporadic. Should expansive soils be encountered beneath the foundations, mitigation will be necessary. Mitigation of expansive soils will require overexcavation and replacement with non-expansive soils at 95% of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation which is common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. Final recommendations should be determined after additional investigation of each building site.

PRELIMINARY FOUNDATION RECOMMENDATIONS:

Shallow spread footing/stemwall foundation systems in conjunction with overexcavation/fill mitigation is anticipated for any structures to be built on this site. An allowable bearing pressure of 2000 pounds per square foot (psf) are anticipated for the site soils. Exterior footings should extend to a minimum of 30 inches for frost protection. Recommendations should be made after additional investigation and completion of the grading plans. Density testing of the reconditioned soil or structural fill placed on this site should be performed by a qualified individual.

Foundation walls retaining soils should be designed to resist lateral pressures generated by the soils. An equivalent hydrostatic fluid pressure (in the active state) of 45 pcf is recommended for the site soils. It should be noted that this value applies to level backfill conditions. Pressures may increase depending on the conditions adjacent to the walls. Surcharge loading if any, should be considered in wall designs. Equivalent fluid pressures for sloping conditions should be determined on an individual basis.

FOUNDATION EXCAVATION OBSERVATION:

The open foundation excavations should be observed by a representative of Entech Engineering, Inc. prior to construction of the foundation in order to verify that no anomalies are present, materials at the proper design bearing capacity have been encountered, and no soft or loose areas or debris are present in the excavation. Loose areas that require removal and or recompaction should be identified during site observations.

CONCRETE:

Type II cement is recommended for all concrete on this site. Concrete should not be placed on frozen or wet ground. Care should be taken to prevent the accumulation and ponding of water in the footing excavation prior to the placement of concrete. If standing water is present in the excavation, it should be removed from the excavation by pumping it away from the building area. Concrete placed during cold temperatures must be kept from freezing, which may require covering the concrete with insulated blankets and heating it.

FLOOR SLABS:

Floor slabs placed on loose soils should be expected to experience movement. The uncontrolled fill must be mitigated below slabs. Floor slabs on grade, if any should be separated from structural portions of the building, unless they are designed as part of the foundation system. Backfill placed below floor slabs should be compacted to a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557.

SITE SEISMIC CLASSIFICATION

Based on the subsurface conditions encountered at the site and in accordance with Section 1613 of the 2015 International Building Code (IBC), the site meets the conditions of a Site Class E.

SURFACE AND SUBSURFACE DRAINAGE:

Positive surface drainage must be maintained around the structure to minimize infiltration of surface water. A minimum gradient of 5 percent in the first 10 feet adjacent to foundations is recommended. A minimum gradient of 2 percent is recommended for paved areas. All grades should be directed away from the structure. All downspouts should be extended to discharge well beyond the backfill zone of the structure.

A subsurface drain is recommended around portions of the structure which will have useable space located below the finished ground surface. A perimeter drain will not be required for slab on grade construction is the slab if above exterior grade. Typical drain details are included with this letter.

STRUCTURAL FILL:

Areas to receive structural fill should have all topsoil, organic material or debris removed. Fill must be properly benched. Prior to placing new fill, the surface should be scarified and moisture conditioned to within ± 2 percent of its optimum moisture content and compacted to 95 percent of its maximum Modified Proctor Dry Density (ASTM D-1557) or to 95 percent of the soils maximum Standard Proctor Dry Density, ASTM D-698 at or above optimum moisture content. New fill should be placed in lifts not to exceed 6 inches after compaction while maintaining the above noted compaction requirements. Fill should be placed at a moisture content conducive to compaction. The placement and compaction of fill should be observed and tested by Entech. Any imported soils should be approved by Entech prior to being hauled to the site. The on-site soils may be used as structural fill pending approval by Entech.

UTILITIES:

Backfill placed in utility trenches should be compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density (ASTM D-1557). Utility backfill should be placed in lifts having a compacted thickness of six inches or less and a moisture content conducive to adequate compaction, usually ±2 percent of its optimum Proctor moisture content. Mechanical methods should be used in placement of backfill; however, heavy equipment should be kept away from foundation walls. No water flooding techniques of any type should be used in compaction of backfill on the site.

Trench backfilling should be performed in accordance with City of Fountain specifications. Excavating should be performed in accordance with OSHA guidelines.

CLOSING:

The test borings were located to provide preliminary geotechnical information; variations in subsurface conditions may be encountered. In the event that the project scope changes, the conclusions and recommendations in this report should not be considered valid unless the changes are reviewed and the conclusions of this report are verified in writing or, if necessary, modified. Additional investigation will be required on the site as development/grading plans are prepared.

This report has been prepared for Front Row Properties for application to the proposed project in accordance with generally accepted soil and foundation engineering practices. No other warranty expressed or implied is made.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Geologist
LLL

COLORADO REGISTERED
JOSEPH COLLIN GOODE JR.
6-29-2022
23725
PROFESSIONAL ENGINEER

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

Encl.

Entech Job No. 221305
AA projects\2022\221305-pssi

TABLE

TABLE 1

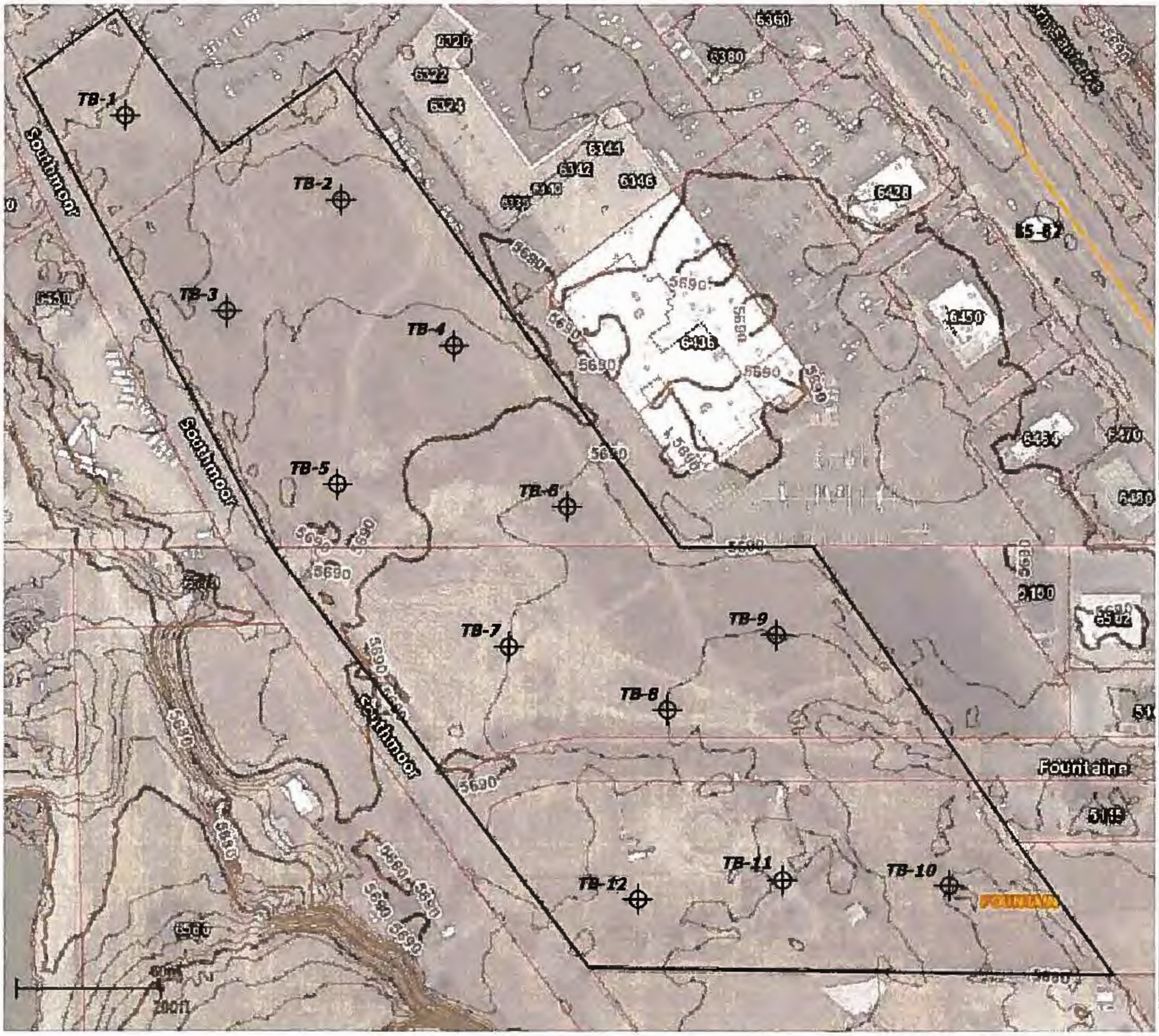
SUMMARY OF LABORATORY TEST RESULTS

CLIENT FRONT ROW PROPERTIES
PROJECT SOUTHMOOR DRIVE
JOB NO. 221305

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	1	2-3			43.9	26	10	<0.01			SC	SAND, VERY CLAYEY
1	4	5			4.7						SW	SAND
1	6	5			5.1						SM-SW	SAND, SLIGHTLY SILTY
1	8	2-3			10.2						SM-SW	SAND, SLIGHTLY SILTY
1	9	2-3			49.1						SC	SAND, VERY CLAYEY
1	10	5			24.2						SM	SAND, SILTY
1	11	10			22.4						SM	SAND,S ILTY
2	5	15	14.9	100.0	97.4	49	21	<0.01		1.7	ML	SILT, SANDY
2	7	15	21.9	97.7	98.5					1.3	CL	CLAY, SANDY
2	12	20	23.4	89.5	70.2					0.7	CL	CLAY, SANDY
3	2	15	15.1	97.5	97.0	44	16	0.00		0.8	ML	SHALE
3	3	20			88.2	40	14	0.02			ML	SHALE

FIGURES

ENTECH ENGINEERING, INC. 505 ELKTON DRIVE COLORADO SPRINGS, CO. 80907 (719) 531-5599	VICINITY MAP SOUTHMOOR DRIVE PROPERTIES FOUNTAIN, COLORADO FOR: FRONT ROW PROPERTIES	JOB NO.: 221305
	DRAWN: LLL · DATE: 6/28/22 · CHECKED: · DATE:	FIG NO.: 1



TB- APPROXIMATE TEST BORING LOCATION AND NUMBER

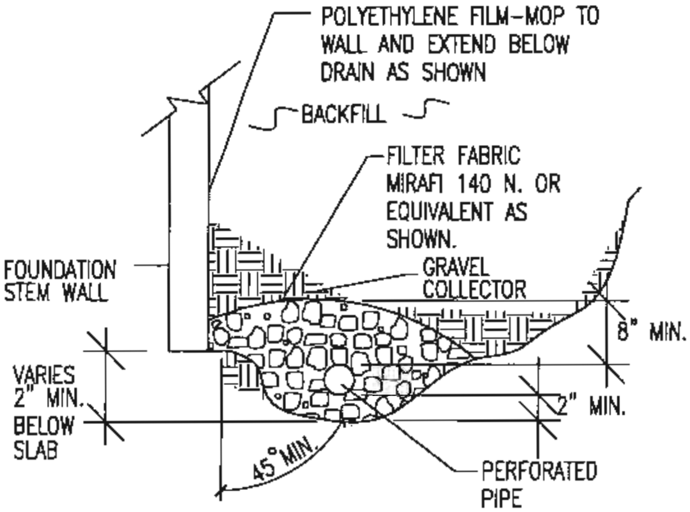
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

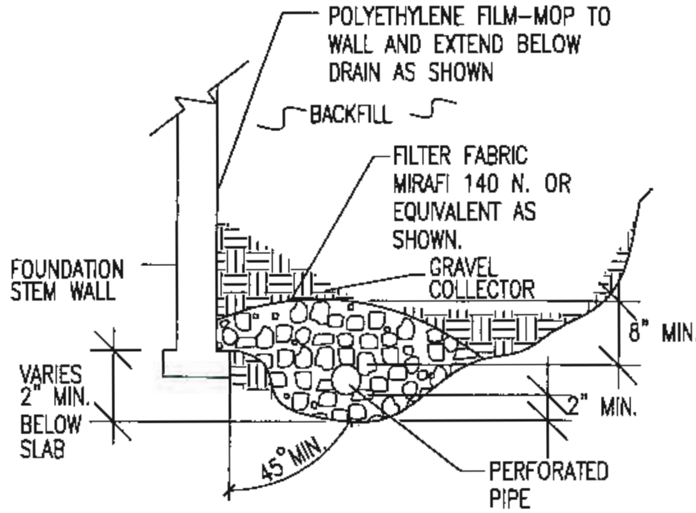
SITE MAP/TEST BORING LOCATION MAP
SOUTHMOOR DRIVE PROPERTIES
FOUNTAIN, COLORADO
FOR: FRONT ROW PROPERTIES

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/28/22		

JOB NO.: 221305

FIG NO.: 2





NOTES:

-GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS-85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

-PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4-INCH DIAMETER IS MOST OFTEN USED.

-ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON-PERFORATED PIPE.

-FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

-MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

-DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP ANO PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:

JOB NO.: 221305

FIG NO.: 3

APPENDIX A: Test Boring Logs

TEST BORING NO.	1
DATE DRILLED	6/7/2022
Job #	221305

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 18.5', 6/9/22						
SAND, VERY CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST				24	3.8	1
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO DENSE, MOIST TO DRY	5			15	3.1	1
	10			33	1.3	1
CLAYSTONE, SANDY, DARK GRAY, HARD, MOIST	15			50/10"	12.9	3
	20			50/5"	13.4	3

TEST BORING NO.	2
DATE DRILLED	6/7/2022
CLIENT	FRONT ROW PROPERTIES
LOCATION	SOUTHMOOR DRIVE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 15.5', 6/9/22						
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO LOOSE, MOIST				25	5.0	1
	5			8	2.3	1
	10			11	1.6	1
SHALE, GRAY BROWN, VERY STIFF TO HARD, MOIST	15			44	14.0	3
	20			50/9"	13.8	3

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/27/22

JOB NO.: 221305
FIG NO.: A- 1

TEST BORING NO. 3

DATE DRILLED 6/7/2022
Job # 221305

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 18.5', 6/9/22						
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, BROWN TO TAN, MEDIUM DENSE TO DENSE, DRY				13	0.9	1
	5			41	0.8	1
	10			14	2.4	1
CLAY, SANDY, GRAY BROWN, STIFF, MOIST	15			20	10.7	2
WEATHERED SHALE, GRAY BROWN, STIFF, MOIST	20			28	17.3	3

TEST BORING NO. 4

DATE DRILLED 6/7/2022
CLIENT FRONT ROW PROPERTIES
LOCATION SOUTHMOOR DRIVE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 19', 6/9/22						
SAND, GRAVELLY, CLEAN TO SILTY, FINE TO COARSE GRAINED, TAN, DENSE TO MEDIUM DENSE, DRY TO MOIST				32	1.7	1
	5			27	2.3	1
	10			15	2.7	1
	15			19	3.2	1
CLAY, SANDY, GRAY BROWN, VERY STIFF, MOIST	20			33	10.9	2

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305
FIG NO.: A- 2

TEST BORING NO.	5
DATE DRILLED	6/7/2022
Job #	221305

REMARKS

DRY TO 19', 6/9/22

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, TAN, LOOSE TO DENSE, DRY				7	1.0	1
	5			8	1.5	1
	10			33	1.7	1
SILT, SANDY, DARK GRAY, VERY STIFF TO STIFF, MOIST	15			45	13.8	2
	20			23	12.1	2

TEST BORING NO.	6
DATE DRILLED	6/7/2022
CLIENT	FRONT ROW PROPERTIES
LOCATION	SOUTHMOOR DRIVE

REMARKS

DRY TO 18', 6/9/22

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, GRAVELLY, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, LOOSE TO MEDIUM DENSE, DRY TO MOIST				4	1.2	1
	5			14	1.2	1
	10			2	7.3	1
	15			26	3.0	1
	20			9	2.9	1

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TEST BORING LOG

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/27/22

JOB NO.: 221305

FIG NO.: A- 3

TEST BORING NO.	7
DATE DRILLED	6/7/2022
Job #	221305

REMARKS

DRY TO 18.5', 6/9/22

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, TAN, LOOSE TO DENSE, DRY				23	0.9	1
	5			24	1.5	1
	10			22	1.9	1
CLAY, SANDY, TAN, STIFF, MOIST	15			28	22.1	2
CLAYSTONE, SANDY, GRAY BROWN, HARD, MOIST	20			50/8"	17.3	3

TEST BORING NO.	8
DATE DRILLED	6/7/2022
CLIENT	FRONT ROW PROPERTIES
LOCATION	SOUTHMOOR DRIVE

REMARKS

DRY TO 15.5', 6/9/22

Description	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
SAND, GRAVELLY, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST				15	6.0	1
	5			14	5.6	1
	10			20	3.1	1
	15			28	4.3	1
	20			12	8.5	1

TEST BORING NO. 9
DATE DRILLED 6/8/2022
Job # 221305

REMARKS

DRY TO 20', 6/9/22

Soil description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, VERY CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST	3	17	5.8	1
	5	19	6.1	1
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, DRY TO MOIST	10	14	1.6	1
	15	27	4.1	1
	20	28	4.5	1

TEST BORING NO. 10
DATE DRILLED 6/8/2022
CLIENT FRONT ROW PROPERTIES
LOCATION SOUTHMOOR DRIVE

REMARKS

DRY TO 20', 6/8/22

Soil description	Depth (ft)	Blows per foot	Watercontent %	Soil Type
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO DENSE, MOIST TO DRY	3	24	8.7	1
	5	17	2.8	1
	10	32	2.1	1
	15	35	7.3	1
	20	36	6.3	1

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TEST BORING LOG

DRAWN: DATE: CHECKED: LLL DATE: 6/27/22

JOB NO.: 221305
FIG NO.: A- 5

TEST BORING NO.	11
DATE DRILLED	6/8/2022
Job #	221305

REMARKS

DRY TO 20', 6/8/22

2" ASPHALT, SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, TAN, DENSE TO MEDIUM DENSE, DRY

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			30	1.2	1
5			28	1.1	1
10			29	1.8	1
15			30	2.4	1
20			13	1.9	1

TEST BORING NO.	12
DATE DRILLED	6/8/2022
CLIENT	FRONT ROW PROPERTIES
LOCATION	SOUTHMOOR DRIVE

REMARKS

DRY TO 20', 6/8/22

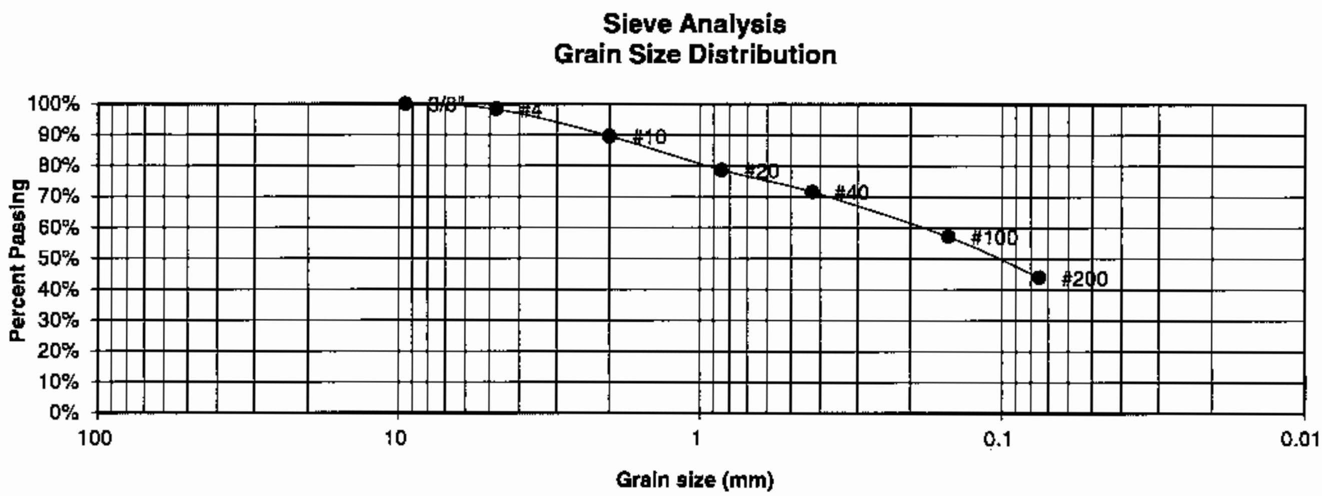
SAND, GRAVELLY, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO DENSE, MOIST TO DRY

CLAY, SANDY, BROWN, STIFF, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			10	1.3	1
5			21	1.4	1
10			32	3.4	1
15			27	2.1	1
20			19	12.0	2

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	SC	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	1	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	1	JOB NO.	221305
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.3%
10	89.6%
20	78.7%
40	71.6%
100	57.2%
200	43.9%

Atterberg
Limits

Plastic Limit	16
Liquid Limit	26
Plastic Index	10

Swell

Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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COLORADO SPRINGS, COLORADO 80907

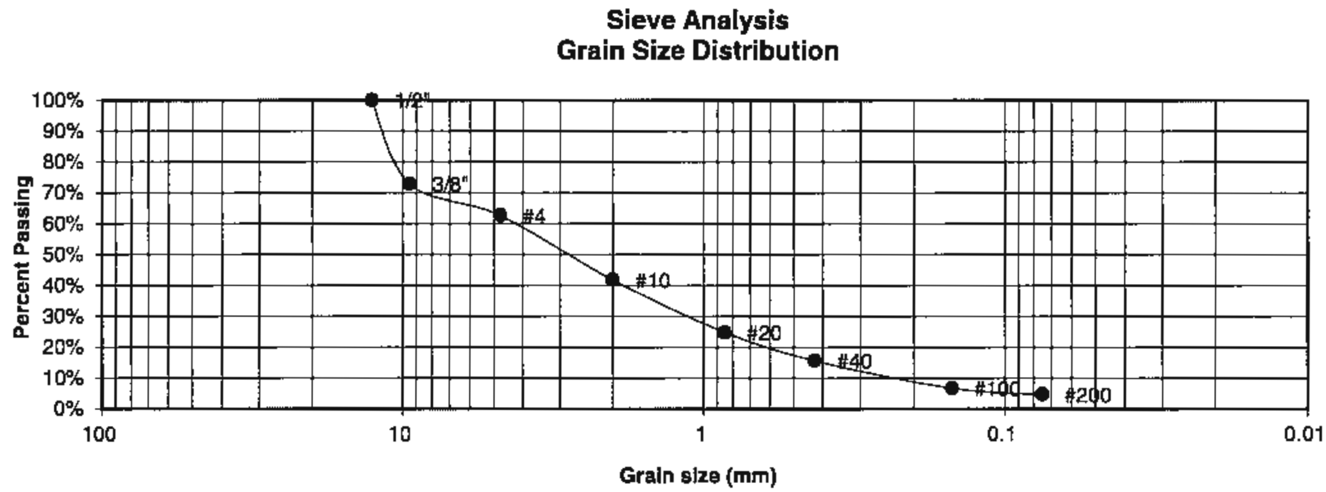
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305

FIG NO.: B-1

UNIFIED CLASSIFICATION	SW	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	1	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	4	JOB NO.	221305
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	72.8%
4	62.6%
10	41.8%
20	24.8%
40	15.6%
100	6.7%
200	4.7%

Atterberg Limits
- Plastic Limit
- Liquid Limit
- Plastic Index

Swell
- Moisture at start
- Moisture at finish
- Moisture increase
- Initial dry density (pcf)
- Swell (psf)

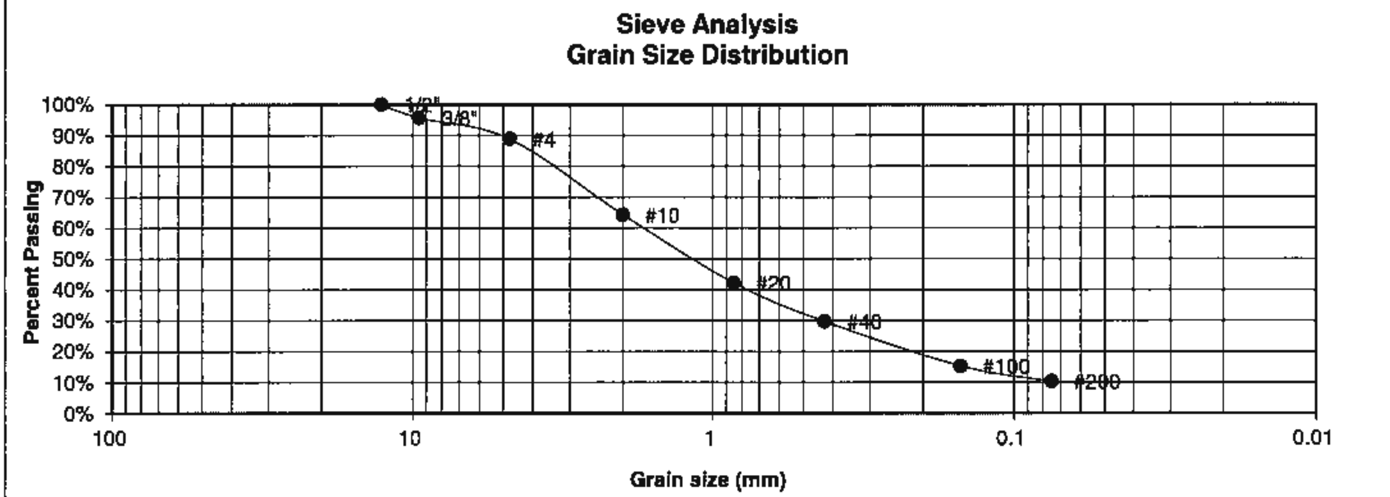
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305
FIG NO.: B-2

UNIFIED CLASSIFICATION	SM-SW	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	1	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	8	JOB NO.	221305
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	95.5%
4	88.8%
10	64.3%
20	42.2%
40	29.7%
100	15.3%
200	10.2%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

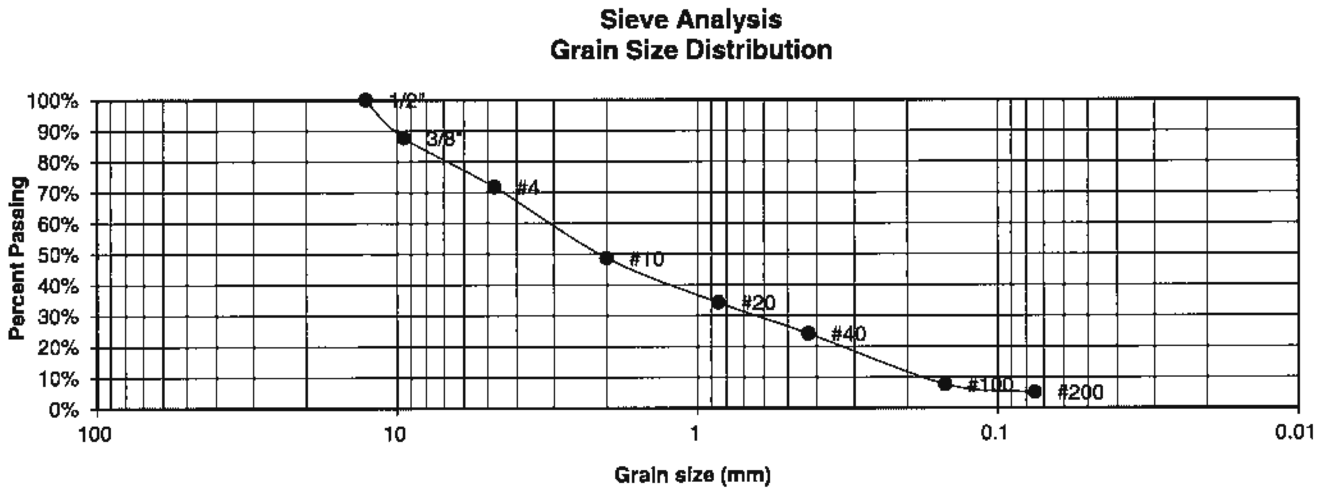
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305
FIG NO.: B-3

UNIFIED CLASSIFICATION	SM-SW	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	1	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	6	JOB NO.	221305
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	87.7%
4	71.8%
10	48.6%
20	34.2%
40	24.1%
100	7.7%
200	5.1%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

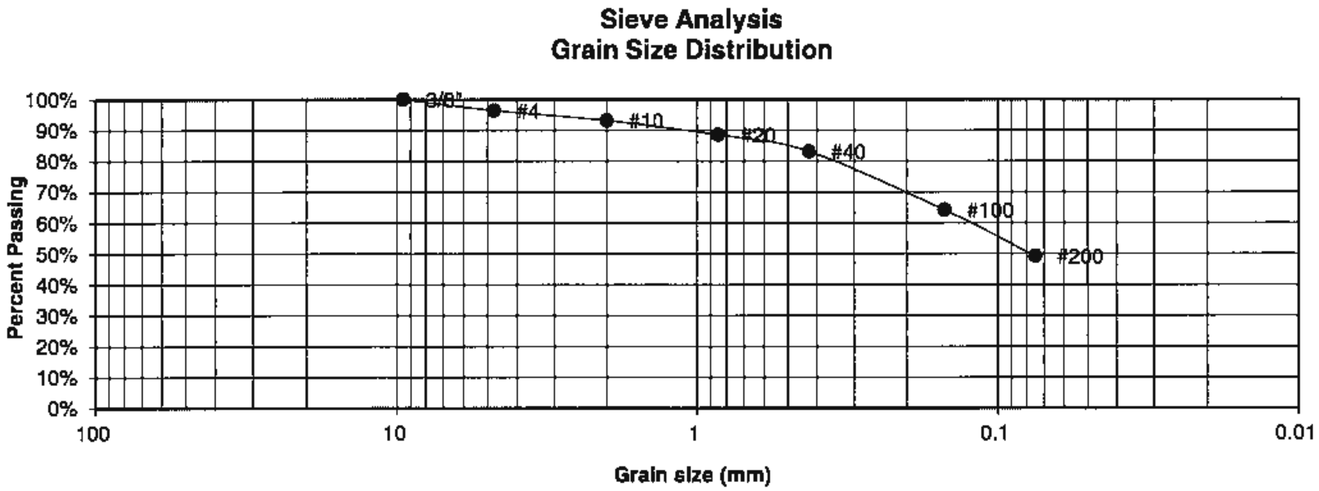
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305

FIG NO.: B-4

UNIFIED CLASSIFICATION	SC	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	1	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	9	JOB NO.	221305
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.4%
10	93.2%
20	88.5%
40	83.1%
100	64.2%
200	49.1%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

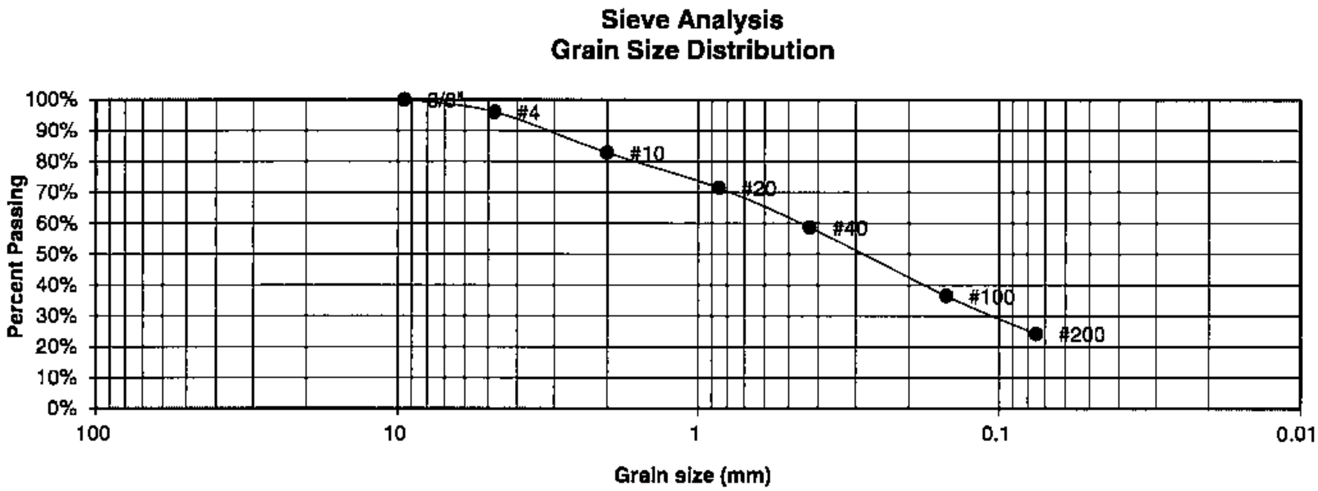
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305

FIG NO.: B-5

UNIFIED CLASSIFICATION	SM	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	1	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	10	JOB NO.	221305
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.0%
10	82.8%
20	71.4%
40	58.6%
100	36.5%
200	24.2%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

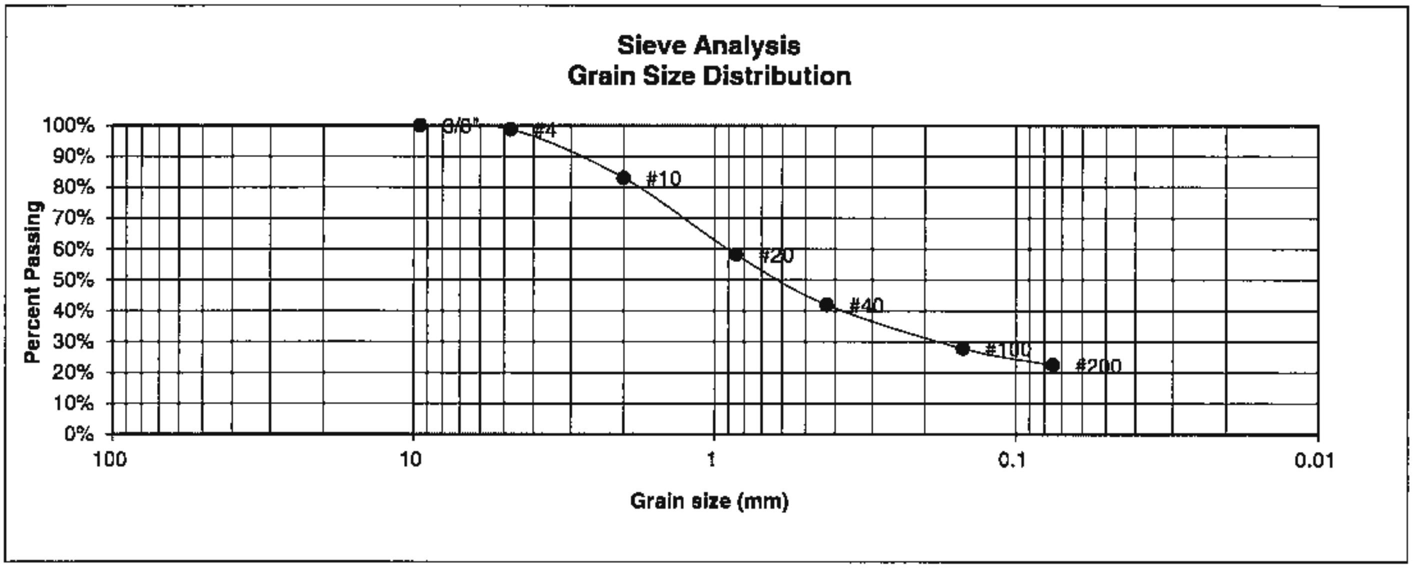
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305
FIG NO.: B-4

UNIFIED CLASSIFICATION	SM	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	1	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	11	JOB NO.	221305
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.7%
10	83.0%
20	58.2%
40	41.9%
100	27.8%
200	22.4%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

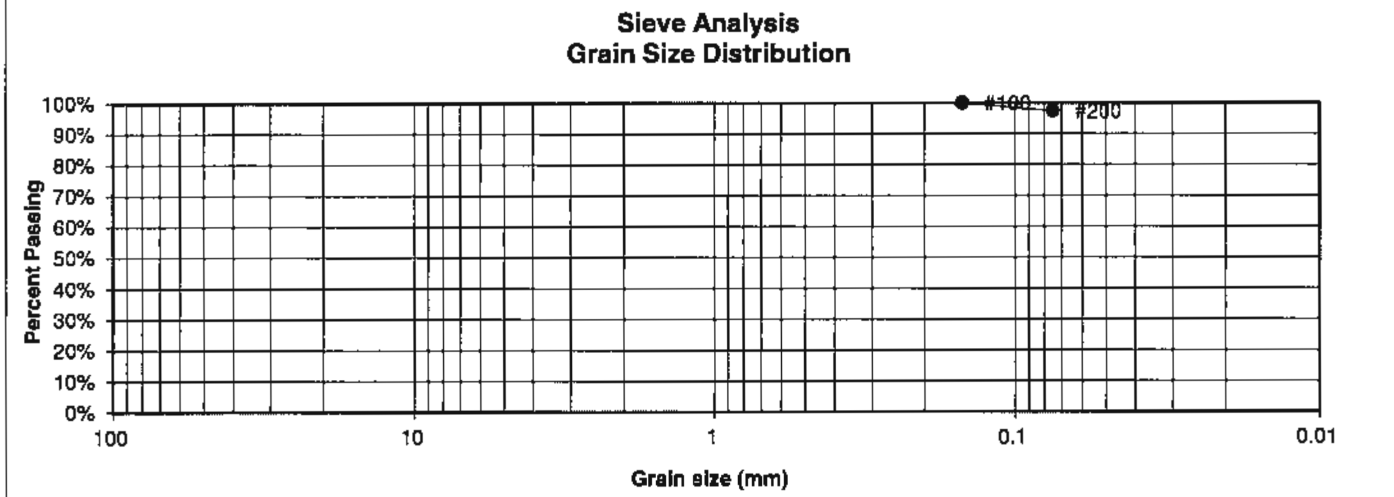
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/27/22

JOB NO.: 221305

FIG NO.: B-7

UNIFIED CLASSIFICATION	ML	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	2	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	5	JOB NO.	221305
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	
100	100.0%
200	97.4%

Atterberg Limits

Plastic Limit	28
Liquid Limit	49
Plastic Index	21

Swell

Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

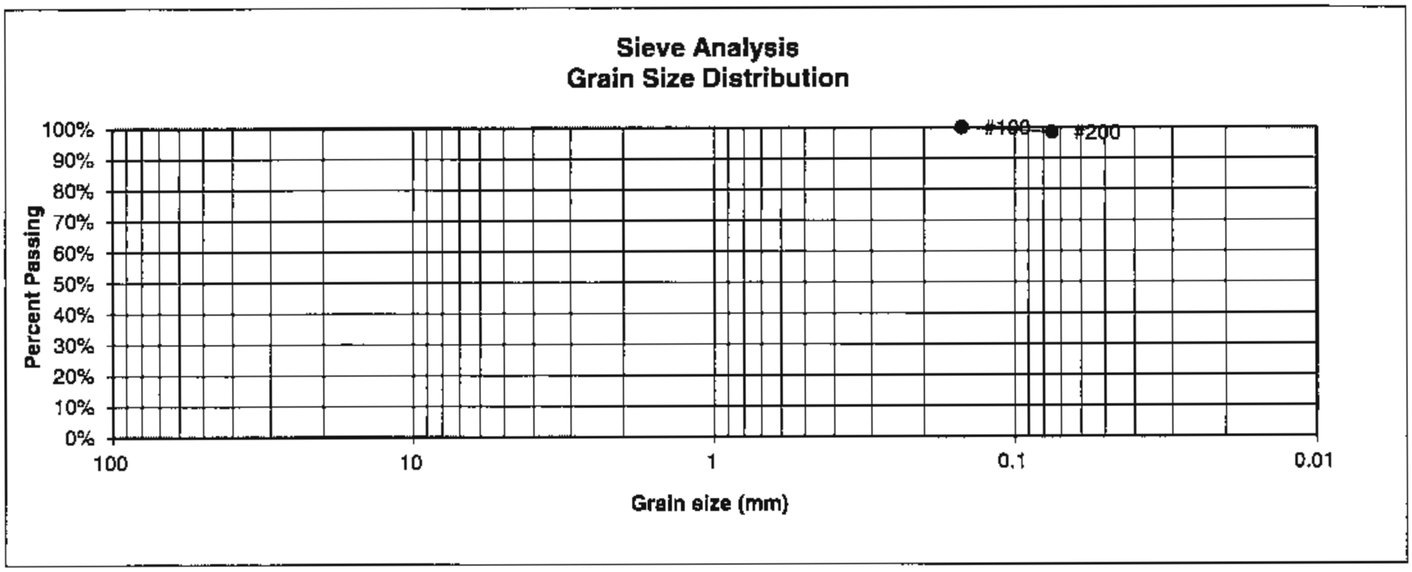
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305

FIG NO.: B-8

UNIFIED CLASSIFICATION	CL	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	2	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	7	JOB NO.	221305
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	
100	100.0%
200	98.5%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

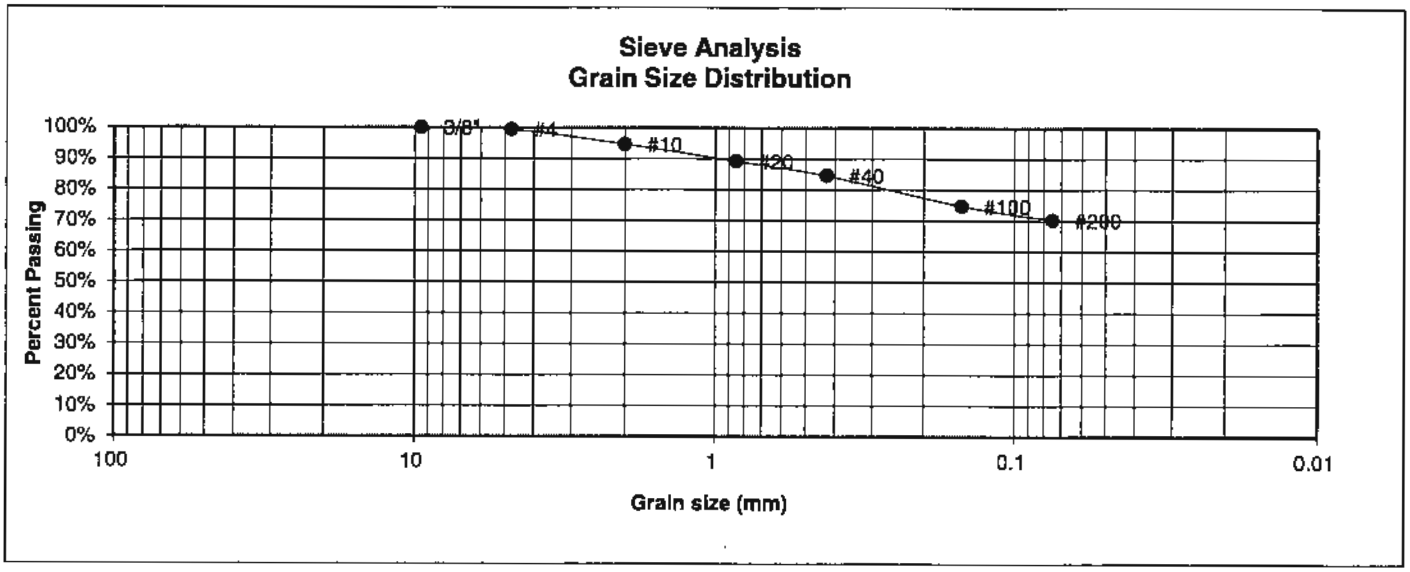
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305

FIG NO.: B-9

UNIFIED CLASSIFICATION	CL	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	2	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	12	JOB NO.	221305
DEPTH (FT)	20	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.4%
10	94.7%
20	89.2%
40	84.5%
100	74.7%
200	70.2%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

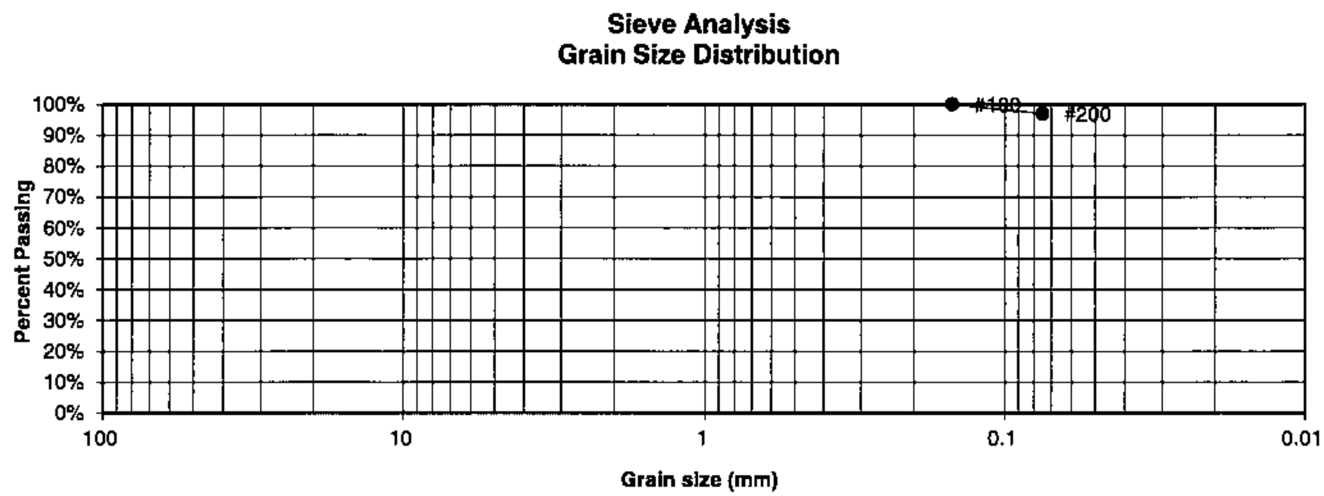
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: LLL	DATE: 6/27/22

JOB NO.: 221305
FIG NO.: B-10

UNIFIED CLASSIFICATION	ML	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	3	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	2	JOB NO.	221305
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	
100	100.0%
200	97.0%

Atterberg Limits	
Plastic Limit	28
Liquid Limit	44
Plastic Index	16

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

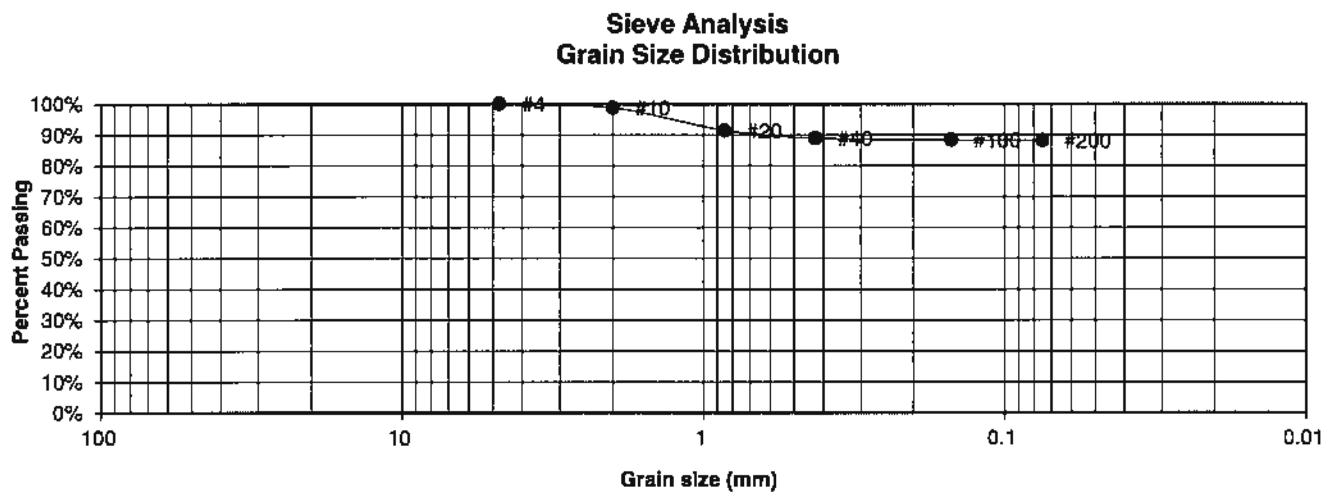
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305
FIG NO.: B-11

UNIFIED CLASSIFICATION	ML	CLIENT	FRONT ROW PROPERTIES
SOIL TYPE #	3	PROJECT	SOUTHMOOR DRIVE
TEST BORING #	3	JOB NO.	221305
DEPTH (FT)	20	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	98.8%
20	91.4%
40	88.9%
100	88.3%
200	88.2%

Atterberg Limits	
Plastic Limit	26
Liquid Limit	40
Plastic Index	14

Swell

Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

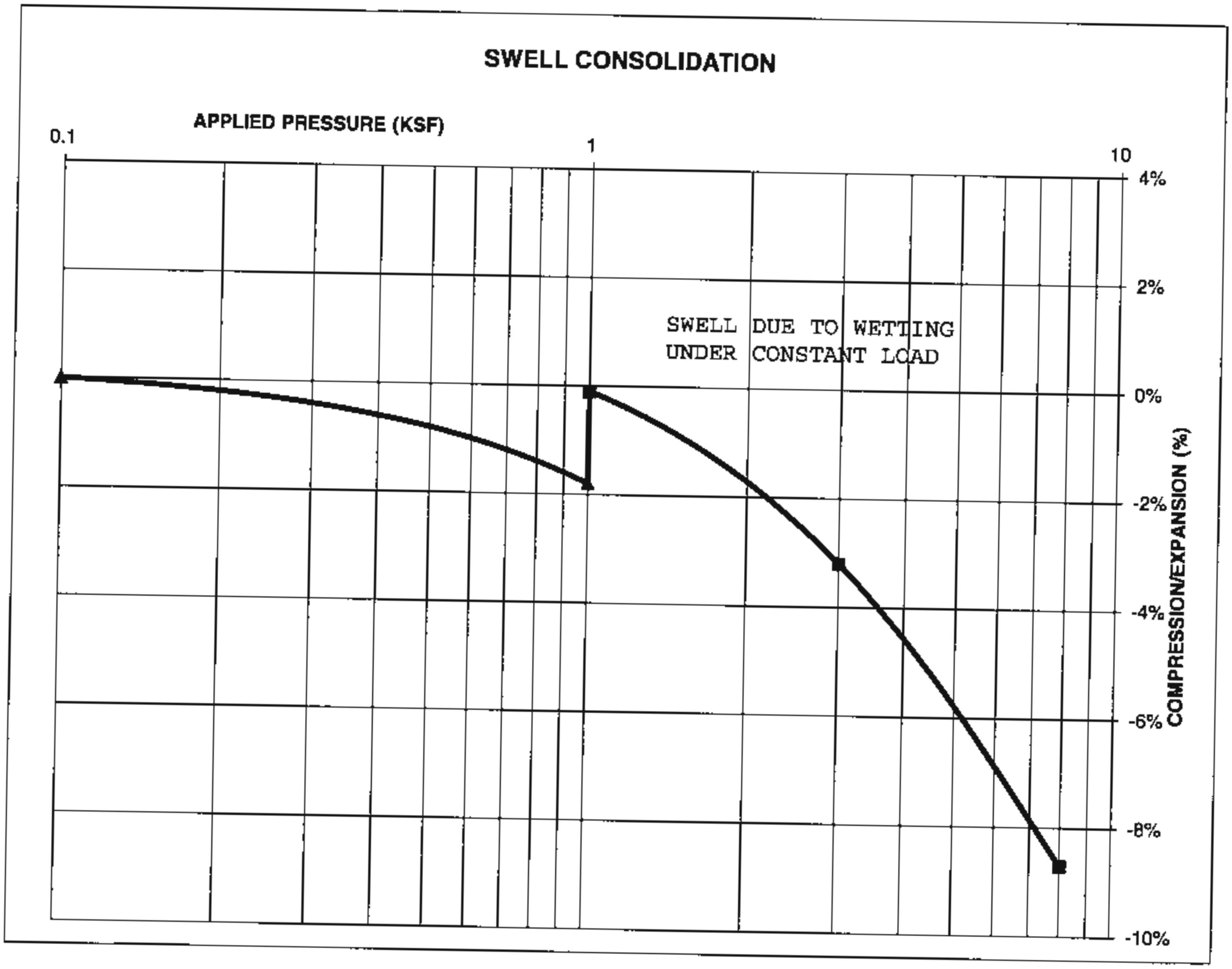
JOB NO.: 221305

FIG NO.: B-12

CONSOLIDATION TEST RESULTS

TEST BORING #	5	DEPTH(ft)	15
DESCRIPTION	ML	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			100
NATURAL MOISTURE CONTENT			14.9%
SWELL/CONSOLIDATION (%)			1.7%

JOB NO. 221305
CLIENT FRONT ROW PROPERTIES
PROJECT SOUTHMOOR DRIVE



ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

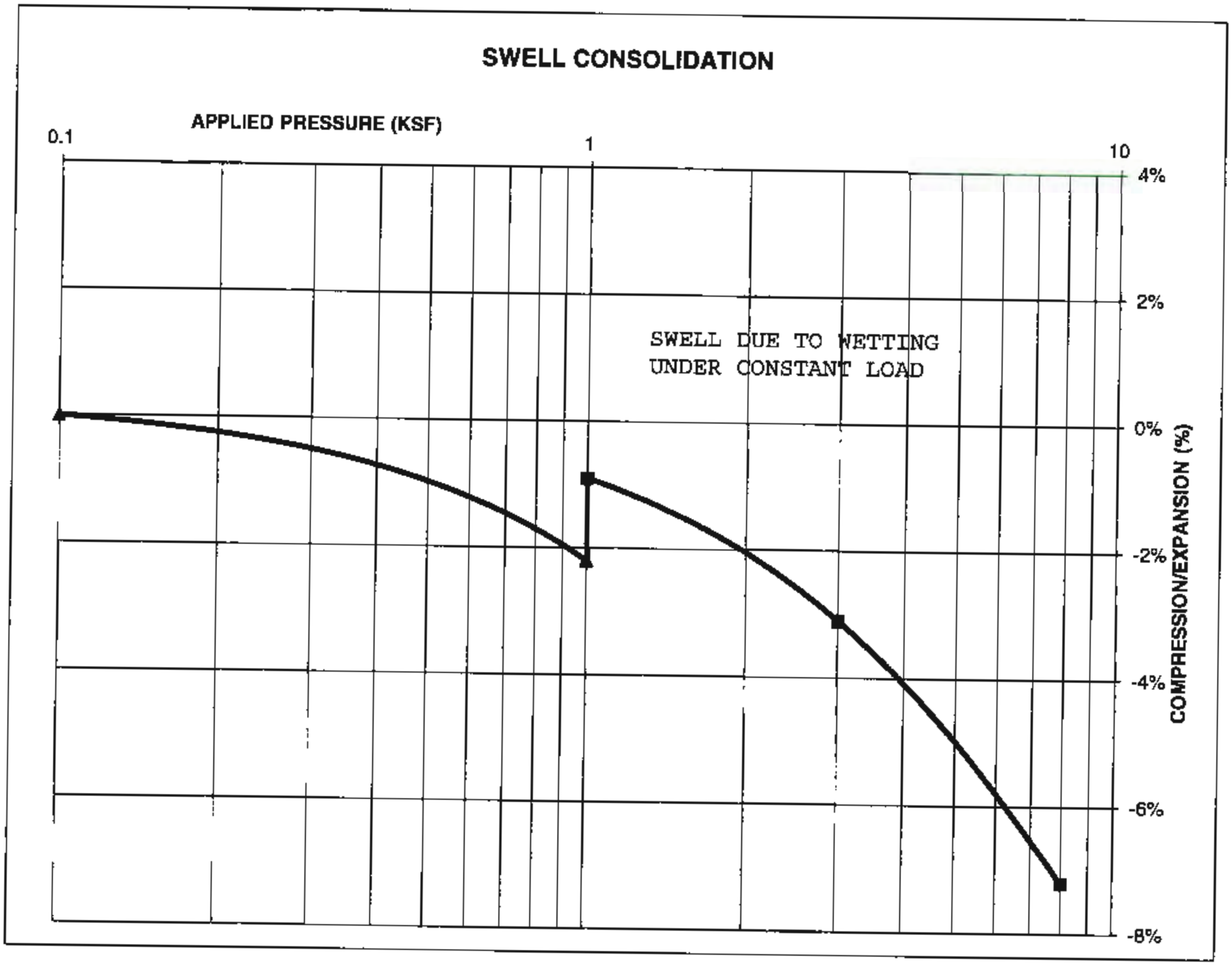
JOB NO.: 221305

FIG NO.: B-13

CONSOLIDATION TEST RESULTS

TEST BORING #	7	DEPTH(ft)	15
DESCRIPTION	CL	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			98
NATURAL MOISTURE CONTENT			21.9%
SWELL/CONSOLIDATION (%)			1.3%

JOB NO. 221305
CLIENT FRONT ROW PROPERTIES
PROJECT SOUTHMOOR DRIVE



ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

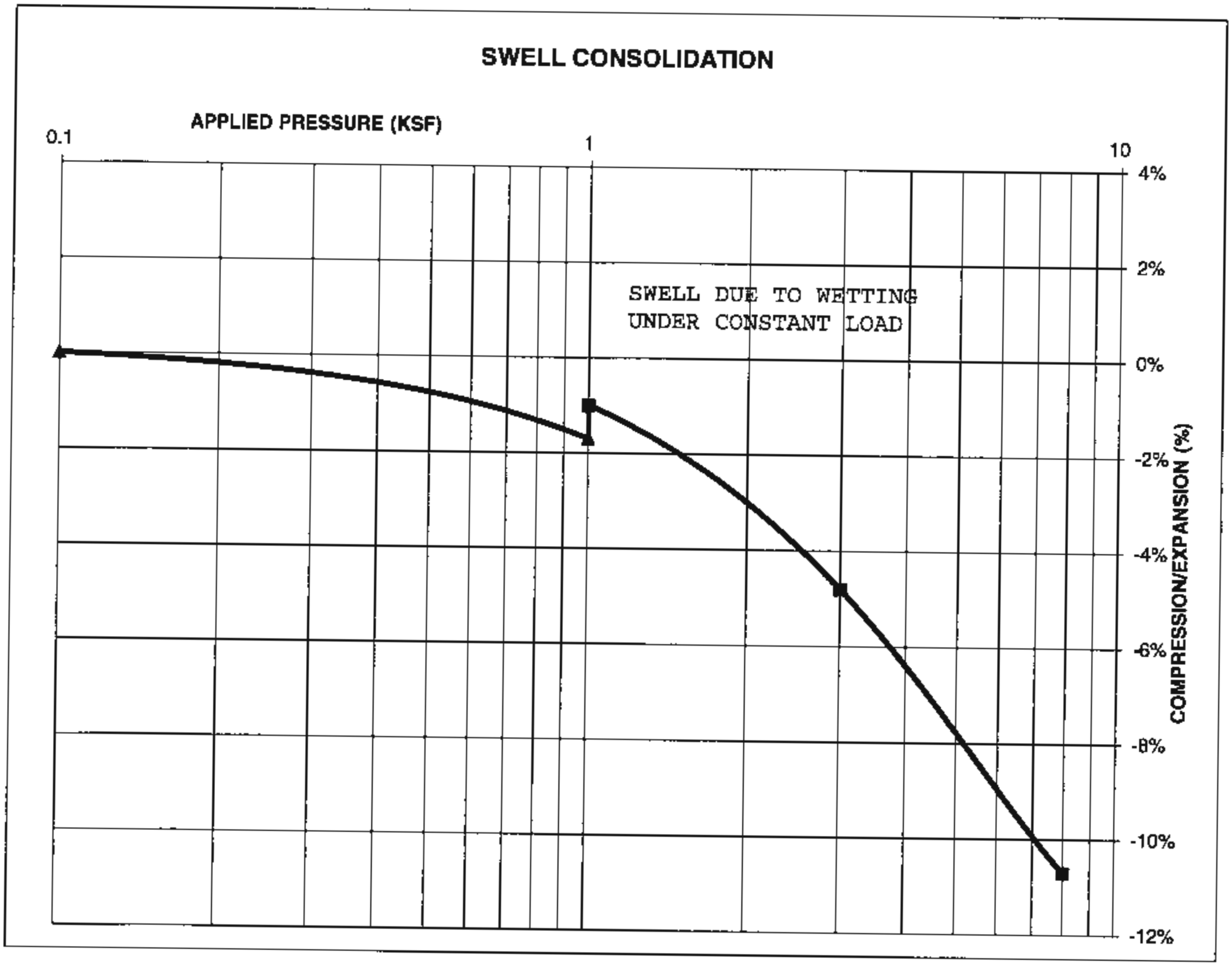
JOB NO.: 221305

FIG NO.: B-14

CONSOLIDATION TEST RESULTS

TEST BORING #	12	DEPTH(ft)	20
DESCRIPTION	CL	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			89
NATURAL MOISTURE CONTENT			23.4%
SWELL/CONSOLIDATION (%)			0.7%

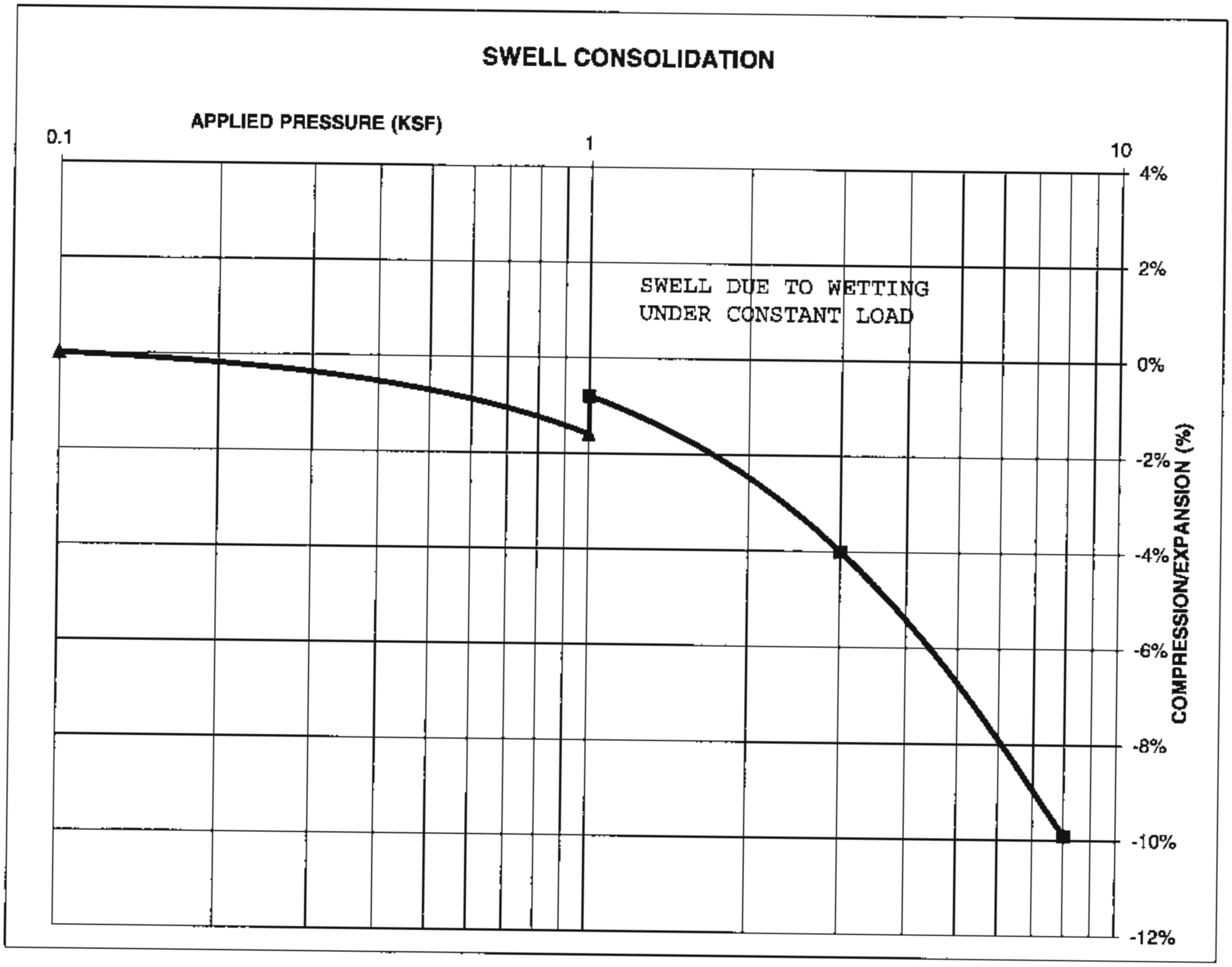
JOB NO. 221305
CLIENT FRONT ROW PROPERTIES
PROJECT SOUTHMOOR DRIVE



CONSOLIDATION TEST RESULTS

TEST BORING #	2	DEPTH(ft)	15
DESCRIPTION	ML	SOIL TYPE	3
NATURAL UNIT DRY WEIGHT (PCF)			98
NATURAL MOISTURE CONTENT			15.1%
SWELL/CONSOLIDATION (%)			0.8%

JOB NO. 221305
CLIENT FRONT ROW PROPERTIES
PROJECT SOUTHMOOR DRIVE



ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305
FIG NO.: B-16

CLIENT	FRONT ROW PROPERTIES	JOB NO.	221305
PROJECT	SOUTHMOOR DRIVE	DATE	6/22/2022
LOCATION	SOUTHMOOR DRIVE	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	2-3	1	SC	<0.01
TB-2	15	3	ML	0.00
TB-3	20	3	ML	0.02
TB-5	15	2	ML	<0.01

QC BLANK PASS

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	6/27/22

JOB NO.: 221305

FIG NO.: B-17

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

October 26, 2022

Front Row Properties
1378 Promontory Bluff View
Colorado Springs, CO 80921

Attn: Ron Waldthausen

Re: Infiltration Rates (Percolation Test Method)
Southmoor Drive
Parcel Nos. 6513314015, 6513300021, 6524200052, and 6524200053
Fountain, Colorado

Dear Mr. Waldthausen:

As requested, personnel of Entech Engineering, Inc. have performed percolation testing at the above referenced site to evaluate the site soils to determine the infiltration rate for the proposed detention pond.

The testing was performed on October 21, 2022. The site vicinity map is shown in Figure 1 and the test locations are shown in Figure 2. The Test Boring Logs, Percolation Test results, Infiltration Rates, and Laboratory Test results are shown in Figures 3 through 11. Soils encountered in the profile and percolation hole consisted of silty to very silty sand. Bedrock and groundwater were not encountered in the profile holes, which was drilled to 10 feet.

The percolation rates were 4 minutes/inch for P1, 3 minutes/inch for P2, and 4 minutes/inch for P3. The percolation rates correspond to adjusted average Infiltration Rate of 1.95 inches/hour for pond 1, 3.31 inches/hour for pond 2, and 2.15 inches/hour for pond 3.

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Geologist

COLORADO LICENSED
AUSTIN M NOSSOKOFF
53477
10-26-22
PROFESSIONAL ENGINEER

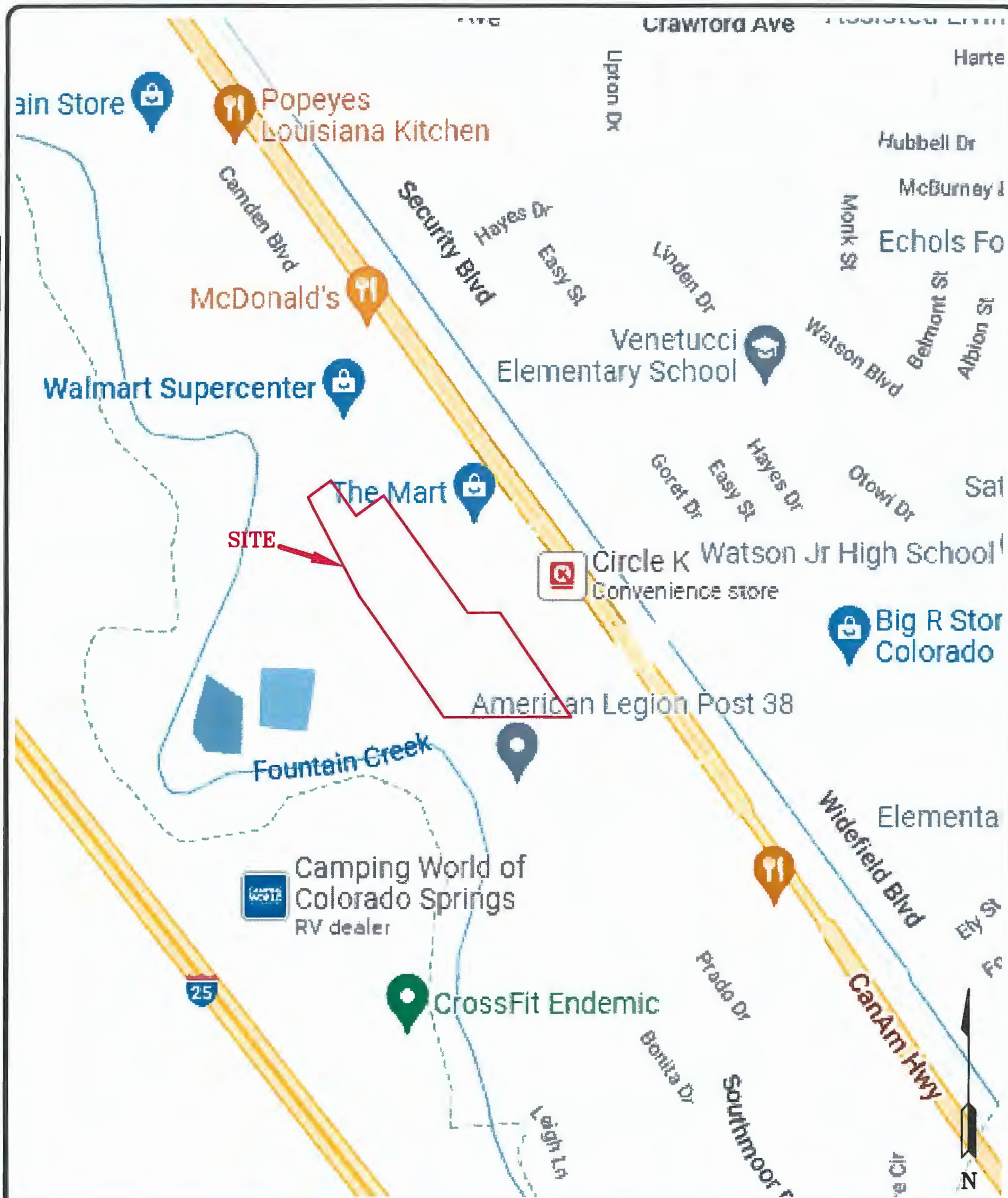
Reviewed by:

Austin M. Nossokoff, P.E.
Project Engineer

LLL/jr

Encl.

Entech Job No. 222077
AAprojects/2022/222077 Infiltration Rate



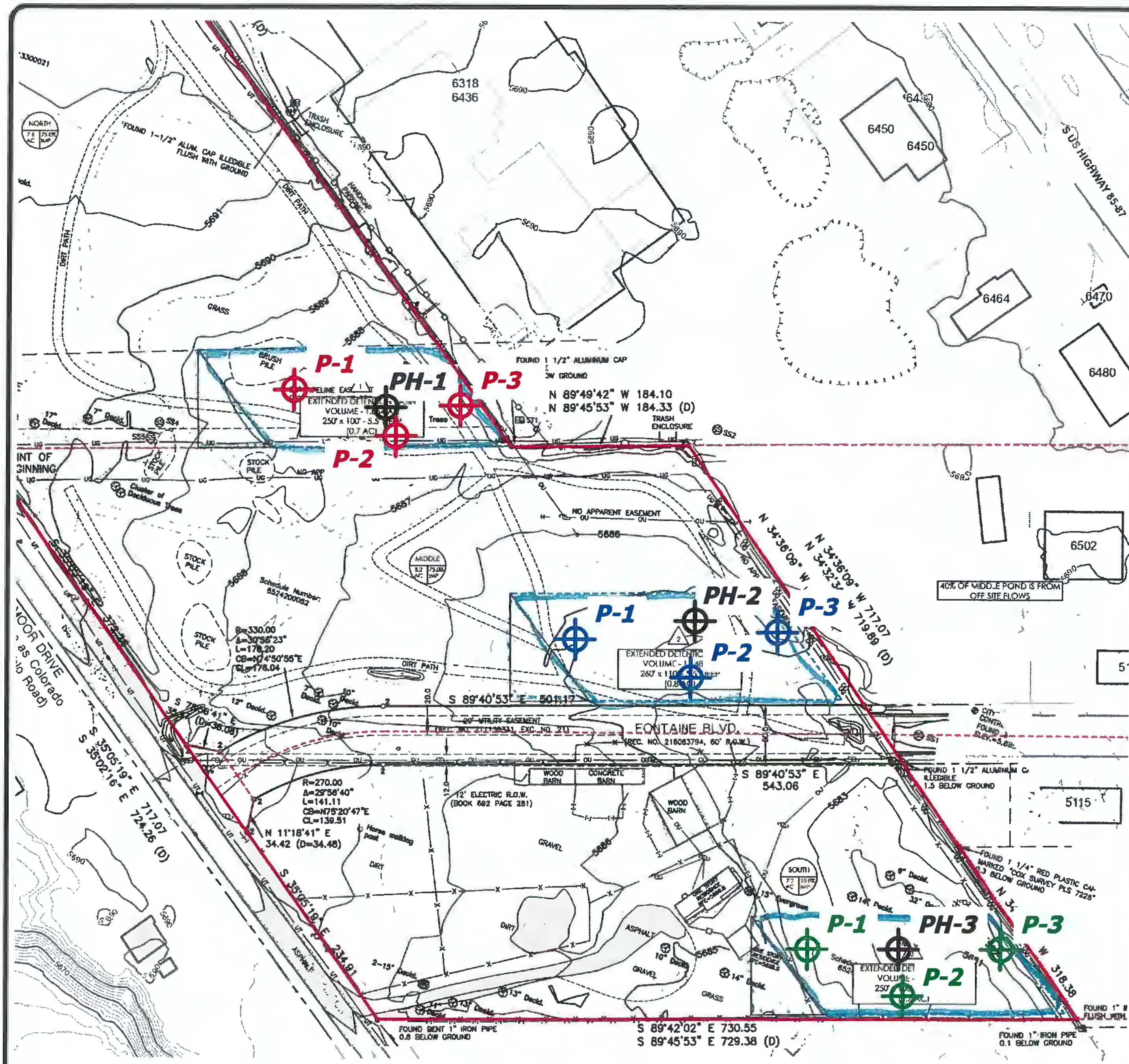
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY MAP
SOUTHMOOR DRIVE
FOUNTAIN, CO
FOR: FRONT ROW PROPERTIES

DRAWN:	DATE:	CHECKED:	DATE:
JHR	10/21/22	LLL	

JOB NO.:
222077

FIG NO.:
1



PH- APPROXIMATE PROFILE HOLE LOCATION AND NUMBER

P- APPROXIMATE PERCOLATION HOLE LOCATION AND NUMBER (POND 1)

P- APPROXIMATE PERCOLATION HOLE LOCATION AND NUMBER (POND 2)

P- APPROXIMATE PERCOLATION HOLE LOCATION AND NUMBER (POND 3)

N

ENTECH ENGINEERING, INC. 505 ELKTON DRIVE COLORADO SPRINGS, CO. 80907 (719) 531-5599	SITE PLAN/PERCOLATION HOLE LOCATION MAP SOUTHMOOR DRIVE FOUNTAIN, COLORADO FOR: FRONT ROW PROPERTIES				JOB NO.: 222077
	DRAWN: JHR	DATE: 10/21/22	CHECKED: LLL	DATE:	FIG NO.: 2

TEST BORING NO. 1
DATE DRILLED 10/19/2022
Job # 222077

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 10', 10/19/22						
SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST TO DRY						
				23	3.5	
	5			26	1.3	
	10			*	1.4	
* - BULK SAMPLE TAKEN						
	15					
	20					

TEST BORING NO. 2
DATE DRILLED 10/19/2022
CLIENT FRONT ROW PROPERTIES
LOCATION SOUTHMOOR DRIVE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 10', 10/19/22						
SAND, VERY SILTY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE TO DENSE, MOIST						
				24	6.7	
	5			12	4.4	
	10			30	4.6	
	15					
	20					

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-21-22

JOB NO.: 222077
FIG NO.: 3

TEST BORING NO.	3
DATE DRILLED	10/19/2022
Job #	222077

TEST BORING NO.	
DATE DRILLED	
CLIENT	FRONT ROW PROPERTIES
LOCATION	SOUTHMOOR DRIVE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 10', 10/19/22						
SAND, VERY SILTY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE, MOIST TO DRY				20	6.0	
	5			15	3.0	
	10			*	1.9	
* - BULK SAMPLE TAKEN						
	15					
	20					

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	5					
	10					
	15					
	20					

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

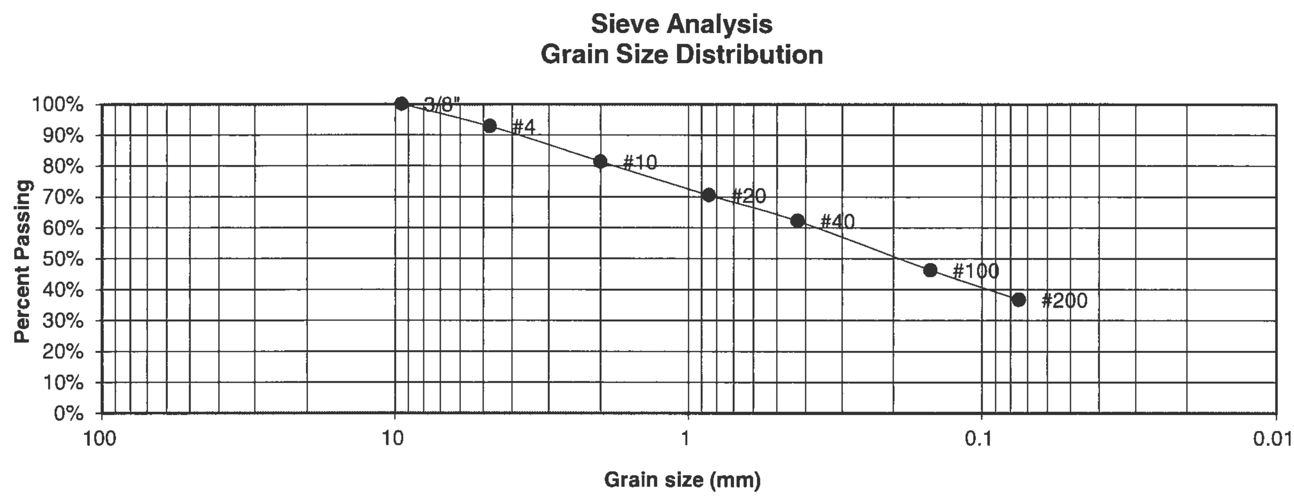
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-21-22

JOB NO.: 222077

FIG NO.: 4

BORING NO.	PH-1	UNIFIED CLASSIFICATION	SM	TEST BY	BL
DEPTH(ft)	2-3	AASHTO CLASSIFICATION		JOB NO.	222077
CLIENT	FRONT ROW PROPERTIES				
PROJECT	SOUTHMOOR DRIVE				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	92.8%
10	81.3%
20	70.5%
40	62.2%
100	46.3%
200	36.7%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

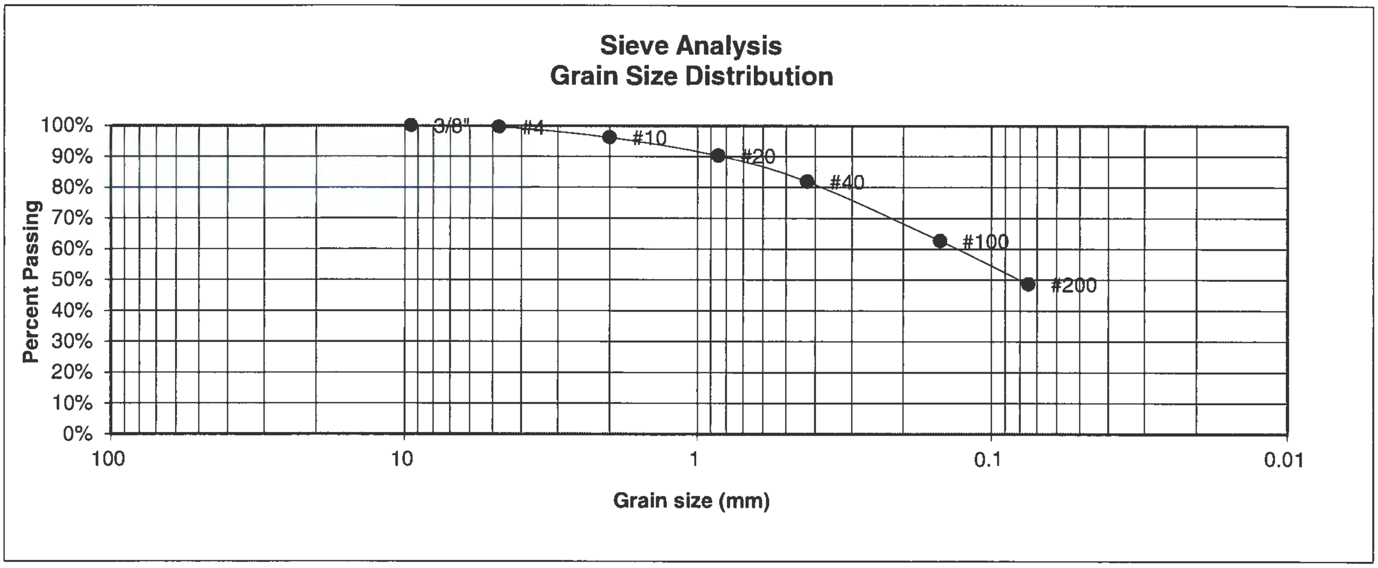
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-24-22

JOB NO.:

FIG NO.: 5

BORING NO.	PH-2	UNIFIED CLASSIFICATION	SM	TEST BY	BL
DEPTH(ft)	2-3	AASHTO CLASSIFICATION		JOB NO.	222077
CLIENT	FRONT ROW PROPERTIES				
PROJECT	SOUTHMOOR DRIVE				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.5%
10	96.2%
20	90.3%
40	81.9%
100	62.7%
200	48.6%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

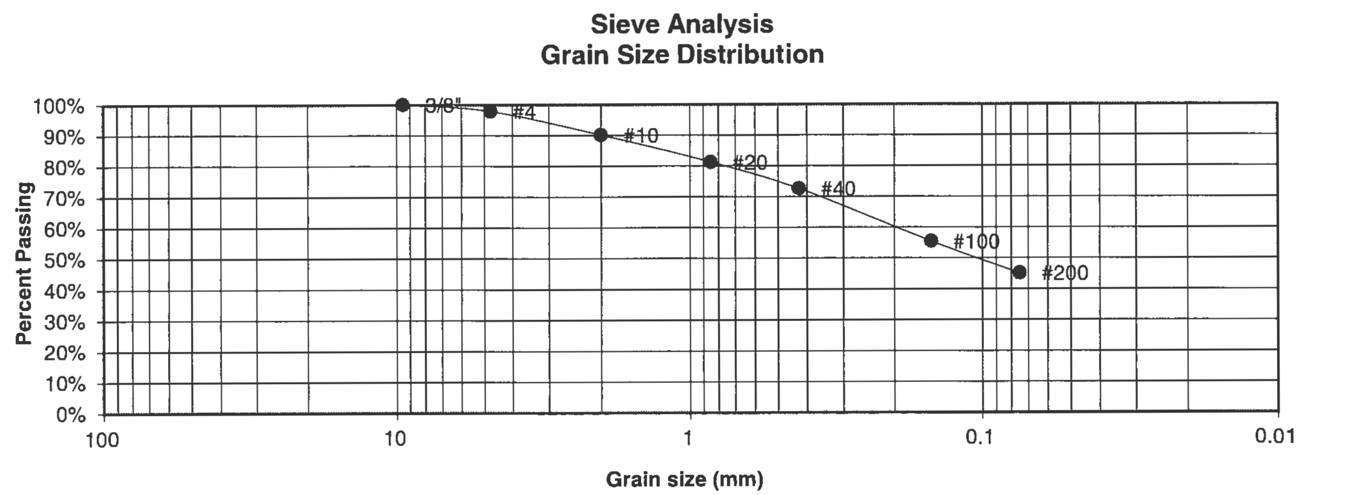
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-21-22

JOB NO.:

FIG NO.: 6

BORING NO.	PH-3	UNIFIED CLASSIFICATION	SM	TEST BY	BL
DEPTH(ft)	2-3	AASHTO CLASSIFICATION		JOB NO.	222077
CLIENT	FRONT ROW PROPERTIES				
PROJECT	SOUTHMOOR DRIVE				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.8%
10	90.1%
20	81.3%
40	72.6%
100	55.5%
200	45.1%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-21-22

JOB NO.:

FIG NO.: 7

Client: Front Row Properties

Test Location: Southmoor Drive

Job Number: 222077

PERCOLATION HOLES #1

Date Holes Prepared: 10/19/2022

Date Hole Completed: 10/20/2022

Hole No. 1
Depth: 59"

Trial	Time (min.)	Water Level Change (in.)
1	5	1
2	5	2
3	5	1

Perc Rate (min./in.): 4

Hole No. 2
Depth: 61"

Trial	Time (min.)	Water Level Change (in.)
1	5	2
2	5	2
3	5	2

Perc Rate (min./in.): 2.5

Hole No. 3
Depth: 70"

Trial	Time (min.)	Water Level Change (in.)
1	5	1
2	5	1
3	5	1

Perc Rate (min./in.): 5

Average Perc Rate (min./in.) 4

PROFILE HOLE

Date Profile Hole Completed: 10/19/2022

Depth	Visual Classification	Remarks
0-10'	Sand, silty, fine to coarse grained, tan	No Bedrock No Groundwater

23 Blows / ft. @ 2'
26 Blows / ft. @ 4'

Remarks:

GPS Coordinates: 38° 73.74694' N, -104° 73.4822' W

Observer: N. Schletzbaum By:

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

PERCOLATION TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10/21/22

JOB NO.: 222077

FIG NO.: 8

Client: Front Row Properties
Test Location: Southmoor Drive

Job Number: 222077

PERCOLATION HOLES #2

Date Holes Prepared: 10/19/2022

Date Hole Completed: 10/20/2022

Hole No. 4
Depth:

Trial	Time (min.)	Water Level Change (in.)
1	5	1 1/2
2	5	1/2
3	5	1

Perc Rate (min./in.): 3 1/2

Hole No. 5
Depth:

Trial	Time (min.)	Water Level Change (in.)
1	5	0
2	5	0
3	5	1

Perc Rate (min./in.): 2

Hole No. 6
Depth:

Trial	Time (min.)	Water Level Change (in.)
1	5	3
2	5	2
3	5	2

Perc Rate (min./in.): 2

Average Perc Rate (min./in.) 3

PROFILE HOLE

Date Profile Hole Completed: 10/19/2022

Depth	Visual Classification	Remarks
0-10'	Sand, very silty, fine to coarse grained, tan	No Bedrock No Groundwater

24 Blows / ft. @ 2'
12 Blows / ft. @ 4'
30 Blows / ft. @ 9'

Remarks:

GPS Coordinates: 38° 73.76873' N, -104° 73.3695' W

Observer: N. Schletzbaum

By:

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

PERCOLATION TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-28-22

JOB NO.:

FIG NO.: 9

Client: Front Row Properties

Test Location: Southmoor Drive

Job Number: 222077

PERCOLATION HOLES #3

Date Holes Prepared: 10/19/2022

Date Hole Completed: 10/20/2022

Hole No. 7
Depth:

Trial	Time (min.)	Water Level Change (in.)
1	5	1
2	5	1
3	5	1

Perc Rate (min./in.): 5

Hole No. 8
Depth:

Trial	Time (min.)	Water Level Change (in.)
1	5	2
2	5	1
3	5	1

Perc Rate (min./in.): 4

Hole No. 9
Depth:

Trial	Time (min.)	Water Level Change (in.)
1	5	2
2	5	1
3	5	2

Perc Rate (min./in.): 3

Average Perc Rate (min./in.) 4

PROFILE HOLE

Date Profile Hole Completed: 10/19/2022

Depth	Visual Classification	Remarks
0-10'	Sand, very silty, fine to coarse grained, tan	No Bedrock No Groundwater

20 Blows / ft. @ 2'
15 Blows / ft. @ 4'

Remarks:

GPS Coordinates: 38° 73.59461' N, -104° 73.2943' W

Observer: N. Schletzbaum By:

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

PERCOLATION TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-21-22

JOB NO.:

FIG NO.: 10

Infiltration Rate (I) = Percolation Rate (P)/ Reduction Factor(RF)
I=P/RF

CLIENT FRONT ROW PROPERTIES
PROJECT SOUTHMOOR DRIVE
JOB NO. 222077

$R_f = [(2d_1 - \Delta d) / dia] + 1$

d_1 = initial water depth (in.)

Δd = final water level drop (in.)

dia = diameter of the percolation hole (in.)

Test No. P1 (PH-1)
Perc Rate= 15 in/hr
dia = 8

P1
d_1 = 36.0
Δd = 1.0
R_f = 9.9

I = 1.519 in/hr

Test No. P2 (PH-1)
Perc Rate= 24 in/hr
dia = 8

P2
d_1 = 26.0
Δd = 2.0
R_f = 7.3

I = 3.310 in/hr

Test No. P3 (PH-1)
Perc Rate= 12 in/hr
dia = 8

P3
d_1 = 43.0
Δd = 1.0
R_f = 11.6

I = 1.032 in/hr

(PH-1) I AVG= 1.954 in/hr

Test No. P1 (PH-2)
Perc Rate= 17.14 in/hr
dia = 8

P1
d_1 = 32.0
Δd = 1.0
R_f = 8.9

I = 1.932 in/hr

Test No. P2 (PH-2)
Perc Rate= 30.00 in/hr
dia = 8

P2
d_1 = 19.0
Δd = 0.0
R_f = 5.8

I = 5.217 in/hr

Test No. P3 (PH-2)
Perc Rate= 30 in/hr
dia = 8

P3
d_1 = 40.0
Δd = 2.0
R_f = 10.8

I = 2.791 in/hr

(PH-2) I AVG= 3.313 in/hr

Test No. P1 (PH-3)
Perc Rate= 12.00 in/hr
dia = 8

P1
d_1 = 21.0
Δd = 1.0
R_f = 6.1

I = 1.959 in/hr

Test No. P2 (PH-3)
Perc Rate= 15.00 in/hr
dia = 8

P2
d_1 = 39.0
Δd = 1.0
R_f = 10.6

I = 1.412 in/hr

Test No. P3 (PH-3)
Perc Rate= 20 in/hr
dia = 8

P3
d_1 = 23.0
Δd = 2.0
R_f = 6.5

I = 3.077 in/hr

(PH-3) I AVG= 2.149 in/hr

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

INFILTRATION TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	10-26-22

JOB NO.:

FIG NO.: 11

October 2, 2023

Front Row Properties, LLC
1378 Promontory Bluff View
Colorado Springs, CO 80921

Subject: Southmoor Ridge Drainage Concept

Mr. Ronald Waldthausen:

The City of Fountain has performed a cursory review of the report prepared by M.V.E., Inc. titled "Master Developed Drainage Plan, Southmoor Ridge Development" (MDDP report), dated August 24, 2023, which concerns the development of four parcels located within the City of Fountain including 6513314015, 6513300021, 6524200052 and 6524200053.

The MDDP Report presents a drainage concept in which water quality treatment and stormwater detention are provided in conventional private Extended Detention Basins. The MDDP report also proposes that the outflows of the conventional facilities will be conveyed to a separate private onsite Infiltration Basin in which the runoff would infiltrate into the basin floor consisting of the existing soils (if found suitable and maintainable) at the location.

It is our understanding that the concept design presented in the MDDP report will be used to fully infiltrate all tributary runoff generated by the 100-year storm event. Although not included in the report, our office feels providing storage of at least twice the 100yr volume must be provided as a safety factor. This minimum requirement needs to be verified and provided meeting all local, state and federal requirements including but not limited to water rights and industry standard design methodology with other appropriate safety factors as required for an infiltration basin design.

Final detailed design calculations and other support methodology information must be provided for facility design prior to construction document submittal to verify the proposed facility feasible and meets the aforementioned requirements. Furthermore, additional analysis may be required if deemed necessary by the City to verify if in the event of failure, downstream properties will not be adversely affected.

In summary, based on the cursory design review, the City of Fountain finds that the MDDP report appears to provide the data, analysis, and discussion for the city to consent to the overall drainage concept. The adequacy of the specific design elements of each stormwater facility will be reviewed during future submittals. This letter does not grant an approval or concurrence that the final design will be acceptable.

If you have any questions or concerns, please contact me at 719-393-4935.

Sincerely,

Benjamin E. Sheets, P.E.
City Engineer

Cc: Scott Trainor, City Manager
Todd Evans, Deputy City Manager
Troy Johnson, City Attorney

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

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs By:	**TJW**
		Checked By:	

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

	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		
Sub-Basin	Area (Acres)	C_5	C_{100}/CN	% Imp.	L_0 (ft)	S_0 (%)	t_i (min)	L_{0t} (ft)	S_{0t} (ft/ft)	v_{0sc} (ft/s)	t_t (min)	L_{0c} (ft)	S_{0c} (ft/ft)	v_{0c} (ft/s)	t_c (min)	L (min)	$t_{c,alt}$ (min)	t_c (min)
EXISTING																		
EX-OS1	3.14	0.85	0.93	95%	100	2%	3.5	100	0.020	2.8	0.6	134.9	0.023	5.3	0.4	334.9	11.9	5.0
EX-OS2	2.40	0.38	0.64	32%	62	3%	6.9	249	0.004	0.4	9.4	0	0.000	0.0	0.0	311	11.7	11.7
EX-NORTH	7.53	0.15	0.50	0%	134.5	1%	21.9	533.8	0.008	0.6	13.8	0	0.000	0.0	0.0	668.3	13.7	13.7
EX-MIDDLE A	1.66	0.08	0.35	0%	81.37	1%	15.5	391.4	0.008	0.6	10.5	0	0.000	0.0	0.0	472.8	12.6	12.6
EX-MIDDLE C	3.36	0.15	0.50	0%	124.9	2%	16.4	133.6	0.010	0.7	3.1	0	0.000	0.0	0.0	258.5	11.4	11.4
EX-SOUTH A	3.98	0.13	0.39	6%	158	1%	25.6	434.5	0.012	1.1	6.7	0	0.000	0.0	0.0	592.5	13.3	13.3
EX-SOUTH C	0.82	0.15	0.50	0%	90.96	1%	15.0	0	0.000	0.0	0.0	0	0.000	0.0	0.0	90.96	10.5	10.5
PROPOSED																		
OS1	3.14	0.85	0.93	95%	120.9	2%	4.1	84.36	0.024	3.1	0.5	134.9	0.023	5.3	0.4	340.2	11.9	5.0
OS2	2.40	0.71	0.83	80%	100	2%	5.5	185	0.011	2.1	1.5	300	0.010	3.9	1.3	585	13.3	8.3
A1	1.92	0.63	0.78	68%	50	2%	4.8	500	0.010	2.0	4.2	0	0.000	0.0	0.0	550	13.1	9.0
A2	1.46	0.68	0.82	72%	50	2%	4.2	250	0.010	2.0	2.1	0	0.000	0.0	0.0	300	11.7	6.3
A3	1.61	0.75	0.86	82%	50	2%	3.6	550	0.010	2.0	4.6	0	0.000	0.0	0.0	600	13.3	8.1
A4	0.46	0.27	0.58	17%	30	33%	2.6	100	0.010	2.0	0.8	0	0.000	0.0	0.0	130	10.7	5.0
B1	2.76	0.52	0.72	52%	20	2%	3.7	700	0.010	2.0	5.8	0	0.000	0.0	0.0	720	14.0	9.6
B2	0.39	0.29	0.59	20%	20	34%	2.0	100	0.010	2.0	0.8	0	0.000	0.0	0.0	120	10.7	5.0
C1	3.15	0.65	0.80	69%	50	2%	4.6	750	0.010	2.0	6.3	0	0.000	0.0	0.0	800	14.4	10.9
C2	0.44	0.87	0.94	96%	20	2%	1.5	530	0.010	2.0	4.4	0	0.000	0.0	0.0	550	13.1	5.9
C3	1.24	0.56	0.74	57%	20	2%	3.5	450	0.010	2.0	3.8	0	0.000	0.0	0.0	470	12.6	7.2
C4	1.54	0.27	0.57	17%	50	3%	7.2	150	0.010	2.0	1.3	0	0.000	0.0	0.0	200	11.1	8.4
D	1.44	0.17	0.52	3%	20	3%	5.1	100	0.010	2.0	0.8	0	0.000	0.0	0.0	120	10.7	5.9
E	0.96	0.22	0.55	10%	100	2%	12.6	1500	0.007	1.7	14.9	0	0.000	0.0	0.0	1600	18.9	18.9

Job No.: **61186**
Project: **Southmoor Ridge**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **2/8/2024 16:55**
Calcs By: **TJW**
Checked By:

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

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
	Sub-	Area		t_c	CA	I5	Q5	t_c	CA	I5	Q5	Slope	Length	Q	Q	Slope	Mnngs	Length	D_{Pipe}	Length	v_{0sc}	t_t
DP	Basin	(Acres)	C5	(min)	(Acres)	(in/hr)	(cfs)	(min)	(Acres)	(in/hr)	(cfs)	(%)	(ft)	(cfs)	(cfs)	(%)	n	(ft)	(in)	(ft)	(ft/s)	(min)
EXISTING CONDITIONS																						
	EX-OS1	3.14	0.85	5.0	2.69	5.17	13.9															
	EX-OS2	2.40	0.38	11.7	0.92	3.89	3.6															
	EX-NORTH	7.53	0.15	13.7	1.13	3.66	4.1															
	EX-MIDDLE A	1.66	0.08	12.6	0.13	3.78	0.5															
	EX-MIDDLE C	3.36	0.15	11.4	0.50	3.93	2.0															
	EX-SOUTH A	3.98	0.13	13.3	0.52	3.70	1.9															
	EX-SOUTH C	0.82	0.15	10.5	0.12	4.06	0.5															
EXISTING DESIGN POINTS																					######	######
EX-DP2		15.69	0.28					16.5	4.45	3.38	15.1											
	EX-OS1	3.14	0.85	5.0	2.69	5.17	13.9															
	EX-NORTH	7.53	0.15	13.7	1.13	3.66	4.1															
	EX-MIDDLE A	1.66	0.08	12.6	0.13	3.78	0.5															
	EX-MIDDLE C	3.36	0.15	11.4	0.50	3.93	2.0															
EX-DP3		22.89	0.26					20.0	6.02	3.09	18.6											
	EX-OS1	3.14	0.85	5.0	2.69	5.17	13.9															
	EX-OS2	2.40	0.38	11.7	0.92	3.89	3.6															
	EX-NORTH	7.53	0.15	13.7	1.13	3.66	4.1															
	EX-MIDDLE A	1.66	0.08	12.6	0.13	3.78	0.5															
	EX-MIDDLE C	3.36	0.15	11.4	0.50	3.93	2.0															
	EX-SOUTH A	3.98	0.13	13.3	0.52	3.70	1.9															
	EX-SOUTH C	0.82	0.15	10.5	0.12	4.06	0.5															

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

Job No.: **61186**
Project: **Southmoor Ridge**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **DCM**

Date: **2/8/2024 16:55**
Calcs By: **TJW**
Checked By:

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

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
	Sub-	Area		t_c	CA	I100	Q100	t_c	CA	I100	Q100	Slope	Length	Q	Q	Slope	Mnngs	Length	D_{Pipe}	Length	v_{0sc}	t_t
DP	Basin	(Acres)	C100	(min)	(Acres)	(in/hr)	(cfs)	(min)	(Acres)	(in/hr)	(cfs)	(%)	(ft)	(cfs)	(cfs)	(%)	n	(ft)	(in)	(ft)	(ft/s)	(min)
EXISTING CONDITIONS																						
	EX-OS1	3.14	0.93	5.0	2.92	8.68	25.3															
	EX-OS2	2.40	0.64	11.7	1.54	6.53	10.1															
	EX-NORTH	7.53	0.50	13.7	3.76	6.14	23.1															
	EX-MIDDLE A	1.66	0.35	12.6	0.58	6.34	3.7															
	EX-MIDDLE C	3.36	0.50	11.4	1.68	6.59	11.1															
	EX-SOUTH A	3.98	0.39	13.3	1.54	6.22	9.6															
	EX-SOUTH C	0.82	0.50	10.5	0.41	6.81	2.8															
EXISTING DESIGN POINTS																					######	######
EX-DP2		15.69	0.57					16.5	8.94	5.68	50.7											
	EX-OS1	3.14	0.93	5.0	2.92	8.68	25.3															
	EX-NORTH	7.53	0.50	13.7	3.76	6.14	23.1															
	EX-MIDDLE A	1.66	0.35	12.6	0.58	6.34	3.7															
	EX-MIDDLE C	3.36	0.50	11.4	1.68	6.59	11.1															
EX-DP3		22.89	0.54					20.0	12.43	5.18	64.4											
	EX-OS1	3.14	0.93	5.0	2.92	8.68	25.3															
	EX-OS2	2.40	0.64	11.7	1.54	6.53	10.1															
	EX-NORTH	7.53	0.50	13.7	3.76	6.14	23.1															
	EX-MIDDLE A	1.66	0.35	12.6	0.58	6.34	3.68															
	EX-MIDDLE C	3.36	0.50	11.4	1.68	6.59	11.09															
	EX-SOUTH A	3.98	0.39	13.3	1.54	6.22	9.55															
	EX-SOUTH C	0.82	0.50	10.5	0.41	6.81	2.78															

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

Job No.: **61186**
Project: **Southmoor Ridge**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **2/8/2024 16:55**
Calcs By: **TJW**
Checked By:

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

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C5	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
PROPOSED CONDITIONS																						
	OS1	3.14	0.85	5.0	2.69	5.17	13.9															
	OS2	2.40	0.71	8.3	1.72	4.41	7.6															
	A1	1.92	0.63	9.0	1.20	4.29	5.2															
	A2	1.46	0.68	6.3	1.00	4.82	4.8															
	A3	1.61	0.75	8.1	1.21	4.44	5.3															
	A4	0.46	0.27	5.0	0.12	5.17	0.6															
DP4		5.45	0.60					9.0	3.29	4.29	14.1											
	B1	2.76	0.52	9.6	1.43	4.20	6.0															
	B2	0.39	0.29	5.0	0.11	5.17	0.6															
DP6		3.15	0.45					9.6	1.42	4.20	6.0											
	C1	3.15	0.65	10.9	2.03	4.00	8.1															
	C2	0.44	0.87	5.9	0.38	4.92	1.9															
	C3	1.24	0.56	7.2	0.69	4.61	3.2															
	C4	1.54	0.27	8.4	0.41	4.39	1.79															
DP10		11.91	0.63					10.9	7.46	4.00	29.9											
	D	1.44	0.17	5.9	0.24	4.92	1.21															
	E	0.96	0.22	18.9	0.21	3.18	0.67															

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

Job No.: **61186**
Project: **Southmoor Ridge**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **DCM**

Date: **2/8/2024 16:55**
Calcs By: **TJW**
Checked By:

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

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C100	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
PROPOSED CONDITIONS																						
	OS1	3.14	0.93	5.0	2.92	8.68	25.3															
	OS2	2.40	0.83	8.3	1.99	7.40	14.8															
	A1	1.92	0.78	9.0	1.49	7.20	10.8															
	A2	1.46	0.82	6.3	1.20	8.09	9.7															
	A3	1.61	0.86	8.1	1.38	7.45	10.3															
	A4	0.46	0.58	5.0	0.26	8.68	2.3															
DP4		5.45	0.77					9.0	4.17	7.20	30.1											
	B1	2.76	0.72	9.6	1.98	7.04	14.0															
	B2	0.39	0.59	5.0	0.23	8.68	2.0															
DP6		3.15	0.68					9.6	2.13	7.04	15.0											
	C1	3.15	0.80	10.9	2.50	6.72	16.8															
	C2	0.44	0.94	5.9	0.41	8.26	3.4															
	C3	1.24	0.74	7.2	0.92	7.74	7.14															
	C4	1.54	0.57	8.4	0.88	7.37	6.47															
DP10		11.91	0.78					10.9	9.31	6.72	62.6											
	D	1.44	0.52	5.9	0.74	8.26	6.14															
	E	0.96	0.55	18.9	0.52	5.33	2.79															

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

Existing Sub-Basin Runoff Calculations (EX-OS1)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	15,890	0.36	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	115,872	2.66	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	5,174	0.12	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**136,935**	**3.14**	**0.84**	**0.85**	**0.88**	**0.90**	**0.92**	**0.93**	**95.1%**
	136935								

Basin Travel Time

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft; C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	335	7	-	-	-	-	
Initial Time	100	2	0.020	-	3.5	11.9	DCM Eq. 6-8
Shallow Channel	100	2	0.020	2.8	0.6	-	DCM Eq. 6-9
Channelized	135	3	0.023	5.3	0.4	-	C&G
				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)	10.9	**13.9**	16.6	19.6	22.3	**25.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	10.9	**13.9**	16.6	19.6	22.3	**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

Existing Sub-Basin Runoff Calculations (EX-OS2)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	5,227	0.12	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	28,478	0.65	0.89	0.90	0.92	0.94	0.95	0.96	100%
Lawns	10,384	0.24	0.04	0.15	0.25	0.37	0.44	0.50	0%
Pasture/Meadow	60,623	1.39	0.04	0.15	0.25	0.37	0.44	0.50	0%
Combined	**104,712**	**2.40**	**0.31**	**0.38**	**0.46**	**0.55**	**0.60**	**0.64**	**31.7%**
	104712								

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	311	3	-	-	-	-	
Initial Time	62	2	0.032	-	6.9	11.7	DCM Eq. 6-8
Shallow Channel	249	1	0.004	0.4	9.4	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**11.7**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.11	3.89	4.54	5.19	5.84	6.53
Runoff (cfs)	2.3	**3.6**	5.0	6.8	8.4	**10.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.3	**3.6**	5.0	6.8	8.4	**10.1**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Existing Sub-Basin Runoff Calculations (EX-NORTH)

Job No.:	**61186**	Date:		**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:		**TJW**
		Checked by:		
Jurisdiction	**DCM**		Soil Type	**C**
Runoff Coefficient	**Surface Type**		Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	327,799	7.53	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**327,799**	**7.53**	**0.04**	**0.15**	**0.25**	**0.37**	**0.44**	**0.50**	**0.0%**
	327799								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

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

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	668	6	0.008	-	-	-	
Initial Time	134	1	0.007	-	21.9	13.7	DCM Eq. 6-8
Shallow Channel	534	5	0.008	0.6	13.8	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**13.7**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.92	3.66	4.26	4.87	5.48	6.14
Runoff (cfs)	0.9	**4.1**	8.0	13.6	18.2	**23.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.9	**4.1**	8.0	13.6	18.2	**23.1**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Existing Sub-Basin Runoff Calculations (EX-MID-A)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	72,106	1.66	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**72,106**	**1.66**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	72106								

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	473	4	0.009	-	-	-	
Initial Time	81	1	0.012	-	15.5	12.6	DCM Eq. 6-8
Shallow Channel	391	3	0.008	0.6	10.5	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**12.6**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.02	3.78	4.41	5.04	5.67	6.34
Runoff (cfs)	0.1	**0.5**	1.1	2.1	2.8	**3.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.5**	1.1	2.1	2.8	**3.7**

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

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

Notes

Existing Sub-Basin Runoff Calculations (EX-MID-C)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	146,521	3.36	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**146,521**	**3.36**	**0.04**	**0.15**	**0.25**	**0.37**	**0.44**	**0.50**	**0.0%**
	146521								

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	258	3	0.013	-	-	-	
Initial Time	125	2	0.016	-	16.4	11.4	DCM Eq. 6-8
Shallow Channel	134	1	0.010	0.7	3.1	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**11.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.14	3.93	4.58	5.24	5.89	6.59
Runoff (cfs)	0.4	**2.0**	3.9	6.5	8.7	**11.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.4	**2.0**	3.9	6.5	8.7	**11.1**

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

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

Notes

Existing Sub-Basin Runoff Calculations (EX-SOU-A)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	6,163	0.14	0.71	0.73	0.75	0.78	0.8	0.81	90%
Paved	5,712	0.13	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	161,372	3.70	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**173,247**	**3.98**	**0.07**	**0.13**	**0.20**	**0.29**	**0.34**	**0.39**	**6.5%**
	173247								

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	593	6	0.010	-	-	-	
Initial Time	158	1	0.006	-	25.6	13.3	DCM Eq. 6-8
Shallow Channel	434	5	0.012	1.1	6.7	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	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)	0.9	**1.9**	3.4	5.7	7.5	**9.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.9	**1.9**	3.4	5.7	7.5	**9.6**
DCM: $I = C1 * \ln(tc) + C2$						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Existing Sub-Basin Runoff Calculations (EX-SOU-C)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	35,612	0.82	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**35,612**	**0.82**	**0.04**	**0.15**	**0.25**	**0.37**	**0.44**	**0.50**	**0.0%**
	35612								

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	91	1	0.013	-	-	-	
Initial Time	91	1	0.013	-	15.0	10.5	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	**10.5**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.24	4.06	4.73	5.41	6.08	6.81
Runoff (cfs)	0.1	**0.5**	1.0	1.6	2.2	**2.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.5**	1.0	1.6	2.2	**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

Existing Combined Sub-Basin Runoff Calculations (EX-DP2)

Includes Basins EX-OS1 EX-NORTH EX-MIDDLE A EX-MIDDLE C

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	15,890	0.36	0.73	0.75	0.77	0.8	0.82	0.83	90%
Landscaping	5,174	0.12	0.05	0.16	0.26	0.38	0.45	0.51	2%
Paved	115,872	2.66	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow, Type A	72,106	1.66	0.02	0.08	0.15	0.25	0.3	0.35	0%
Pasture/Meadow	474,319	10.89	0.04	0.15	0.25	0.37	0.44	0.5	0%
Combined	**683,361**	**15.69**	**0.20**	**0.28**	**0.37**	**0.46**	**0.52**	**0.57**	**19.1%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	EX-NORTH	-	668	6	-	-	-	-	13.7
Channelized-1	V-Ditch	2	471	4	23	0	2	2.8	2.8
Channelized-2									
Channelized-3									
Total			1,140	10					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **16.5**

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

Contributing Basins/Areas

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

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

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.70	3.38	3.94	4.51	5.07	5.68
Site Runoff (cfs)	8.40	**15.05**	22.60	32.82	41.42	**50.74**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**15.1**	-	-	-	**50.7**

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

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

Notes

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

Existing Combined Sub-Basin Runoff Calculations (EX-DP3)

Includes Basins EX-OS1 EX-OS2 EX-NORTH EX-MIDDLE A EX-MIDDLE C EX-SOUTH A EX-SOUTH C

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs, Type A	6,163	0.14	0.71	0.73	0.75	0.78	0.80	0.81	90%
Roofs	21,117	0.48	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved, Type A	5,712	0.13	0.89	0.90	0.92	0.94	0.95	0.96	100%
Paved	144,350	3.31	0.89	0.90	0.92	0.94	0.95	0.96	100%
Lawns	10,384	0.24	0.04	0.15	0.25	0.37	0.44	0.50	0%
Landscaping	5,174	0.12	0.05	0.16	0.26	0.38	0.45	0.51	2%
Pasture/Meadow, Type A	233,477	5.36	0.02	0.08	0.15	0.25	0.30	0.35	0%
Pasture/Meadow	570,554	13.10	0.04	0.15	0.25	0.37	0.44	0.50	0%
Combined	**996,932**	**22.89**	**0.18**	**0.26**	**0.34**	**0.44**	**0.49**	**0.54**	**17.5%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	EX-NORTH	-	668	6	-	-	-	-	13.7
Channelized-1	V-Ditch	2	874	4	23	0	2	2.3	6.3
Channelized-2									
Channelized-3									
Total			1,542	10					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **20.0**

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

Contributing Basins/Areas

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

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

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.47	3.09	3.60	4.12	4.63	5.18
Site Runoff (cfs)	10.29	**18.58**	28.17	41.41	52.41	**64.43**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**18.6**	-	-	-	**64.4**

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.

Developed Sub-Basin Runoff Calculations (OS1)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	15,890	0.36	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	115,872	2.66	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	5,174	0.12	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**136,935**	**3.14**	**0.84**	**0.85**	**0.88**	**0.90**	**0.92**	**0.93**	**95.1%**
	136935								

Basin Travel Time

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft; C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	340	7	-	-	-	-	
Initial Time	121	2	0.017	-	4.1	11.9	DCM Eq. 6-8
Shallow Channel	84	2	0.024	3.1	0.5	-	DCM Eq. 6-9
Channelized	135	3	0.023	5.3	0.4	-	C&G
				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)	10.9	**13.9**	16.6	19.5	22.3	**25.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	10.9	**13.9**	16.6	19.5	22.3	**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

Developed Sub-Basin Runoff Calculations (OS2)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	48,351	1.11	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	39,940	0.92	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	16,431	0.38	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**104,722**	**2.40**	**0.68**	**0.71**	**0.75**	**0.79**	**0.81**	**0.83**	**80.0%**
	104712								

Basin Travel Time

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft $\qquad C_v$ 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	585	7	-	-	-	-	
Initial Time	100	2	0.020	-	5.5	13.3	DCM Eq. 6-8
Shallow Channel	185	2	0.011	2.1	1.5	-	DCM Eq. 6-9
Channelized	300	3	0.010	3.9	1.3	-	C&G
				t_c	**8.3**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.52	4.41	5.15	5.88	6.62	7.40
Runoff (cfs)	5.8	**7.6**	9.2	11.1	12.9	**14.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	5.8	**7.6**	9.2	11.1	12.9	**14.8**

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

Developed Sub-Basin Runoff Calculations (A1)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	34,412	0.79	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	25,265	0.58	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	24,085	0.55	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**83,762**	**1.92**	**0.58**	**0.63**	**0.67**	**0.72**	**0.75**	**0.78**	**67.7%**
	83762								

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	550	6	-	-	-	-	
Initial Time	50	1	0.020	-	4.8	13.1	DCM Eq. 6-8
Shallow Channel	500	5	0.010	2.0	4.2	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**9.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.42	4.29	5.00	5.72	6.44	7.20
Runoff (cfs)	3.8	**5.2**	6.4	7.9	9.3	**10.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	3.8	**5.2**	6.4	7.9	9.3	**10.8**

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

Developed Sub-Basin Runoff Calculations (A2)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	8,712	0.20	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	37,897	0.87	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	16,957	0.39	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**63,566**	**1.46**	**0.64**	**0.68**	**0.72**	**0.77**	**0.80**	**0.82**	**72.5%**
	63566								

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	300	4	-	-	-	-	
Initial Time	50	1	0.020	-	4.2	11.7	DCM Eq. 6-8
Shallow Channel	250	3	0.010	2.0	2.1	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				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	4.82	5.62	6.42	7.22	8.09
Runoff (cfs)	3.6	**4.8**	5.9	7.2	8.4	**9.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	3.6	**4.8**	5.9	7.2	8.4	**9.7**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Developed Sub-Basin Runoff Calculations (A3)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	16,988	0.39	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	42,253	0.97	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	10,828	0.25	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**70,069**	**1.61**	**0.72**	**0.75**	**0.78**	**0.82**	**0.84**	**0.86**	**82.4%**
	70069								

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft $\qquad C_v$ 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	600	7	-	-	-	-	
Initial Time	50	1	0.020	-	3.6	13.3	DCM Eq. 6-8
Shallow Channel	550	6	0.010	2.0	4.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**8.1**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.54	4.44	5.18	5.92	6.66	7.45
Runoff (cfs)	4.1	**5.3**	6.5	7.8	9.0	**10.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	4.1	**5.3**	6.5	7.8	9.0	**10.3**

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

Developed Sub-Basin Runoff Calculations (A4)

Job No.:	**61186**	Date:		**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**C**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	-	0.00	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	3,049	0.07	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	16,868	0.39	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**19,917**	**0.46**	**0.18**	**0.27**	**0.36**	**0.47**	**0.53**	**0.58**	**17.0%**
	19917								

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	130	11	-	-	-	-	
Initial Time	30	10	0.333	-	2.6	10.7	DCM Eq. 6-8
Shallow Channel	100	1	0.010	2.0	0.8	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				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)	0.3	**0.6**	1.0	1.5	1.9	**2.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**0.6**	1.0	1.5	1.9	**2.3**

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

Developed Sub-Basin Runoff Calculations (B1)

Job No.:	**61186**	Date:		**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**C**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	30,928	0.71	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	33,541	0.77	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	55,744	1.28	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**120,213**	**2.76**	**0.46**	**0.52**	**0.58**	**0.64**	**0.68**	**0.72**	**52.0%**
	120213								

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft $\quad C_v$ 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	720	7	-	-	-	-	
Initial Time	20	0	0.020	-	3.7	14.0	DCM Eq. 6-8
Shallow Channel	700	7	0.010	2.0	5.8	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**9.6**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.35	4.20	4.89	5.59	6.29	7.04
Runoff (cfs)	4.2	**6.0**	7.8	9.9	11.9	**14.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	4.2	**6.0**	7.8	9.9	11.9	**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

Developed Sub-Basin Runoff Calculations (B2)

Job No.:	**61186**	Date:		**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**C**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	-	0.00	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	3,049	0.07	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	13,861	0.32	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**16,910**	**0.39**	**0.20**	**0.29**	**0.38**	**0.48**	**0.54**	**0.59**	**19.7%**
	16910								

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	120	8	-	-	-	-	
Initial Time	20	7	0.338	-	2.0	10.7	DCM Eq. 6-8
Shallow Channel	100	1	0.010	2.0	0.8	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				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)	0.3	**0.6**	0.9	1.3	1.6	**2.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**0.6**	0.9	1.3	1.6	**2.0**

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

Developed Sub-Basin Runoff Calculations (C1)

Job No.:	**61186**	Date:		**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**C**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	31,799	0.73	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	64,469	1.48	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	40,733	0.94	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**137,001**	**3.15**	**0.60**	**0.65**	**0.69**	**0.74**	**0.77**	**0.80**	**68.5%**

137001

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	800	9	-	-	-	-	
Initial Time	50	1	0.020	-	4.6	14.4	DCM Eq. 6-8
Shallow Channel	750	8	0.010	2.0	6.3	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**10.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.20	4.00	4.67	5.34	6.01	6.72
Runoff (cfs)	6.1	**8.1**	10.1	12.4	14.6	**16.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	6.1	**8.1**	10.1	12.4	14.6	**16.8**
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

Developed Sub-Basin Runoff Calculations (C2)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	-	0.00	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	18,295	0.42	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	828	0.02	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**19,123**	**0.44**	**0.85**	**0.87**	**0.89**	**0.92**	**0.93**	**0.94**	**95.8%**
	19123								

Basin Travel Time

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Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	550	6	-	-	-	-	
Initial Time	20	0	0.020	-	1.5	13.1	DCM Eq. 6-8
Shallow Channel	530	5	0.010	2.0	4.4	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**5.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.92	4.92	5.74	6.56	7.38	8.26
Runoff (cfs)	1.5	**1.9**	2.2	2.6	3.0	**3.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.5	**1.9**	2.2	2.6	3.0	**3.4**

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

Developed Sub-Basin Runoff Calculations (C3)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	13,939	0.32	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	17,860	0.41	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	22,413	0.51	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**54,212**	**1.24**	**0.50**	**0.56**	**0.61**	**0.67**	**0.71**	**0.74**	**56.9%**

54212

Basin Travel Time

-

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	470	5	-	-	-	-	
Initial Time	20	0	0.020	-	3.5	12.6	DCM Eq. 6-8
Shallow Channel	450	5	0.010	2.0	3.8	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				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)	2.3	**3.2**	4.1	5.1	6.1	**7.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.3	**3.2**	4.1	5.1	6.1	**7.1**

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

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

Notes

Developed Sub-Basin Runoff Calculations (C4)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	6,534	0.15	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	4,356	0.10	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	56,131	1.29	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**67,021**	**1.54**	**0.17**	**0.27**	**0.35**	**0.46**	**0.52**	**0.57**	**16.9%**
	67021								

Basin Travel Time

-

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft; C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	200	3	-	-	-	-	
Initial Time	50	2	0.033	-	7.2	11.1	DCM Eq. 6-8
Shallow Channel	150	2	0.010	2.0	1.3	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**8.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.50	4.39	5.12	5.85	6.58	7.37
Runoff (cfs)	0.9	**1.8**	2.8	4.1	5.3	**6.5**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.9	**1.8**	2.8	4.1	5.3	**6.5**

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

Developed Sub-Basin Runoff Calculations (D)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	-	0.00	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	871	0.02	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	61,793	1.42	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**62,664**	**1.44**	**0.06**	**0.17**	**0.27**	**0.39**	**0.46**	**0.52**	**3.4%**

62664

Basin Travel Time

-

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft; C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	120	2	-	-	-	-	
Initial Time	20	1	0.033	-	5.1	10.7	DCM Eq. 6-8
Shallow Channel	100	1	0.010	2.0	0.8	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**5.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.92	4.92	5.74	6.56	7.38	8.26
Runoff (cfs)	0.3	**1.2**	2.2	3.7	4.9	**6.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**1.2**	2.2	3.7	4.9	**6.1**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Developed Sub-Basin Runoff Calculations (E)

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Roofs	-	0.00	0.73	0.75	0.77	0.80	0.82	0.83	90%
Paved	3,485	0.08	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	38,217	0.88	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**41,702**	**0.96**	**0.12**	**0.22**	**0.32**	**0.43**	**0.49**	**0.55**	**10.2%**
	41702								

Basin Travel Time

-

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	1,600	13	-	-	-	-	
Initial Time	100	2	0.020	-	12.6	18.9	DCM Eq. 6-8
Shallow Channel	1,500	11	0.007	1.7	14.9	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**18.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.54	3.18	3.70	4.23	4.76	5.33
Runoff (cfs)	0.3	**0.7**	1.1	1.7	2.2	**2.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**0.7**	1.1	1.7	2.2	**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

Developed Combined Sub-Basin Runoff Calculations (DP4/POND A)

Includes Basins A1 A2 A3 A4

Job No.:	61186	Date:	2/8/2024 16:55
Project:	Southmoor Ridge	Calcs by:	TJW
		Checked by:	
Jurisdiction	DCM	Soil Type	C
Runoff Coefficient	Percent Impervious	Urbanization	Urban

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	(SF)	(Acres)	C2	C5	C10	C25	C50	C100	Imperv.
Roofs	60,112	1.38	0.54	0.58	0.62	0.66	0.68	0.71	75%
Paved	108,464	2.49	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	68,738	1.58	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**237,314**	**5.45**	**0.56**	**0.60**	**0.65**	**0.71**	**0.74**	**0.77**	**65.3%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	A1	-	550	6	-	-	-	-	9.0
Channelized-1									
Channelized-2									
Channelized-3									
Total			550	6					
								t_c (min)	**9.0**

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

Contributing Basins/Areas

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

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

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.42	4.29	5.00	5.72	6.44	7.20
Site Runoff (cfs)	10.40	**14.13**	17.80	22.03	25.83	**30.07**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**14.1**	-	-	-	**30.1**

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

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

Notes

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

Developed Combined Sub-Basin Runoff Calculations (DP6/POND B)

Includes Basins B1 B2

Job No.:	**61186**	Date:		**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**C**	
Runoff Coefficient	**Percent Impervious**	Urbanization	**Urban**	

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	30,928	0.71	0.54	0.58	0.62	0.66	0.68	0.71	75%
Paved	36,590	0.84	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	69,605	1.60	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**137,123**	**3.15**	**0.38**	**0.45**	**0.52**	**0.59**	**0.64**	**0.68**	**44.6%**

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	B1	-	720	7	-	-	-	-	9.6
Channelized-1									
Channelized-2									
Channelized-3									
Total			720	7					
								t_c (min)	**9.6**

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)	3.35	4.20	4.89	5.59	6.29	7.04
Site Runoff (cfs)	4.05	**5.97**	7.97	10.43	12.59	**14.97**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**6.0**	-	-	-	**15.0**

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

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

Developed Combined Sub-Basin Runoff Calculations (DP10/POND C)

Includes Basins C1 C2 C3 C4 OS1 OS2

Job No.:	**61186**	Date:	**2/8/2024 16:55**
Project:	**Southmoor Ridge**	Calcs by:	**TJW**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**C**
Runoff Coefficient	**Percent Impervious**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Roofs	116,513	2.67	0.54	0.58	0.62	0.66	0.68	0.71	75%
Paved	260,792	5.99	0.89	0.90	0.92	0.94	0.95	0.96	100%
Landscaping	141,710	3.25	0.05	0.16	0.26	0.38	0.45	0.51	2%
Combined	**519,014**	**11.91**	**0.58**	**0.63**	**0.67**	**0.72**	**0.75**	**0.78**	**67.6%**

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	C1	-	800	9	-	-	-	-	10.9
Channelized-1									
Channelized-2									
Channelized-3									
Total			800	9					
								t_c (min)	**10.9**

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)	3.20	4.00	4.67	5.34	6.01	6.72
Site Runoff (cfs)	22.16	**29.87**	37.43	46.07	53.88	**62.56**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**29.9**	-	-	-	**62.6**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

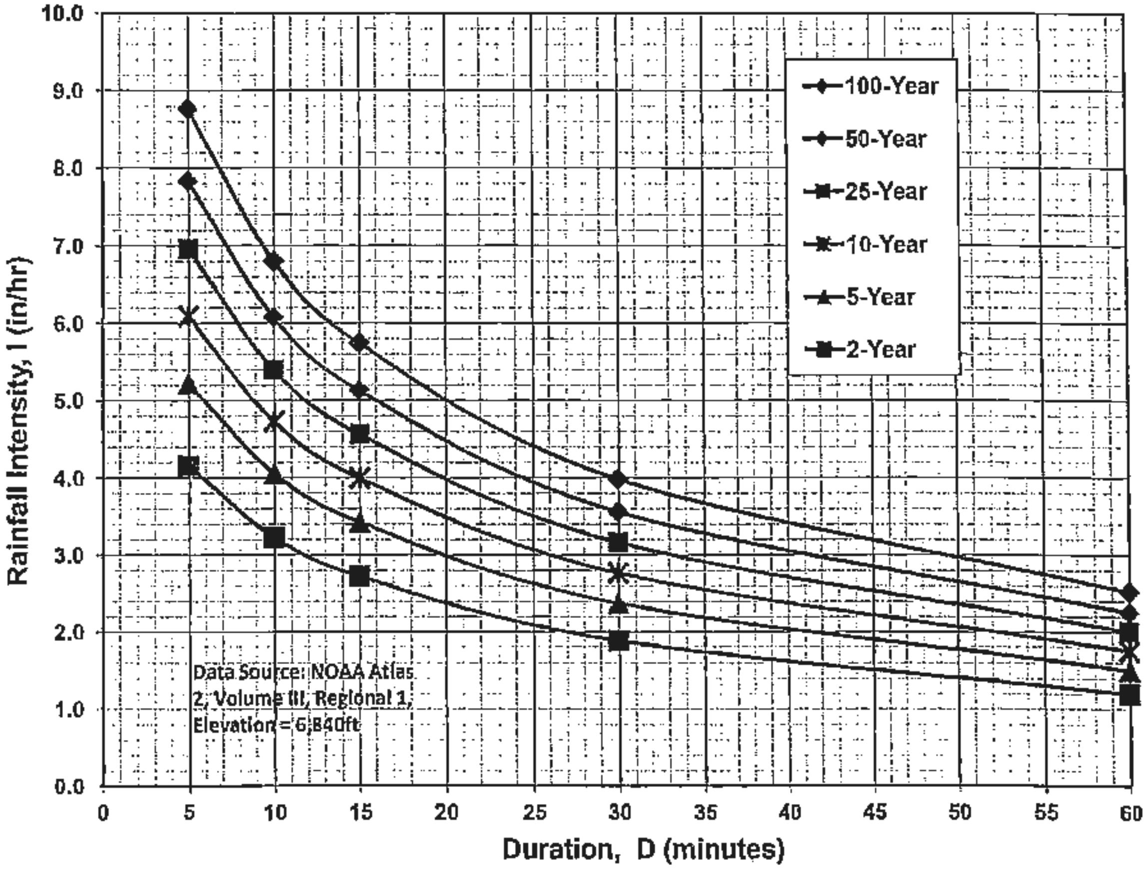
Notes

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

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.

10 Hydraulic Calculations

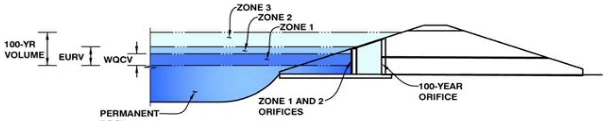
MHFD-Detention Worksheet Calculations
Resulting Outflow Hydrographs From MHFD-Detention Worksheets
Full Infiltration Pond Stage-Storage Relationship
Full Infiltration Pond Sizing Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Southmoor Drainage

Basin ID: Pond A - DP4



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	5.45	acres
Watershed Length =	930	ft
Watershed Length to Centroid =	465	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	65.30%	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) =	0.116	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.344	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.369	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.506	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.621	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.747	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.866	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.004	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.25 in.) =	1.353	acre-feet	3.25	inches
Approximate 2-yr Detention Volume =	0.308	acre-feet		
Approximate 5-yr Detention Volume =	0.435	acre-feet		
Approximate 10-yr Detention Volume =	0.498	acre-feet		
Approximate 25-yr Detention Volume =	0.531	acre-feet		
Approximate 50-yr Detention Volume =	0.547	acre-feet		
Approximate 100-yr Detention Volume =	0.597	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.116	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.228	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.253	acre-feet
Total Detention Basin Volume =	0.597	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		
	--	0.25	--	--	--	10	0.000	3	0.000
	--	1.25	--	--	--	1,064	0.024	539	0.012
	--	2.25	--	--	--	6,160	0.141	4,151	0.095
	--	3.25	--	--	--	8,430	0.194	11,446	0.263
	--	4.25	--	--	--	10,572	0.243	20,947	0.481
	--	5.25	--	--	--	12,858	0.295	32,662	0.750
	--	6.25	--	--	--	15,103	0.347	46,643	1.071
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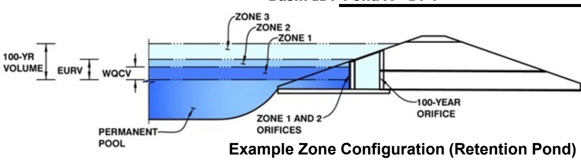
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Southmoor Drainage**

Basin ID: **Pond A - DP4**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.40	0.116	Orifice Plate
Zone 2 (EURV)	3.65	0.228	Orifice Plate
Zone 3 (100-year)	4.71	0.253	Weir&Pipe (Restrict)
Total (all zones)		0.597	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.65	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.40	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.22	2.43					
Orifice Area (sq. inches)	0.53	0.53	1.66					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	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 Open Area % =	81%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.00	N/A	feet
Overflow Weir Slope Length =	2.92	N/A	feet
Grate Open Area / 100-yr Orifice Area =	14.03	N/A	
Overflow Grate Open Area w/o Debris =	6.91	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.45	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 =	5.80		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.49	N/A	ft^2
Outlet Orifice Centroid =	0.28	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.21	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.27	feet
Stage at Top of Freeboard =	6.27	feet
Basin Area at Top of Freeboard =	0.35	acres
Basin Volume at Top of Freeboard =	1.07	acre-ft

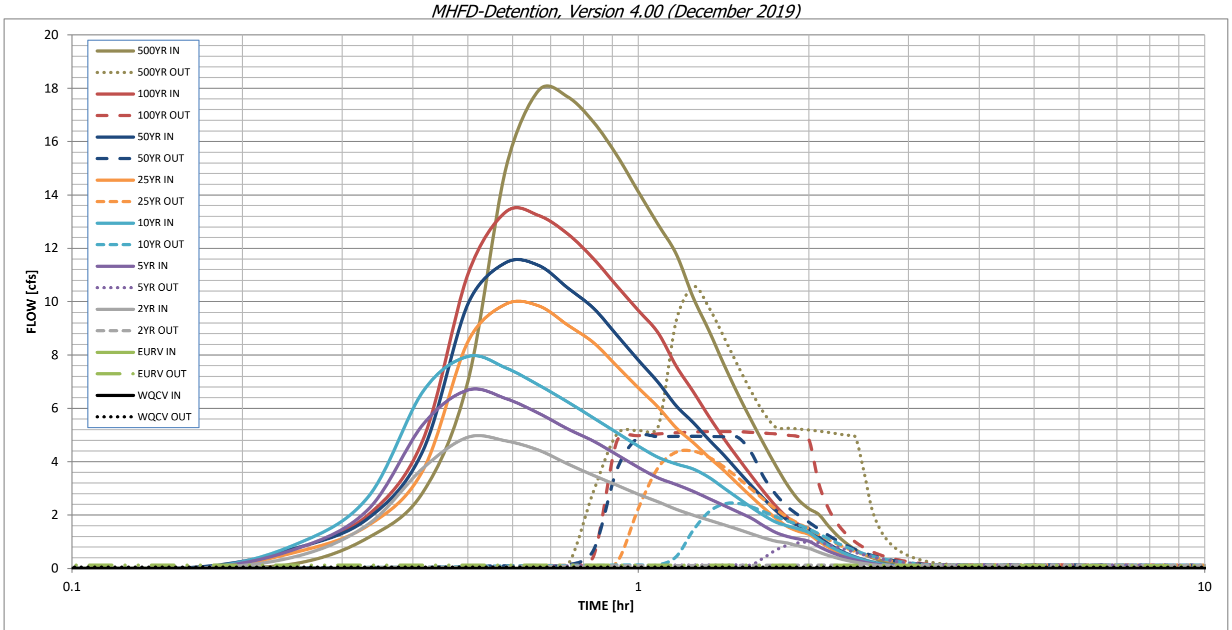
Routed Hydrograph Results

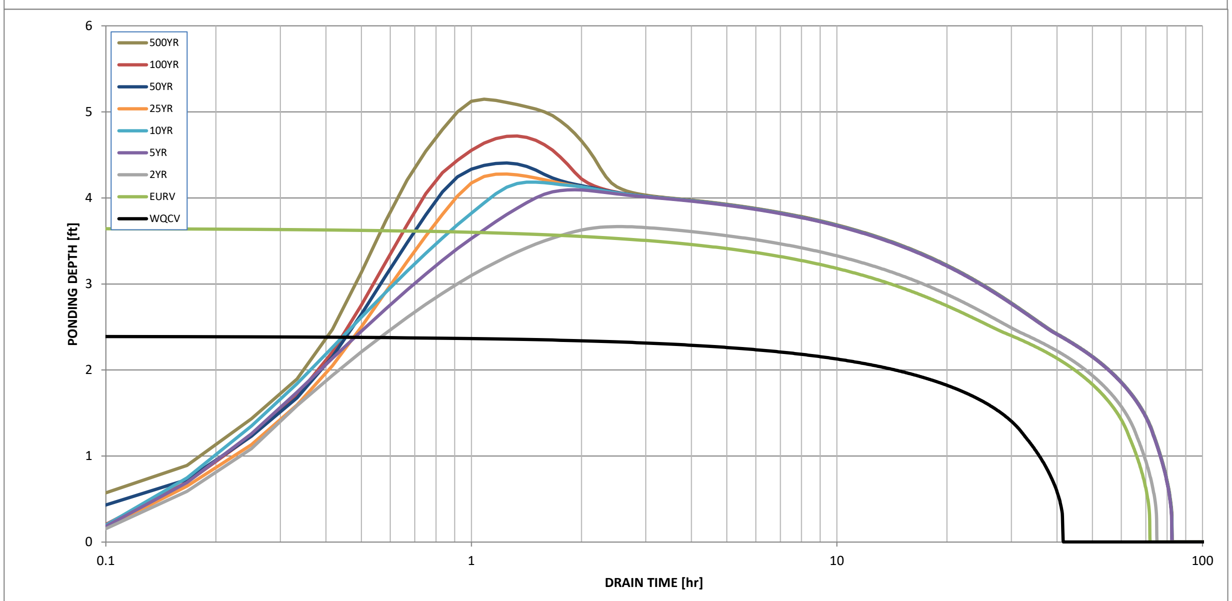
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

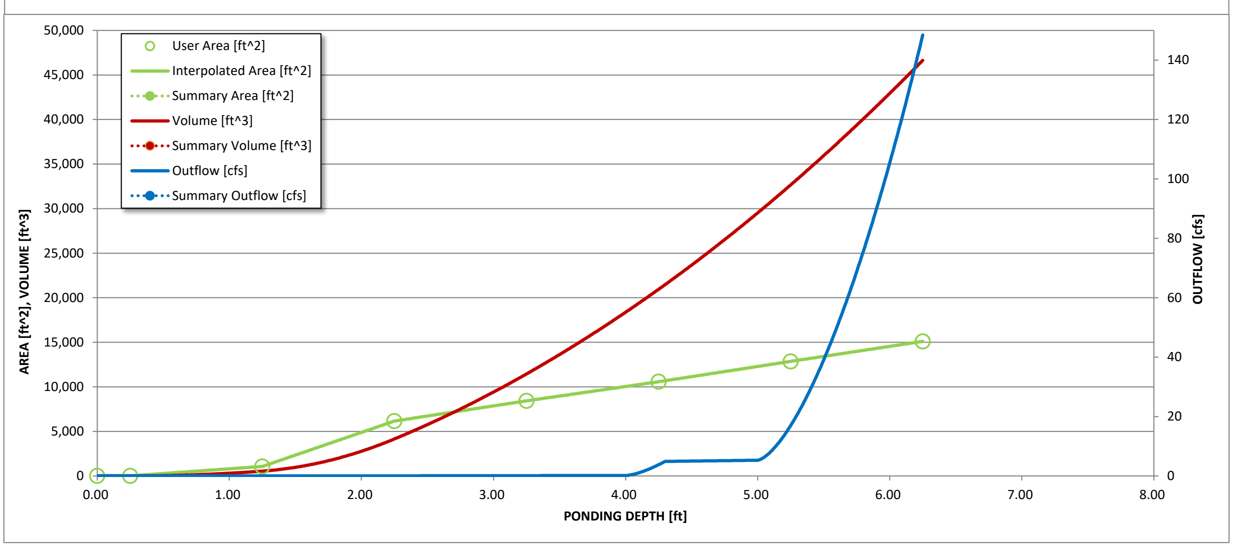
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.25
CUHP Runoff Volume (acre-ft) =	0.116	0.344	0.369	0.506	0.621	0.747	0.866	1.004	1.353
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.369	0.506	0.621	0.747	0.866	1.004	1.353
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.8	1.6	2.3	3.6	4.5	5.6	8.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.30	0.42	0.67	0.83	1.03	1.50
Peak Inflow Q (cfs) =	N/A	N/A	4.9	6.7	7.9	9.9	11.5	13.4	17.9
Peak Outflow Q (cfs) =	0.0	0.1	0.1	1.0	2.4	4.4	5.0	5.1	10.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	1.1	1.2	1.1	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.6	0.7	0.7	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	64	67	72	71	69	68	66	63
Time to Drain 99% of Inflow Volume (hours) =	**40**	69	72	78	77	77	76	75	73
Maximum Ponding Depth (ft) =	2.40	3.65	3.67	4.09	4.18	4.28	4.41	4.72	5.15
Area at Maximum Ponding Depth (acres) =	0.15	0.21	0.21	0.23	0.24	0.24	0.25	0.27	0.29
Maximum Volume Stored (acre-ft) =	0.117	0.344	0.346	0.443	0.464	0.486	0.518	0.598	0.718

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: *Pond A Outflow*

Inflow Hydrographs

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

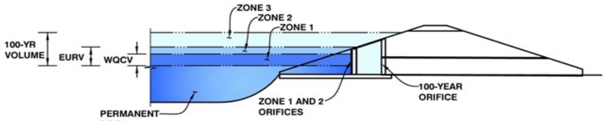
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.19
	0:15:00	0.00	0.00	0.46	0.75	0.93	0.62	0.78	0.76	1.15
	0:20:00	0.00	0.00	1.65	2.21	2.68	1.61	1.88	2.00	2.86
	0:25:00	0.00	0.00	3.76	5.39	6.63	3.68	4.41	4.82	7.00
	0:30:00	0.00	0.00	4.92	6.69	7.94	8.49	9.91	11.02	14.97
	0:35:00	0.00	0.00	4.78	6.37	7.52	9.91	11.46	13.36	17.92
	0:40:00	0.00	0.00	4.43	5.82	6.87	9.84	11.36	13.23	17.68
	0:45:00	0.00	0.00	3.92	5.23	6.24	9.13	10.52	12.55	16.73
	0:50:00	0.00	0.00	3.49	4.77	5.64	8.47	9.76	11.61	15.48
	0:55:00	0.00	0.00	3.12	4.26	5.09	7.58	8.74	10.59	14.12
	1:00:00	0.00	0.00	2.78	3.79	4.58	6.77	7.81	9.67	12.90
	1:05:00	0.00	0.00	2.50	3.40	4.17	6.05	6.98	8.84	11.78
	1:10:00	0.00	0.00	2.21	3.14	3.91	5.27	6.09	7.58	10.15
	1:15:00	0.00	0.00	2.00	2.89	3.73	4.72	5.47	6.63	8.91
	1:20:00	0.00	0.00	1.81	2.61	3.41	4.16	4.82	5.69	7.64
	1:25:00	0.00	0.00	1.63	2.36	3.01	3.67	4.24	4.86	6.52
	1:30:00	0.00	0.00	1.47	2.12	2.64	3.16	3.65	4.14	5.55
	1:35:00	0.00	0.00	1.30	1.88	2.29	2.69	3.10	3.47	4.65
	1:40:00	0.00	0.00	1.14	1.59	1.98	2.26	2.61	2.87	3.84
	1:45:00	0.00	0.00	1.02	1.34	1.73	1.87	2.16	2.33	3.13
	1:50:00	0.00	0.00	0.95	1.20	1.59	1.57	1.81	1.91	2.58
	1:55:00	0.00	0.00	0.84	1.10	1.48	1.39	1.61	1.66	2.24
	2:00:00	0.00	0.00	0.75	1.02	1.35	1.28	1.48	1.49	2.02
	2:05:00	0.00	0.00	0.61	0.82	1.09	1.02	1.18	1.17	1.59
	2:10:00	0.00	0.00	0.48	0.65	0.86	0.79	0.92	0.89	1.22
	2:15:00	0.00	0.00	0.38	0.51	0.68	0.62	0.72	0.68	0.93
	2:20:00	0.00	0.00	0.30	0.40	0.53	0.48	0.56	0.52	0.70
	2:25:00	0.00	0.00	0.23	0.31	0.41	0.37	0.43	0.39	0.53
	2:30:00	0.00	0.00	0.18	0.24	0.31	0.28	0.33	0.30	0.41
	2:35:00	0.00	0.00	0.14	0.18	0.23	0.21	0.25	0.23	0.31
	2:40:00	0.00	0.00	0.11	0.14	0.18	0.16	0.19	0.18	0.24
	2:45:00	0.00	0.00	0.08	0.10	0.14	0.12	0.14	0.14	0.18
	2:50:00	0.00	0.00	0.06	0.07	0.10	0.09	0.11	0.10	0.14
	2:55:00	0.00	0.00	0.04	0.05	0.07	0.07	0.08	0.07	0.10
	3:00:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.06
	3:05:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
	3:10:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Southmoor Drainage

Basin ID: Pond B - DP6



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	3.15	acres		
Watershed Length =	800	ft		
Watershed Length to Centroid =	400	ft		
Watershed Slope =	0.008	ft/ft		
Watershed Imperviousness =	44.60%	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) =	0.050	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.132	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.157	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.232	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.296	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.372	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.439	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.523	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.25 in.) =	0.723	acre-feet	3.25	inches
Approximate 2-yr Detention Volume =	0.116	acre-feet		
Approximate 5-yr Detention Volume =	0.176	acre-feet		
Approximate 10-yr Detention Volume =	0.201	acre-feet		
Approximate 25-yr Detention Volume =	0.219	acre-feet		
Approximate 50-yr Detention Volume =	0.228	acre-feet		
Approximate 100-yr Detention Volume =	0.264	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.050	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.081	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.132	acre-feet
Total Detention Basin Volume =	0.264	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		
	--	0.25	--	--	--	10	0.000	3	0.000
	--	1.25	--	--	--	1,446	0.033	730	0.017
	--	2.25	--	--	--	6,655	0.153	4,781	0.110
	--	3.25	--	--	--	8,775	0.201	12,496	0.287
	--	4.25	--	--	--	11,098	0.255	22,432	0.515
	--	5.25	--	--	--	13,308	0.306	34,635	0.795
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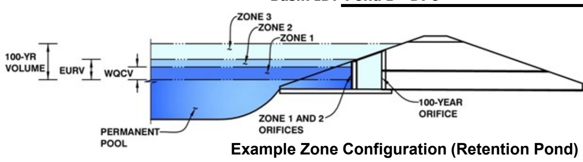
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Southmoor Drainage

Basin ID: Pond B - DP6



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.78	0.050	Orifice Plate
Zone 2 (EURV)	2.40	0.081	Orifice Plate
Zone 3 (100-year)	3.14	0.132	Weir&Pipe (Restrict)
Total (all zones)		0.264	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.40	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00					
Orifice Area (sq. inches)	0.27	0.27	2.22					

	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	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =		N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =		N/A	ft^2
Vertical Orifice Centroid =		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 =	2.66	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 Open Area % =	81%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.66	N/A	feet
Overflow Weir Slope Length =	2.92	N/A	feet
Grate Open Area / 100-yr Orifice Area =	23.62	N/A	
Overflow Grate Open Area w/o Debris =	6.91	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.45	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 =	4.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.29	N/A	ft^2
Outlet Orifice Centroid =	0.20	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.98	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.75	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.29	feet
Stage at Top of Freeboard =	5.04	feet
Basin Area at Top of Freeboard =	0.29	acres
Basin Volume at Top of Freeboard =	0.73	acre-ft

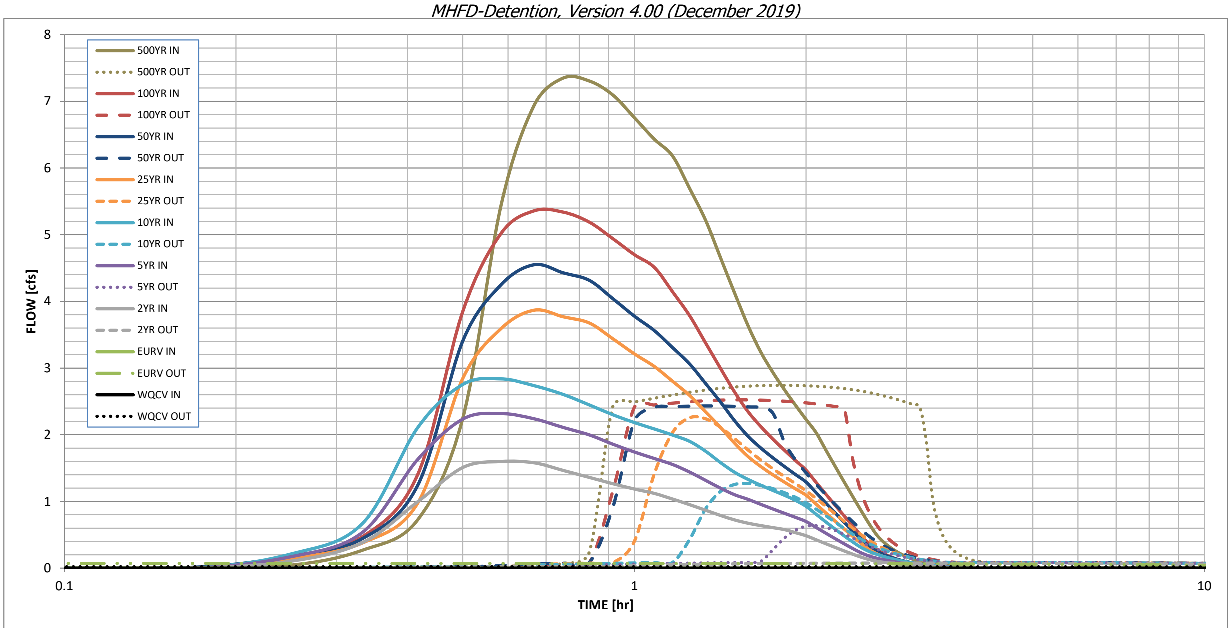
Routed Hydrograph Results

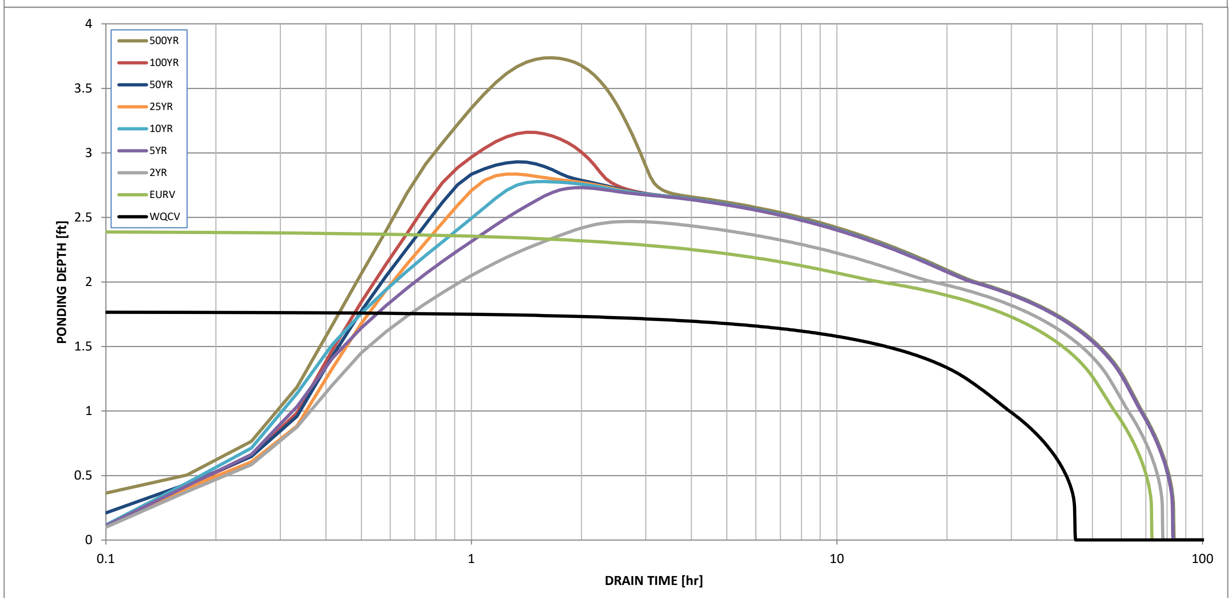
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

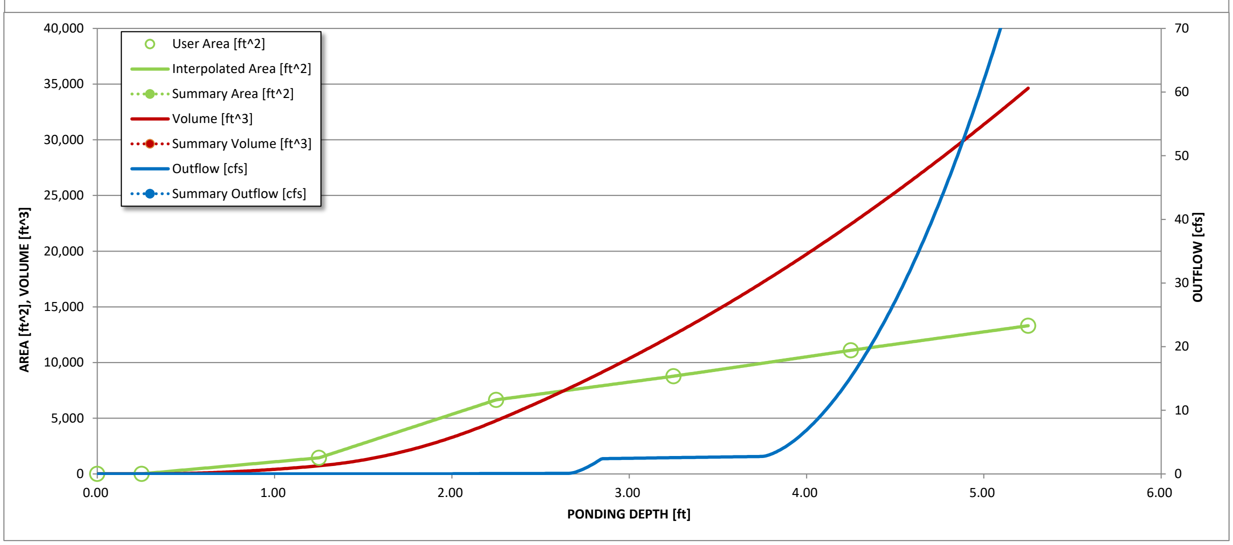
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.25
CUHP Runoff Volume (acre-ft) =	0.050	0.132	0.157	0.232	0.296	0.372	0.439	0.523	0.723
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.157	0.232	0.296	0.372	0.439	0.523	0.723
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	0.8	1.2	1.9	2.3	2.9	4.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.12	0.26	0.37	0.59	0.73	0.91	1.32
Peak Inflow Q (cfs) =	N/A	N/A	1.6	2.3	2.8	3.9	4.5	5.4	7.3
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.6	1.3	2.3	2.4	2.5	2.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.1	1.2	1.1	0.9	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.2	0.3	0.3	0.3	0.4
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) =	42	66	70	71	69	66	64	62	57
Time to Drain 99% of Inflow Volume (hours) =	**44**	70	75	78	78	76	75	74	72
Maximum Ponding Depth (ft) =	1.77	2.40	2.47	2.73	2.78	2.84	2.93	3.16	3.74
Area at Maximum Ponding Depth (acres) =	0.10	0.16	0.16	0.18	0.18	0.18	0.19	0.20	0.23
Maximum Volume Stored (acre-ft) =	0.050	0.133	0.143	0.189	0.196	0.207	0.225	0.267	0.390

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: *Pond B Outflow*

Inflow Hydrographs

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

Time Interval: 5.00 min

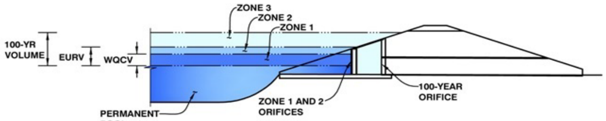
SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05
0:15:00	0.00	0.00	0.11	0.17	0.21	0.14	0.18	0.17	0.27
0:20:00	0.00	0.00	0.38	0.54	0.67	0.38	0.44	0.47	0.72
0:25:00	0.00	0.00	1.00	1.63	2.11	0.98	1.24	1.40	2.25
0:30:00	0.00	0.00	1.51	2.24	2.75	2.85	3.41	3.85	5.44
0:35:00	0.00	0.00	1.60	2.32	2.84	3.59	4.25	5.02	6.94
0:40:00	0.00	0.00	1.58	2.24	2.74	3.87	4.55	5.36	7.35
0:45:00	0.00	0.00	1.46	2.11	2.60	3.77	4.43	5.34	7.30
0:50:00	0.00	0.00	1.36	2.00	2.45	3.68	4.32	5.19	7.09
0:55:00	0.00	0.00	1.27	1.86	2.30	3.44	4.04	4.94	6.75
1:00:00	0.00	0.00	1.19	1.74	2.18	3.21	3.78	4.70	6.43
1:05:00	0.00	0.00	1.12	1.64	2.09	3.03	3.56	4.51	6.18
1:10:00	0.00	0.00	1.04	1.55	2.00	2.80	3.31	4.14	5.69
1:15:00	0.00	0.00	0.95	1.44	1.90	2.59	3.06	3.79	5.22
1:20:00	0.00	0.00	0.87	1.32	1.75	2.34	2.77	3.38	4.65
1:25:00	0.00	0.00	0.79	1.20	1.58	2.11	2.49	2.99	4.12
1:30:00	0.00	0.00	0.72	1.10	1.44	1.87	2.21	2.64	3.63
1:35:00	0.00	0.00	0.67	1.03	1.33	1.67	1.98	2.34	3.24
1:40:00	0.00	0.00	0.64	0.96	1.24	1.52	1.80	2.12	2.93
1:45:00	0.00	0.00	0.61	0.89	1.16	1.40	1.65	1.93	2.67
1:50:00	0.00	0.00	0.58	0.82	1.09	1.29	1.52	1.77	2.44
1:55:00	0.00	0.00	0.53	0.76	1.02	1.19	1.40	1.61	2.23
2:00:00	0.00	0.00	0.49	0.70	0.93	1.09	1.29	1.47	2.03
2:05:00	0.00	0.00	0.42	0.61	0.81	0.96	1.13	1.29	1.77
2:10:00	0.00	0.00	0.37	0.52	0.69	0.83	0.98	1.11	1.53
2:15:00	0.00	0.00	0.31	0.44	0.58	0.70	0.83	0.94	1.29
2:20:00	0.00	0.00	0.26	0.37	0.48	0.59	0.69	0.78	1.07
2:25:00	0.00	0.00	0.21	0.29	0.39	0.48	0.56	0.63	0.86
2:30:00	0.00	0.00	0.16	0.23	0.31	0.37	0.43	0.49	0.66
2:35:00	0.00	0.00	0.13	0.18	0.25	0.28	0.32	0.36	0.49
2:40:00	0.00	0.00	0.10	0.15	0.21	0.21	0.25	0.27	0.37
2:45:00	0.00	0.00	0.08	0.12	0.17	0.17	0.20	0.21	0.29
2:50:00	0.00	0.00	0.07	0.10	0.14	0.13	0.16	0.16	0.22
2:55:00	0.00	0.00	0.06	0.08	0.12	0.10	0.12	0.12	0.17
3:00:00	0.00	0.00	0.05	0.07	0.09	0.08	0.10	0.09	0.13
3:05:00	0.00	0.00	0.04	0.06	0.08	0.07	0.08	0.07	0.10
3:10:00	0.00	0.00	0.03	0.05	0.06	0.05	0.06	0.06	0.08
3:15:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.05	0.06
3:20:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.05
3:25:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
3:30:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
3:35:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
3:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
3:45:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: **Southmoor Drainage**

Basin ID: **Pond C - DP10**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	11.91	acres
Watershed Length =	840	ft
Watershed Length to Centroid =	420	ft
Watershed Slope =	0.012	ft/ft
Watershed Imperviousness =	67.60%	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) =	0.263	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.780	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.810	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.104	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.349	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.618	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.871	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.165	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.25 in.) =	2.909	acre-feet	3.25	inches
Approximate 2-yr Detention Volume =	0.700	acre-feet		
Approximate 5-yr Detention Volume =	0.983	acre-feet		
Approximate 10-yr Detention Volume =	1.125	acre-feet		
Approximate 25-yr Detention Volume =	1.199	acre-feet		
Approximate 50-yr Detention Volume =	1.233	acre-feet		
Approximate 100-yr Detention Volume =	1.338	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.263	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.518	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.558	acre-feet
Total Detention Basin Volume =	1.338	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		
	--	0.25	--	--	--	10	0.000	3	0.000
	--	1.25	--	--	--	1,775	0.041	895	0.021
	--	2.25	--	--	--	8,291	0.190	5,928	0.136
	--	3.25	--	--	--	18,975	0.436	19,561	0.449
	--	4.25	--	--	--	22,129	0.508	40,113	0.921
	--	5.25	--	--	--	25,543	0.586	63,949	1.468
	--	6.25	--	--	--	29,033	0.667	91,237	2.095
	--	7.25	--	--	--	32,262	0.741	121,884	2.798
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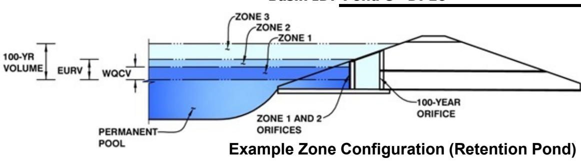
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Southmoor Drainage**

Basin ID: **Pond C - DP10**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.76	0.263	Orifice Plate
Zone 2 (EURV)	3.97	0.518	Orifice Plate
Zone 3 (100-year)	5.03	0.558	Weir&Pipe (Restrict)
	Total (all zones)	1.338	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.97	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.40	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.32	2.65					
Orifice Area (sq. inches)	1.11	1.11	2.30					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	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 Open Area % =	81%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.00	N/A	feet
Overflow Weir Slope Length =	2.92	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.36	N/A	
Overflow Grate Open Area w/o Debris =	6.91	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.45	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 =	15.10		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.58	N/A	ft^2
Outlet Orifice Centroid =	0.68	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.32	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.75	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	50.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.40	feet
Stage at Top of Freeboard =	7.15	feet
Basin Area at Top of Freeboard =	0.73	acres
Basin Volume at Top of Freeboard =	2.72	acre-ft

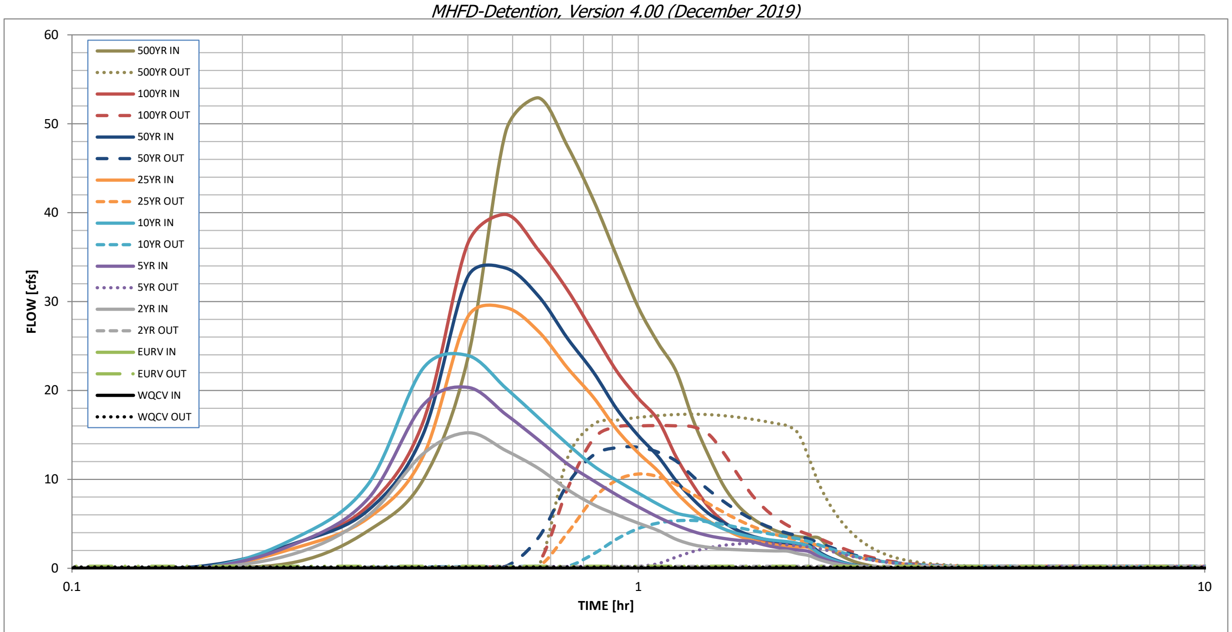
Routed Hydrograph Results

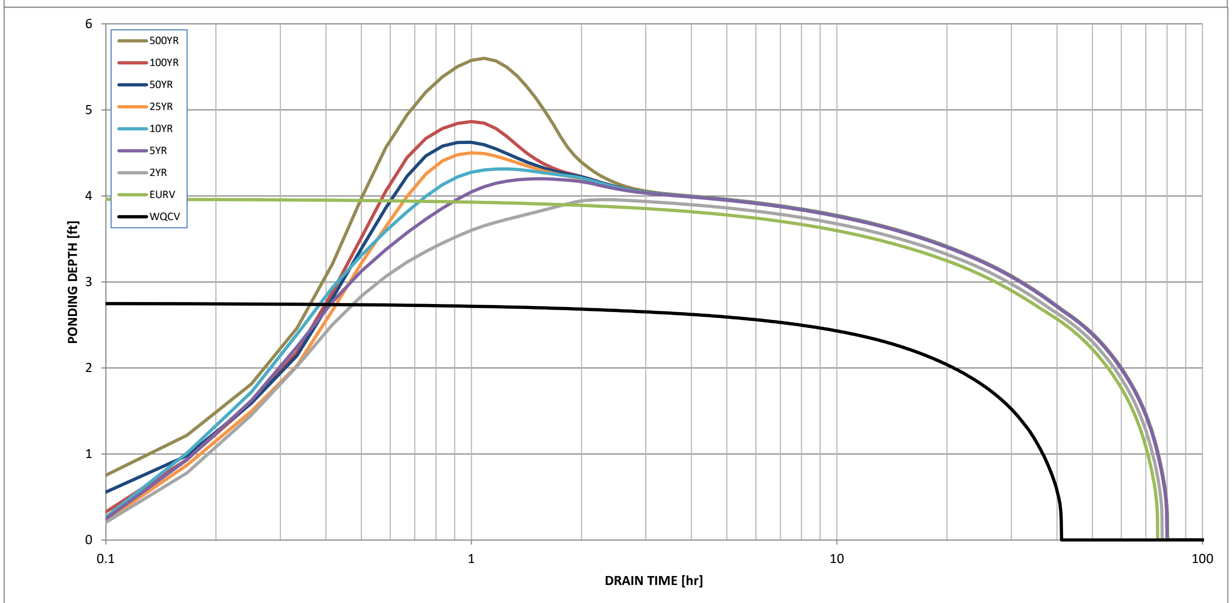
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

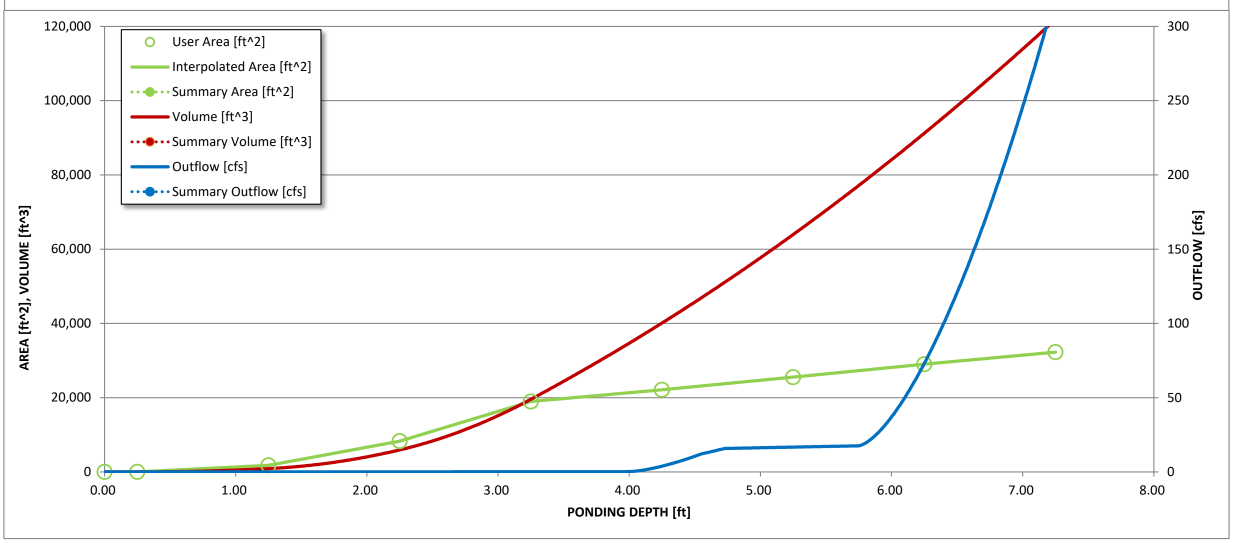
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.25
CUHP Runoff Volume (acre-ft) =	0.263	0.780	0.810	1.104	1.349	1.618	1.871	2.165	2.909
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.810	1.104	1.349	1.618	1.871	2.165	2.909
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.6	5.5	7.5	11.6	14.3	17.6	25.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.22	0.46	0.63	0.97	1.20	1.48	2.14
Peak Inflow Q (cfs) =	N/A	N/A	15.2	20.3	23.9	29.3	33.8	39.8	52.9
Peak Outflow Q (cfs) =	0.1	0.2	0.2	2.8	5.4	10.6	13.6	16.1	17.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	0.9	1.0	0.9	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.4	0.7	1.5	1.9	2.3	2.5
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	69	70	68	67	66	64	61
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	74	76	75	74	73	73	71
Maximum Ponding Depth (ft) =	2.76	3.97	3.96	4.20	4.31	4.50	4.62	4.86	5.60
Area at Maximum Ponding Depth (acres) =	0.32	0.49	0.49	0.50	0.51	0.53	0.54	0.56	0.61
Maximum Volume Stored (acre-ft) =	0.265	0.781	0.772	0.891	0.951	1.050	1.114	1.245	1.672

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: *Pond C Outflow*

Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
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	0.20	0.02	0.74
	0:15:00	0.00	0.00	1.74	2.84	3.51	2.36	2.90	2.86	4.21
	0:20:00	0.00	0.00	5.92	7.82	9.44	5.63	6.52	7.03	9.92
	0:25:00	0.00	0.00	12.86	18.34	22.47	12.57	15.03	16.41	23.61
	0:30:00	0.00	0.00	15.24	20.35	23.93	28.28	32.81	36.54	49.11
	0:35:00	0.00	0.00	13.24	17.32	20.28	29.32	33.77	39.80	52.92
	0:40:00	0.00	0.00	11.22	14.42	16.92	26.63	30.60	35.78	47.47
	0:45:00	0.00	0.00	8.85	11.72	13.96	22.52	25.85	31.29	41.42
	0:50:00	0.00	0.00	7.15	9.85	11.51	19.22	22.05	26.48	35.05
	0:55:00	0.00	0.00	6.01	8.24	9.86	15.58	17.89	22.14	29.34
	1:00:00	0.00	0.00	5.07	6.90	8.46	12.97	14.92	19.12	25.36
	1:05:00	0.00	0.00	4.25	5.75	7.20	10.93	12.58	16.68	22.12
	1:10:00	0.00	0.00	3.25	4.83	6.21	8.52	9.83	12.51	16.66
	1:15:00	0.00	0.00	2.64	4.13	5.78	6.68	7.73	9.34	12.56
	1:20:00	0.00	0.00	2.34	3.64	5.15	5.28	6.12	6.82	9.20
	1:25:00	0.00	0.00	2.17	3.34	4.40	4.42	5.12	5.21	7.05
	1:30:00	0.00	0.00	2.08	3.15	3.89	3.67	4.25	4.21	5.70
	1:35:00	0.00	0.00	2.02	3.01	3.53	3.15	3.65	3.55	4.80
	1:40:00	0.00	0.00	1.97	2.63	3.28	2.83	3.28	3.11	4.21
	1:45:00	0.00	0.00	1.94	2.36	3.11	2.61	3.02	2.81	3.80
	1:50:00	0.00	0.00	1.93	2.17	2.99	2.46	2.84	2.62	3.55
	1:55:00	0.00	0.00	1.63	2.03	2.79	2.38	2.75	2.55	3.45
	2:00:00	0.00	0.00	1.42	1.88	2.47	2.33	2.69	2.52	3.41
	2:05:00	0.00	0.00	0.98	1.30	1.70	1.61	1.86	1.75	2.37
	2:10:00	0.00	0.00	0.66	0.87	1.16	1.09	1.26	1.20	1.62
	2:15:00	0.00	0.00	0.44	0.58	0.78	0.74	0.85	0.81	1.10
	2:20:00	0.00	0.00	0.28	0.37	0.50	0.48	0.55	0.53	0.71
	2:25:00	0.00	0.00	0.17	0.23	0.31	0.31	0.36	0.34	0.45
	2:30:00	0.00	0.00	0.10	0.14	0.18	0.19	0.22	0.20	0.27
	2:35:00	0.00	0.00	0.04	0.07	0.09	0.10	0.11	0.10	0.14
	2:40:00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.05
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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

Concept Infiltration Pond Stage Storage Relationship

Infiltration Pond Sizing Based On Adjusted Pond Worksheets

Infiltration Area (only bottom area)	19,100	SF
Infiltration rate	2.149	inch/hr
	285.0	**ft3, 5 min**

	Required Pond Volume (cub. Ft)	Volume (Acre-ft)	Time at Peak Volume		FoS
Minimum	90,134	2.069	2.92	hrs	2.0
Required	180,268	4.138			

Inflow					
Peak Flowrate	23.6 cfs	At		1.08 hrs	
Outflow					
Inf. Basin Infiltration Flowrate	1.0	cfs	285.0	ft3/5mins	
Fully Drained at	42.67	hrs			

Resulting 100 Year Outflow Hydrographs From Each Pond Is Summed In The Combined Inflow Column. These flowrates are converted into a volume: cubic feet per 5 minute interval. The inflow volume into the infiltration pond is subtracted by the infiltration ponds infiltration flowrate to determine the volume accumulated in the infiltration pond.

11 Report Maps

Existing Condition Drainage Map
Proposed Condition Drainage Map

FLOODPLAIN STATEMENT

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 08041C0305G, EFFECTIVE DECEMBER 7, 2018.

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

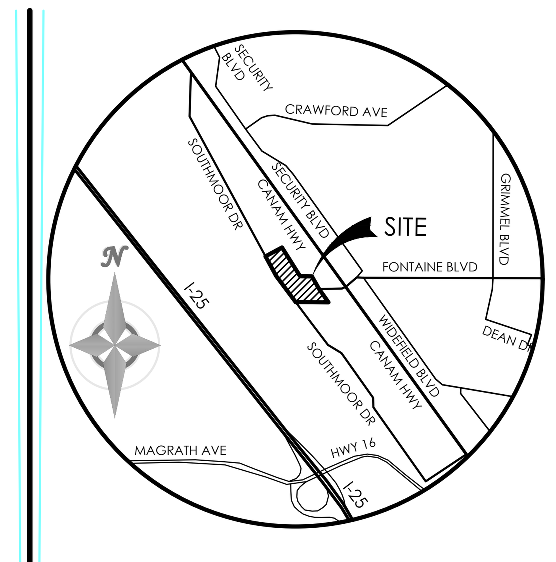
1.5% SLOPE DIRECTION AND GRADE

A1 / 1.0 AC / 50% IMP BASIN LABEL
AREA IN ACRES
PERCENT IMPERVIOUS

1 DESIGN POINT

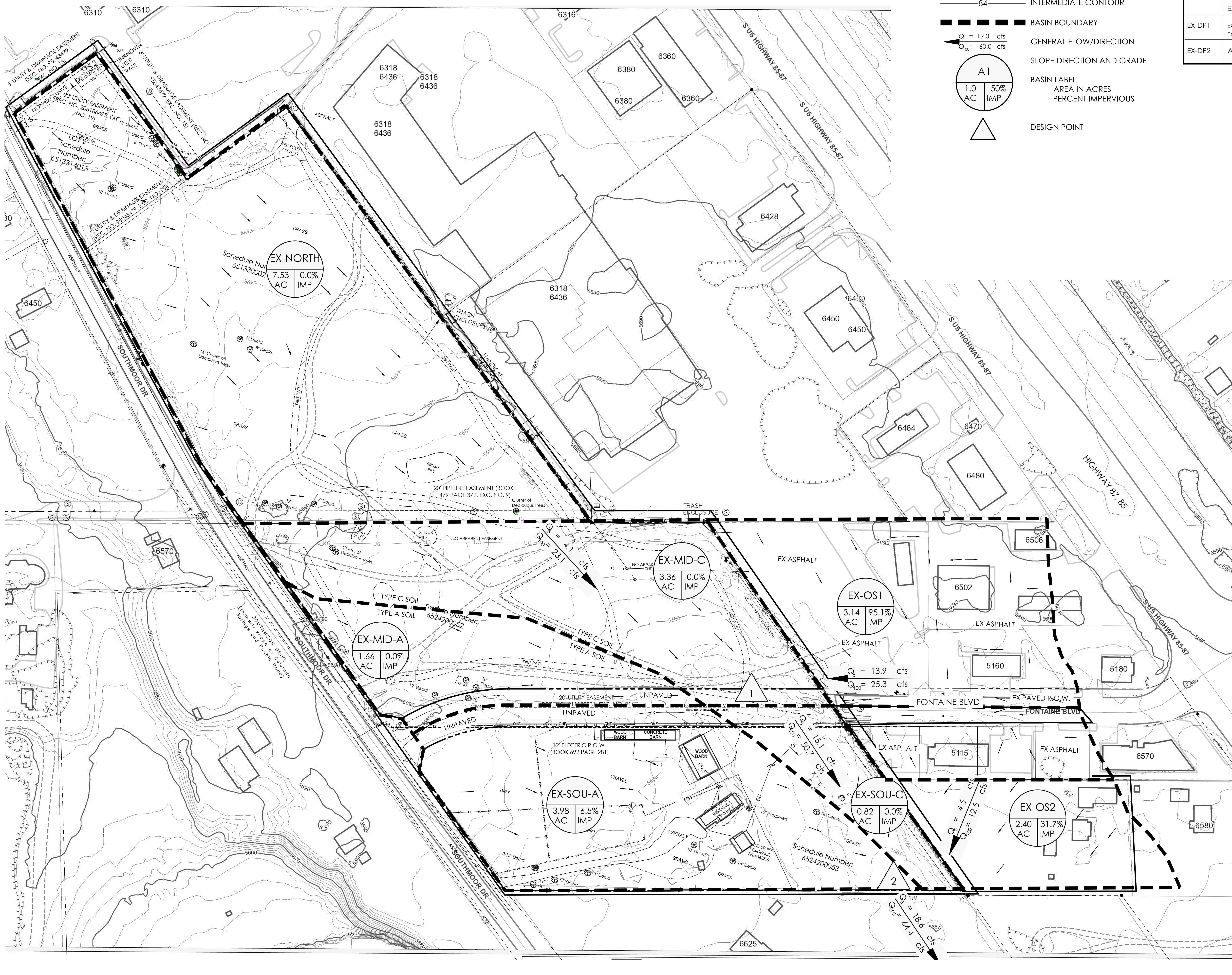
EXISTING DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	RUNOFF METHOD
	EX-OS1	3.14	5.0	13.9	25.3	RATIONAL
	EX-OS2	2.40	6.3	4.5	12.5	RATIONAL
	EX-NORTH	7.53	13.7	4.1	23.1	RATIONAL
	EX-MID A	1.66	12.6	0.5	3.7	RATIONAL
	EX-MID C	3.36	11.4	2.0	11.1	RATIONAL
	EX-SOUTH A	3.98	13.3	1.9	9.6	RATIONAL
	EX-SOUTH C	0.82	10.5	0.5	2.8	RATIONAL
EX-DP1	EX-OS1, EX-OS2, EX-MID A, EX-MID C	15.57	16.5	15.4	51.8	RATIONAL
EX-DP2	ALL SUB-BASINS	22.53	20.0	18.6	64.4	RATIONAL



VICINITY MAP
NOT TO SCALE

BENCHMARK



SCALE: 1"=80' 1:960

MVE INC.
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REVISIONS

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

SOUTHMOOR RIDGE
DRAINAGE CONCEPT

EXISTING DRAINAGE
MAP

MVE PROJECT **61186**
MVE DRAWING **EX-DRN**

FEBRUARY 15, 2024
SHEET 1 OF 1

FLOODPLAIN STATEMENT

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 08041C0305G, EFFECTIVE DECEMBER 7, 2018.

LEGEND

PROPERTY LINE
EASEMENT LINE
LOT LINE

EXISTING

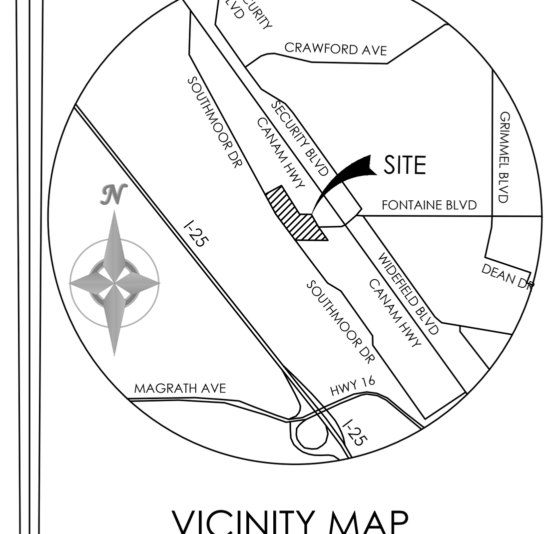
5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR

PROPOSED

5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR
BASIN BOUNDARY
Q2 = 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

PROPOSED DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
	OS1	3.14	5.0	13.9	25.3	RATIONAL
	OS2	2.40	8.3	7.6	14.8	RATIONAL
	A1	1.92	9.0	5.2	10.8	RATIONAL
	A2	1.46	6.3	4.8	9.7	RATIONAL
	A3	1.61	8.1	5.3	10.3	RATIONAL
	A4	0.46	5.0	0.6	2.3	RATIONAL
POND A (DP4)	A1-A4	5.45	9.0	14.1	30.1	RATIONAL
POND A (OUT)		5.45		1.0	5.1	
	B1	2.76	9.6	6.0	14.0	RATIONAL
	B2	0.39	5.0	0.6	2.0	RATIONAL
POND B (DP6)	B1-B2	3.15	9.6	6.0	15.0	RATIONAL
POND B (OUT)		3.15		0.1	2.6	
	C1	3.15	10.9	8.1	16.8	RATIONAL
	C2	0.44	5.9	1.9	3.4	RATIONAL
	C3	1.24	7.2	3.2	7.1	RATIONAL
	C4	1.54	8.4	1.8	6.5	RATIONAL
POND C (DP10)	C1-C4	11.91	10.9	29.9	62.6	RATIONAL
POND A (OUT)		11.91		2.8	16.1	
	D	1.44	5.9	1.2	6.1	RATIONAL
	E	0.96	18.9	0.7	2.8	RATIONAL



VICINITY MAP
NOT TO SCALE

BENCHMARK

SCALE: 1"=80' 1:960

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AS-BUILTS BY
CHECKED BY

SOUTHMOOR RIDGE
MDDP / PDR

PROPOSED DRAINAGE MAP

MVE PROJECT 61186
MVE DRAWING PP-DRN

FEBRUARY 15, 2024
SHEET 1 OF 1