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

Final Drainage Report

Graupner Subdivision Filing No. 1

Project No. 61176

December 6, 2023

PCD File No. MS237

Final Drainage Report

for

Graupner Subdivision Filing No. 1

Project No. 61176

December 6, 2023

prepared for

Garrett Graupner
14710 Tanner Trail
Elbert, CO 80921

prepared by

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

Statements and Acknowledgments

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

COLORADO LICENSED
DAVID RAYMOND GORMAN
4/25/24
31672
PROFESSIONAL ENGINEER

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

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

Garrett Graupner, Owner

2/29/2024
Date

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

Joshua Palmer
County Engineer/ECM Administrator

Date

Conditions:

Contents

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed subdivision for Graupner Subdivision Filing No. 1 at 14710 Tanner Trail, an existing rural residential lot in the town of Elbert within El Paso County, Colorado. The report presents the stormwater management issues specific to this site and discusses the aspects of the drainage design that addresses those issues. The report and included maps present results of the final hydrologic and drainage facility sizing and analyses. The report recommends that no additional drainage improvements are needed for the site and identifies drainage requirements relative to the proposed subdivision. This report has been prepared and submitted in accordance with the requirements of the El Paso County Final Plat approval process. An Appendix is included with this report with pertinent calculations and data used in the drainage analysis.

1 General Location and Description

1.1 Location

The Graupner Subdivision Filing No. 1 site is located within the South ½ of Section 32, Township 11 South, Range 64 West, of the 6th Principal Meridian, County of El Paso, Colorado. The site is situated west of Eastonville Road and north of Murphy Road. The site is made up of a single unplatted parcel having El Paso County Tax Assessor's Schedule Number: 41320-00-010. A Vicinity Map is included in the **Appendix**. This report is submitted in connection with the application for a Final Plat.

1.2 Description of Property

The Graupner Subdivision Filing No. 1 site encompasses 41.019 ± acres of land zoned currently zoned RR-5 (Rural Residential 5 acres). The parcel currently has a single-family residence, detached garage, and a barn/horse stables located within the east 1/3 of the parcel. Access for this developed area is an existing unpaved private driveway easement along the west and south property lines to be named Trust Grove. The owners intend to divide the parcel into one 25.9 acre lot for the existing buildings and three 5 acre lots, all zoned Rural Residential-5 Acres (RR-5).

This parcel is mostly undeveloped with minor grading around the existing buildings. The storm runoff from the site and the offsite basins generally drains from the northwest to southeast. There is an existing drainage channel along the north property line draining southeasterly into an existing livestock pond. The drainage channels within the property have no improvements or previous stabilization. The drainage channels onsite are well vegetated with no indication of erosion and do not require any improvements.

1.3 Soil Description

According to the National Resource Conservation Service, there are two soil types identified at the Graupner Subdivision Filing No. 1 site. Pring coarse sandy loam, 3 to 8 percent slopes (map unit 71) makes up 97% of the site and is contained in Hydrologic Soil Group B. This soil is deep and is well drained, permeability is rapid, surface runoff is medium, and the hazard of erosion is moderate.

The secondary soil group is: Columbine gravelly sandy loam, 0 to 3 percent slopes (map unit 19) which a small amount is present on the northwest portion of the site and is contained in Hydrologic

Soil Group A. This soil is shallow to deep and well drained to excessively drained, permeability is very rapid, surface runoff is slow, and the hazard of erosion is slight to moderate. 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]

The offsite sub-basins are contained within Hydrologic Soil Group B and are included in the **Appendix**.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The Graupner Subdivision Filing No. 1 site is located in the center-north portion of the Upper Black Squirrel Drainage Basin (CHBS2000). At this time, Upper Black Squirrel Drainage Basin is not addressed in a Major Drainage Basin Planning Study. El Paso County determined that Upper Black Squirrel Drainage Basin is not a drainage fee basin.

The current Flood Insurance Study of the region includes a Flood Insurance Rate Map (FIRM), effective on December 7, 2018.[3] The proposed subdivision is included in Community Panel Numbers 08041C0340G of the Flood Insurance Rate Maps for El Paso County and Incorporated Areas. No portion of the site lies within FEMA designated Special Flood Hazard Areas (SFHA's). An excerpt of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the **Appendix**.

2.2 Sub-Basin Description

The existing drainage patterns of the Graupner Subdivision Filing No. 1 site are described by eight off-site drainage sub-basins and six on-site drainage sub-basins. All offsite flows mentioned enter the site along the north property line from unplatted and platted parcels to the north and northwest. Flows within the site drain generally drain southeasterly into existing natural drainage channels found onsite and offsite. Each existing drainage basin will be described in detail in Sub-Basin Specific Details. The drainage sub-basins are shown on the included **Existing Drainage Map**.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This *Final Drainage Report for Graupner Subdivision Filing No. 1* has been prepared according to the report guidelines presented in the *El Paso County Drainage Criteria Manual* (DCM)[4]. The hydrologic analysis is based on a collection of data from the DCM, the NCSS Web Soil Survey[5], Topographic mapping by El Paso County, property boundary information and proposed site layout by Eagle Land Surveying, Inc.

3.2 Hydrologic Criteria

For this Final Drainage Report, the Rational Method as described in the *El Paso County 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. “Colorado Springs Rainfall Intensity Duration Frequency” curves, Figure 6-5 in the DCM, was used to obtain the design rainfall values; a copy is included in the **Appendix**. The “Overland (Initial) Flow Equation” (Eq. 6-8) in the DCM, and Manning's equation with estimated depths were used in time of concentration calculations. “Runoff Coefficients for Rational Method”, Table 6-6 in the DCM, was utilized as a guide in estimating runoff coefficient and Percent Impervious values; a copy is included in the **Appendix**. Peak runoff discharges were

1 WSS
2 OSD
3 FIRM
4 DCM Section 4.3 and Section 4.4
5 WSS

calculated for each drainage sub-basin for both the 5-year storm event and the 100-year storm event with the Rational Method formula, (Eq. 6-5) in the DCM.[6]

4 Drainage Facility Design

4.1 General Concept

The intent of the drainage concept presented in this Final Drainage Report is to provide adequate, safe and appropriate storm drainage, in accordance with El Paso County Drainage Criteria, within the proposed development and to the offsite discharge locations. The existing drainage conditions and the proposed drainage concept is described in more detail below. Input data and results for all calculations are included in the **Appendix**. Drainage maps of existing and proposed conditions are also included in the **Appendix**.

4.2 Sub-Basin Specific Details

4.2.1 Offsite Conditions

Offsite sub-basin OS-1/ Design Point 1 (DP1) containing 14.79 ± acres northwest of the site. This sub-basin contains several RR-5 lots with a single-family residence, detached garage, and gravel. This sub-basin features moderate slopes of 5% to > 25% sloping southeast into the roadside ditch and drains overland over Tanner Trail at Design Point 1 (DP1). This sub-basin generates peak flow discharges of Q_5 = 5.2 cfs and Q_{100} = 33.0 cfs. This runoff combines with flows from OS2 and OS3 at Design Point 3 (DP3) before entering the subject site.

Offsite sub-basin OS-2/ Design Point 2 (DP2) containing 26.84 ± acres is located northwest of the site. This sub-basin contains several RR-5 lots with a single-family residence, detached garage, and gravel. This sub-basin features moderate slopes of 5% to > 25% sloping southeast into the roadside ditch and existing 30” CMP culvert located at Design Point 2 (DP2). This sub-basin generates peak flow discharges of Q_5 = 8.1 cfs and Q_{100} = 51.7 cfs. This runoff combines with flows from OS8 at DP3 before entering the subject site.

Offsite sub-basin OS-3 containing 30.82 ± acres is located directly north of the site. This sub-basin contains several RR-5 lots with a single-family residence, detached garage, and gravel. There is also an undeveloped and unplatted parcel between the developed lots and the subject site This sub-basin features mild slopes of 3% to 15 % sloping south toward the onsite sub-basin EX-B. This sub-basin also accepts flows from OS1 and combines at Design Point 4 (DP4). This sub-basin generates peak flow discharges of Q_5 = 8.1 cfs and Q_{100} = 55.3 cfs. This runoff enters onsite sub-basin EX-B and combines at DP4.

Offsite sub-basin OS-4 containing 13.35 ± acres is located directly north of the site. This sub-basin contains a portion of two developed RR-5 lots and an undeveloped unplatted area in between the developed lots and the subject site. The developed lots contain a single-family residence, detached garage, and gravel. This sub-basin features mild slopes of 2% to 12 % sloping southeast toward the onsite sub-basin EX-A2. This sub-basin generates peak flow discharges of Q_5 = 3.5 cfs and Q_{100} = 24.0 cfs. This runoff enters onsite sub-basin EX-A2 and combines at Existing Design Point 8 (EX-DP8).

Offsite sub-basin OS-5 containing 2.04 ± acres is located at the northeast of the site. This sub-basin contains pasture/meadow. This sub-basin features mild slopes of 2% to 10% sloping southeast toward the onsite sub-basin EX-A1. This sub-basin generates peak flow discharges of Q_5 = 0.5 cfs and Q_{100} = 4.0 cfs. This runoff enters onsite sub-basin EX-A1 and combines at Existing Design Point 7 (EX-DP7).

Offsite sub-basin OS-6 containing 18.33 ± acres is located at the southwest portion of the site. This sub-basin contains 5 acre lots. This sub-basin features mild slopes of 2% to 10% with moderate slopes of 10% to 30% sloping east toward the onsite sub-basin EX-C2. This sub-basin generates

6 DCM

peak flow discharges of Q_5 = 5.5 cfs and Q_{100} = 35.2 cfs. This runoff enters onsite sub-basin EX-C2 and combines at Existing Design Point 10 (EX-DP10).

Offsite sub-basin OS-7 containing 1.31 ± acres located southwest of the site. This sub-basin contains a portion of a 5 acre lot. This sub-basin features mild slopes of 1% to 10% sloping southeasterly toward the onsite sub-basin EX-C1. This sub-basin generates peak flow discharges of Q_5 = 0.4 cfs and Q_{100} = 2.5 cfs. This runoff enters onsite sub-basin EX-C1 and combines at Existing Design Point 9 (EX-DP9).

Offsite sub-basin OS-8 containing 17.98 ± acres located northwest of the site. This sub-basin primarily contains 5 acre lots with pasture/meadow. This sub-basin features mild slopes of 1% to 10% sloping east toward the onsite sub-basin EX-B. This sub-basin generates peak flow discharges of Q_5 = 5.3 cfs and Q_{100} = 34.8 cfs. This runoff enters onsite sub-basin EX-B and combines with only additional offsite flows at Design Point 5 (DP5).

Design Point 3 (DP3) consists of OS2 and OS8 with a collective area of 44.81 ± acres. This design point is located at the northwest property corner just outside of the site. The primary surface type is 5 acre lots with the secondary type of pasture/meadow. This design point collects peak flow discharges of Q_5 = 12.0 cfs and Q_{100} = 77.5 cfs. This runoff drains into EX-B and combines with additional offsite flows at Design Point 5 (DP5) before combining with onsite flows.

Design Point 4 (DP4) consists of OS1 and OS3 with a collective area of 45.61 ± acres. This design point is located at the center north property line just outside of the site. The primary surface type is 5 acre lots with the secondary type of pasture/meadow. The design point collects peak flow discharges of Q_5 = 12.2 cfs and Q_{100} = 81.7 cfs. This runoff drains onsite and combines with additional flows at Design Point 5 (DP5) before combining with onsite flows.

Design Point 5 (DP5) consists of flows from DP3 and DP4 with a collective area of 90.42 ± acres. This design point is located within sub-basin B adjacent to the center of the north property line. The primary surface type is 5 Acre lots with the secondary type of pasture/meadow. The design point collects peak flow discharges of Q_5 = 21.4 cfs and Q_{100} = 140.4 cfs. This runoff continues onsite and combines with flows from sub-basin B at Existing and Proposed Design Point 6 (EX-DP6, DP6) at the southeast property corner.

4.2.2 Existing Onsite Conditions

Existing/proposed onsite sub-basin EX-A1 containing 3.20 ± acres located at the northeast portion of the site. This sub-basin is undeveloped pasture/meadow and is not expected to have any future development for the scope of this report. This sub-basin features mild slopes of 1% to 15% sloping toward the east property line. This sub-basin generates peak flow discharges of Q_5 = 0.8 cfs and Q_{100} = 5.6 cfs (existing/proposed flows). This runoff combines with flows from the offsite sub-basin OS5 at Existing Design Point 7 (EX-DP7).

Existing/proposed onsite sub-basin EX-A2 containing 5.43 ± acres located at the northeast portion of the site. This sub-basin is undeveloped pasture/meadow and is not expected to have any future development for the scope of this report. This sub-basin features mild slopes of 1% to 15% sloping toward the east property line. This sub-basin generates peak flow discharges of Q_5 = 1.6 cfs and Q_{100} = 11.8 cfs (existing/proposed flows). This runoff combines with flows from the offsite sub-basin OS4 at Existing Design Point 8 (EX-DP8).

Existing/proposed onsite sub-basin EX-A3 containing 2.05 ± acres located at the east portion of the site. This sub-basin is undeveloped pasture/meadow and is not expected to have any future development for the scope of this report. This sub-basin features mild slopes of 1% to 10% sloping southeast toward the property line. This sub-basin generates peak flow discharges of Q_5 = 0.6 cfs and Q_{100} = 4.5 cfs (existing/proposed flows). This runoff drains immediately offsite into the east adjacent property and eventually drains into Black Squirrel Creek.

Existing onsite sub-basin EX-B containing 12.87 ± acres located at the center of the site. This sub-basin is primarily undeveloped pasture/meadow with an existing residence, gravel, and livestock

stables. This sub-basin features mild slopes of 1% to 10% and moderate slopes of 15% to 25% found within the natural drainage channel. Runoff within this sub-basin travels southeasterly to the respective property corner. This sub-basin generates peak flow discharges of Q_5 = 3.6 cfs and Q_{100} = 22.1 cfs (existing flows). This runoff combines with additional flows from Design Point 5 at the southeast property corner and is designated as Existing Design Point 6 (EX-DP6).

Existing onsite sub-basin EX-C1 containing 15.78 ± acres located at the center of the site. This sub-basin is primarily undeveloped pasture/meadow with a single-family residence, detached garage, livestock stables, and gravel travel areas. An existing gravel road is found along the west and south property lines connecting the existing residence to Tanner Trail. The drainage path that conveys the majority of runoff within this sub-basin contains a depression found at Design Point 9 (DP9). This 3 foot depression captures this water before draining overland over the existing gravel road. This sub-basin features mild slopes of 1% to 15% and moderate slopes of 15% to 25% found along the sub-basin ridgelines. Runoff within this sub-basin travels southeasterly to the center of the south property line. This sub-basin generates peak flow discharges of Q_5 = 4.6 cfs and Q_{100} = 28.4 cfs (existing flows). This runoff combines with additional flows from Design Point 5 at the southeast property corner and is designated as Existing Design Point 6 (EX-DP9).

Existing onsite sub-basin EX-C2 containing 1.68 ± acres located at the southwest corner of the site. This sub-basin is primarily undeveloped pasture/meadow with an existing gravel road. This sub-basin features mild slopes of 1% to 15% with moderate slopes of 15% to 25% found at the center north ridgeline. This sub-basin generates peak flow discharges of Q_5 = 0.9 cfs and Q_{100} = 4.3 cfs (existing flows). Runoff within this sub-basin travels directly south to the southwest property corner and combines with flows from OS6 at Existing Design Point 10 (EX-DP10).

Existing Design Point 6 (EX-DP6) consists of OS1-3, OS8, and EX-B with a collective area of 103.29 ± acres. This design point is located at the southeast property corner of the site. The primary surface type is 5 acre lots with the secondary type of pasture/meadow. The design point collects peak flow discharges of Q_5 = 21.2 cfs and Q_{100} = 138.2 cfs (existing flows). This runoff drains offsite from the southeast property corner into the southeast-most adjacent property and eventually drains into Black Squirrel Creek.

Existing/Proposed Design Point 7 (EXDP7, DP7) consists of OS5 and EX-A1 with a collective area of 5.23 ± acres. This design point is located at the northeast property corner. The surface type for this design point is pasture/meadow as A1 is not expected to be developed. Therefore, the existing and proposed peak discharges for this design point are Q_5 = 1.3 cfs and Q_{100} = 9.3 cfs. This runoff drains into the east adjacent property with no increase in flows affecting this neighbor. This flow will continue easterly and eventually drains into Black Squirrel Creek.

Existing/Proposed Design Point 8 (EXDP8, DP8) consists of OS4 and EX-A2 with a collective area of 18.78 ± acres. This design point is located at the east property line. The primary surface type for this design point is 5 acre lots with the secondary type of Pasture/Meadow. Sub-Basin A2 is not expected to be developed and will remain as pasture/meadow. Therefore, the existing and proposed peak discharges for this design point are Q_5 = 4.4 cfs and Q_{100} = 31.3 cfs. This runoff drains into the east adjacent property with no increase in flows affecting this neighbor. This flow will continue easterly and eventually drains into Black Squirrel Creek.

Existing Design Point 9 (EX-DP9) consists of OS7 and C1 with a collective area of 17.10 ± acres. This design point is located at the center of the south property line. At DP9, the water drains into a 3' depression at the north side of the existing gravel road. This runoff eventually flows over the road and drains offsite into another shallow depression (1-2 feet) approximately 15 feet on the south side of the road. The primary surface type for this design point is pasture/meadow with the secondary type of 5 acre lots. This design point collects peak flow discharges of Q_5 = 4.3 cfs and Q_{100} = 26.3 cfs (existing flows). This flow continues easterly from the offsite pond and eventually drains into Black Squirrel Creek.

Existing Design Point 10 (EX-DP10) consists of OS6 and C2 with a collective area of 20.01 ± acres. This design point is located at the southwest property corner. The primary surface type for this design point is 5 Acre with the secondary type of pasture/meadow. This design point collects peak

flow discharges of Q_5 = 6.2 cfs and Q_{100} = 38.4 cfs (existing flows). This runoff continues easterly through the south adjacent properties and eventually drains into Black Squirrel Creek.

4.2.3 Proposed Onsite Conditions

The proposed onsite drainage patterns of the site are described by six sub-basins. The drainage paths and sub-basin shapes shall remain the same as developed conditions and are not expected to change drastically. Calculations for proposed development for the site included a calculation for 5 acre lots with an imperviousness of 7%. This 7% imperviousness includes development for a single-family residence, small paved driveway, and gravel vehicle travel areas. The sub-basins that are not expected to have any development are A1 – A3 as vehicle access to this portion of the site is not feasible at this time. Therefore, the mentioned sub-basins will remain as pasture/meadow conditions with 0% imperviousness and are addressed in the Existing Onsite Conditions.

Drainage easements will be applied to any on-site streams with 15 cfs or greater. The drainage sub-basins and proposed drainage easements are shown on the included **Proposed Drainage Map**.

Proposed onsite sub-basin B containing 12.87 ± acres is located at the center of the site. This sub-basin is primarily undeveloped pasture/meadow with an existing residence, gravel, and livestock stables. This sub-basin features mild slopes of 1% to 10% and moderate slopes of 15% to 25% found within the natural drainage channel. Runoff within this sub-basin travels southeasterly to the respective property corner. For sub-basin B, the existing peak flows are Q_5 = 3.6 cfs and Q_{100} = 22.1 cfs and proposed peak flows of Q_5 = 3.6 cfs and Q_{100} = 23.2 cfs. The negligible flow increases in the developed condition for sub-basin B are <0.1 cfs for the 5-year storm and 1.1 cfs for the 100-year storm. This increase will not affect the adjacent neighbors to the east/southeast. Runoff from this sub-basin combines with offsite flows from DP5 at Design Point 6 (DP6) located at the southeast property corner.

Proposed onsite sub-basin C1 containing 15.78 ± acres is located at the center of the site. This sub-basin is primarily undeveloped pasture/meadow with a single-family residence, detached garage, livestock stables, and gravel traveling areas. An existing gravel road is found along the west and south property lines connecting the residence to Tanner Trail. This sub-basin features mild slopes of 1% to 15% and moderate slopes of 15% to 25% found along the sub-basin ridgelines. Runoff within this sub-basin travels southeasterly to the center of the south property line. For sub-basin C1, the existing peak flows are Q_5 = 4.6 cfs and Q_{100} = 28.4 cfs and proposed peak flows of Q_5 = 4.7 cfs and Q_{100} = 29.7 cfs. The negligible flow increases in the developed condition for sub-basin B are 0.1 cfs for the 5-year storm and 1.3 cfs for the 100-year storm. This increase will not affect the adjacent neighbors to the south. Runoff from this sub-basin combines with offsite flows OS7 at Design Point 9 (DP9) located at the center of the south property line.

Proposed onsite sub-basin C2 containing 1.68 ± acres located at the southwest corner of the site. This sub-basin is primarily undeveloped pasture/meadow with an existing gravel road. In proposed conditions, the 5 Acre surface type will be applied to this sub-basin which will account for the existing gravel road and to include residential development found adjacent north of said road. This sub-basin features mild slopes of 1% to 15% with moderate slopes of 15% to 25% found at the center north ridgeline. Runoff within this sub-basin travels directly south to the south property line. For sub-basin C2, the existing peak flows are Q_5 = 0.9 cfs and Q_{100} = 4.3 cfs and proposed peak flows of Q_5 = 1.1 cfs and Q_{100} = 4.6 cfs. The negligible flow increases in the developed condition for sub-basin C2 are 0.2 cfs for the 5-year storm and 0.3 cfs for the 100-year storm. This increase will not affect the adjacent neighbors to the south. This runoff combines with flows from OS6 at Design Point 10 (DP10) located at the southwest property corner.

Proposed Design Point 6 (DP6) consists of OS1-3, OS8, and B with a collective area of 103.29 ± acres. This design point is located at the southeast property corner of the site. The primary surface type is 5 acre lots with the secondary type of Pasture/Meadow. Design Point 6 has an existing peak discharge of Q_5 = 21.2 cfs and Q_{100} = 138.2 cfs and proposed peak flows of Q_5 = 21.3 cfs and Q_{100} = 139.0 cfs. The negligible flow increases in the developed condition for DP6 are 0.1 cfs for the 5-year storm and 0.8 cfs for the 100-year storm. Velocities of the developed flows are less than 4 ft/s and continue in a stable natural drainage path. This increase will not affect the

adjacent neighbors to the south. This runoff drains offsite from the southeast property corner into the southeast-most adjacent property and eventually drains into Black Squirrel Creek.

Proposed Design Point 7 (DP7) consists of OS5 and A1 with a collective area of 5.23 ± acres. This design point is located at the northeast property corner. The surface type for this design point is pasture/meadow as A1 is not expected to be developed. Therefore, the existing and proposed peak discharges for this design point are of Q_5 = 1.3 cfs and Q_{100} = 9.3 cfs. This runoff drains into the east adjacent property in the existing natural flow path with no increase in flows affecting this neighbor. This flow will continue easterly and eventually drains into Black Squirrel Creek.

Proposed Design Point 8 (DP8) consists of OS4 and A2 with a collective area of 18.78 ± acres. This design point is located at the east property line. The primary surface type for this design point is pasture/meadow with the secondary type of 5 acre lots. Sub-Basin A2 is not expected to be developed and will remain as pasture/meadow. Therefore, the existing and proposed peak discharges for this design point are of Q_5 = 4.4 cfs and Q_{100} = 31.3 cfs. This runoff drains into the east adjacent property in the existing natural flow path with no increase in flows affecting this neighbor. This flow will continue easterly and eventually drains into Black Squirrel Creek.

Proposed Design Point 9 (DP9) consists of OS7 and C1 with a collective area of 17.10 ± acres. This design point is located at the center of the south property line. The surface type for this design point is 5 acre lots. This sub-basin will contain the majority of the proposed development along with the existing gravel road. Design Point 9 has an existing peak discharge of Q_5 = 4.3 cfs and Q_{100} = 26.3 cfs and proposed peak discharge of Q_5 = 4.3 cfs and Q_{100} = 27.4 cfs. The negligible flow increases in the developed condition for DP6 are <0.1 cfs for the 5-year storm and 1.1 cfs for the 100-year storm. Velocities of the developed flows are less than 2 ft/s and continue in a stable natural drainage path. This increase will not affect the adjacent neighbors to the south. This runoff continues easterly through the south adjacent properties and eventually drains into Black Squirrel Creek.

Proposed Design Point 10 (DP10) consists of OS6 and C2 with a collective area of 20.01 ± acres. This design point is located at the southwest property corner. The surface type for this design point is 5 acre lots. This sub-basin contains the majority of the proposed development along with the existing gravel road. Design Point 10 has an existing peak discharge of Q_5 = 6.2 cfs and Q_{100} = 38.4 cfs and proposed peak discharge of Q_5 = 6.3 cfs and Q_{100} = 38.6 cfs. The negligible flow increases in the developed condition for DP6 are 0.1 cfs for the 5-year storm and 0.2 cfs for the 100-year storm. This increase will not affect the adjacent neighbors to the south. This runoff continues easterly through the south adjacent properties and eventually drains into Black Squirrel Creek.

4.3 Water Quality Enhancement Best Management Practices

The El Paso County Engineering Criteria Manual (Appendix I, Section I.7.2) requires the consideration of a “Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long term source controls”. The Four Step Process is incorporated in this project and the elements are discussed below.

The entire site is consists of 5-acre single family residential lots which are excluded from Post Construction Stormwater Management requirements by ECM 1.7.1.B.5 due to the low development density as 5-acre lots. There are no public or private roadways being dedicated or constructed as part of this project. The proposed lots shall be served with driveways. The site is not subject to Post Construction Stormwater Treatment requirements.

1) Runoff Reduction Practices are employed in this project. Impervious surfaces have been reduced as much as practically possible. There is only minimal concrete or other hard surfaces proposed. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because the majority of runoff passes through an open space meadow area before leaving the site.

2) There are no drainage paths on the site that are required to be stabilized as they are well vegetated with no visual erosion. The drainage paths have shallow side slopes of >10:1 with 1-3'

fescue grass within the channels. Flows exiting the site in these existing stable drainage paths remain stable and require no protection or mitigation.

3) The project contains no potentially hazardous uses. The site is exempted from the use of WQCV BMPs by ECM 1.7.1.B.5 by virtue of the large lot rural residential nature of the site having percent imperiousness of less than 10%.

4) The rural residential lot is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No site specific or other source control BMPs are required.

5 Drainage Fees

The Graupner Subdivision Filing No. 1 site is located within the Upper Black Squirrel Drainage Basin which is not a fee basin. Therefore, no drainage fees are required at this time.

6 Conclusion

This Final Drainage Report presents existing and proposed drainage conditions for the proposed Graupner Subdivision Filing No. 1 project. The development will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream. The site is exempted from the use of WQCV BMPs by ECM 1.7.1.B.5 by virtue of the large lot rural residential nature of the site having percent imperviousness of less than 10%. The entire site is consists of 5-acre single family residential lots which are excluded from Post Construction Stormwater Management requirements due to the low development density as 5-acre lots. The site is not subject to Post Construction Stormwater Treatment requirements. The combined flows from the site are expected to increase by less than 1% during the 100 yr storm event. With such a negligible increase in stormwater flows from the site detention will not be necessary for the proposed development and will not be provided. The proposed project will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream properties.

References

NRCS Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed October 2016).

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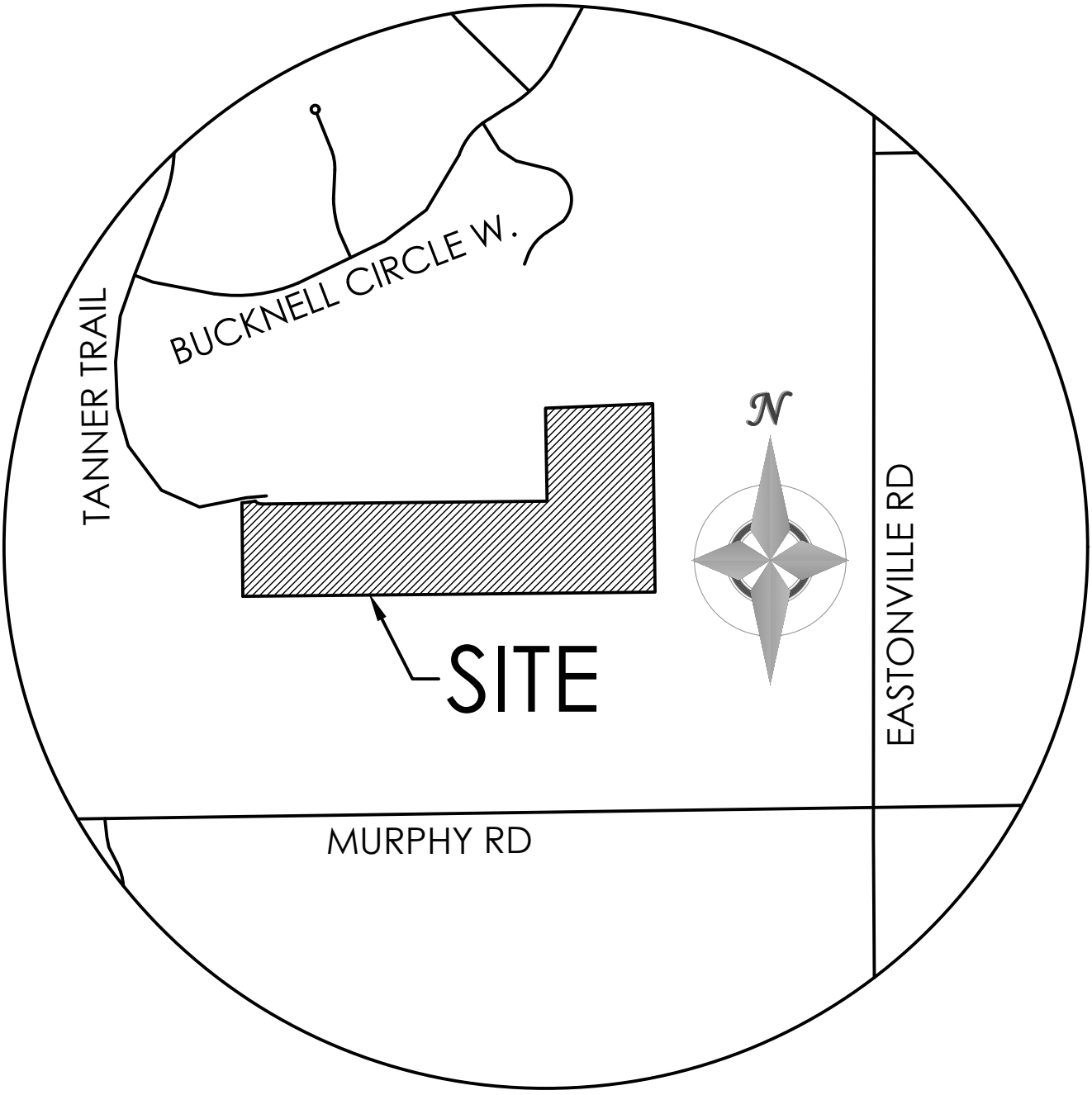
Appendices

1 General Maps and Supporting Data

Vicinity Map
Portion of Flood Insurance Rate Map
Soil Type map and Tables
Official Soil Series Descriptions
Hydrologic Soil Group Map and Tables



VICINITY MAP

NOT TO SCALE

National Flood Hazard Layer FIRMette

FEMA

104°35'7"W 39°3'2"N

104°34'30"W 39°2'35"N

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

1:6,000

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

Legend

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

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

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

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

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

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 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

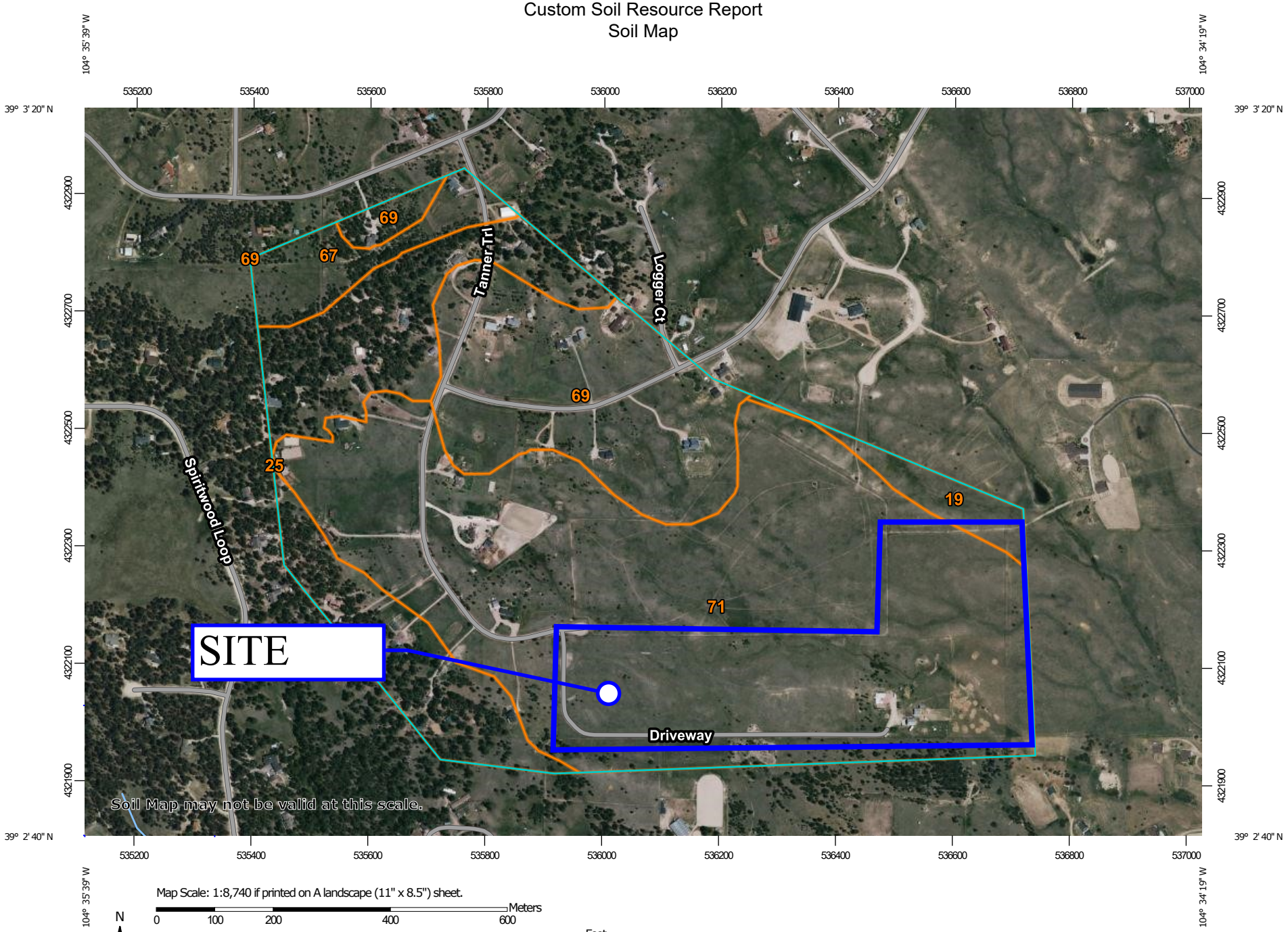
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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 4/11/2023 at 10:45 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



Map Scale: 1:8,740 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

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: Jun 9, 2021—Jun 12, 2021

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	5.4	2.4%
25	Elbeth sandy loam, 3 to 8 percent slopes	38.8	17.1%
67	Peyton sandy loam, 5 to 9 percent slopes	9.5	4.2%
69	Peyton-Pring complex, 8 to 15 percent slopes	40.3	17.8%
71	Pring coarse sandy loam, 3 to 8 percent slopes	132.7	58.5%
Totals for Area of Interest		**226.7**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 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

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Fans, fan terraces, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 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: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

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

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

25—Elbeth sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 367x
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Elbeth and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elbeth

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose

Typical profile

A - 0 to 3 inches: sandy loam
E - 3 to 23 inches: loamy sand
Bt - 23 to 68 inches: sandy clay loam
C - 68 to 74 inches: sandy clay loam

Properties and qualities

Slope: 3 to 8 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): Moderately high (0.20 to 0.60 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: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Minor Components

Other soils
Percent of map unit:
Hydric soil rating: No

67—Peyton sandy loam, 5 to 9 percent slopes

Map Unit Setting
National map unit symbol: 369d
Elevation: 6,800 to 7,600 feet
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 115 to 125 days
Farmland classification: Not prime farmland

Map Unit Composition
Peyton and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting
Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile
A - 0 to 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy loam
C - 35 to 60 inches: sandy loam

Properties and qualities
Slope: 5 to 9 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): Moderately high (0.20 to 0.60 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: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

69—Peyton-Pring complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 369g
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent
Pring and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy clay loam
C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 8 to 9 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): Moderately high (0.20 to 0.60 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: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 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): 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 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 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): 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 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Minor Components

Pleasant

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

Other soils

Percent of map unit:
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group

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

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

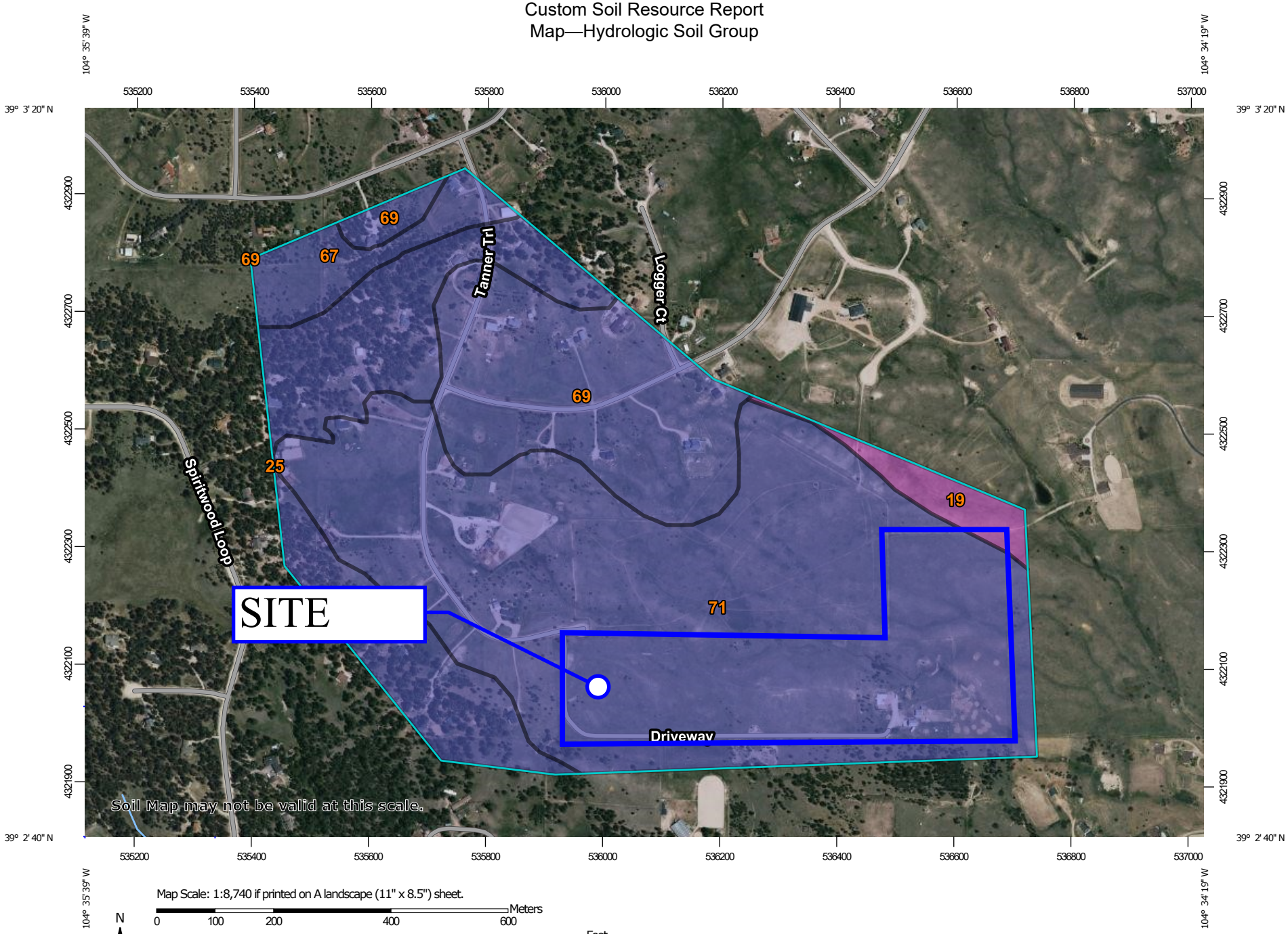
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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

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

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

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



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N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

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

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Survey Area Data: Version 20, Sep 2, 2022

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Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
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69	Peyton-Pring complex, 8 to 15 percent slopes	B	40.3	17.8%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	132.7	58.5%
Totals for Area of Interest			**226.7**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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gravelly subsoil is exposed during site preparation. Access roads must be designed to control surface runoff and help stabilize cut slopes. The Midway soil has poor potential for homesites and roads because of shallow depth to shale, high frost-action potential, and high shrink-swell potential. Special designs are necessary to overcome these limitations. Capability subclass VIIe.

19—Columbine gravelly sandy loam, 0 to 3 percent slopes. This deep, well drained to excessively drained soil formed in coarse textured material on alluvial terraces and fans and on flood plains. 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 gravelly sandy loam about 14 inches thick. The underlying material is light yellowish brown very gravelly loamy sand.

Included with this soil in mapping are small areas of Stapleton sandy loam, 3 to 8 percent slopes; Blendon sandy loam, 0 to 3 percent slopes; Louviers silty clay loam, 3 to 18 percent slopes; and Fluvaquentic Haplaquolls, nearly level. In places the parent arkose beds of sandstone or shale are at a depth of 0 to 40 inches.

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

This soil is used mainly for grazing livestock and for wildlife habitat. It is also used for homesites.

Native vegetation is mainly western wheatgrass, side-oats grama, needleandthread, and little bluestem. The main shrub is true mountainmahogany.

Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal limitations to the establishment of trees and shrubs. The soil is so loose that trees need to be planted in the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

Rangeland wildlife, such as pronghorn antelope, cottontail, coyote, and scaled quail, is best adapted to life on this droughty soil. Forage production is typically loam, and proper livestock grazing management is necessary if wildlife and livestock share the range. Livestock watering developments are also important and are used by various wildlife species.

The main limitation of this soil for urban development is a hazard of flooding in some areas. Care must be taken when locating septic tank absorption fields because of possible pollution as a result of the very rapid permeability of this soil. Capability subclass VIe.

20—Connerton-Rock outcrop complex, 8 to 90 percent slopes. This moderately sloping to extremely steep complex is in the Garden of the Gods area, west of Colorado Springs. Elevation ranges from 6,200 to 6,500 feet. The average annual precipitation is about 16 inches, and the average annual air temperature is about 47 degrees F.

The Connerton soil makes up about 45 percent of the complex and has slopes of 8 to 30 percent, Rock outcrop makes up about 40 percent, and other soils about 15 percent.

Included with this complex in mapping are areas of Neville fine sandy loam, 3 to 9 percent slopes; Penrose-Manvel complex, 3 to 45 percent slopes; and Fortwingate-Rock outcrop complex, 15 to 60 percent slopes. Also included are small areas of soils that contain more sand than is typical for the series.

The Connerton soil is deep and well drained. It formed in alluvium derived from reddish sandstone on moderately sloping alluvial fans and valley side slopes. Typically, the surface layer is reddish brown loam about 13 inches thick. The substratum is reddish brown sandy clay loam.

Permeability of the Connerton soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium to rapid, and the hazard of erosion is moderate. A few gullies are in areas of this soil, especially along paths and trails and in drainageways.

Rock outcrop is in long, narrow bands in the form of cliffs or as monoliths and monuments. It consists of red to gray sandstone and limestone.

This complex is used for recreation, wildlife habitat, homesites, and limited livestock grazing.

Native vegetation is mainly western wheatgrass, needlegrasses, big bluestem, side-oats grama, blue grama, and native bluegrasses.

If the range has deteriorated, blue grama, junegrass, and native bluegrasses increase. Sleepygrass and annuals replace these grasses if the range has seriously deteriorated. 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.

This complex is suited to the production of juniper and pinyon pine. It is capable of producing 4 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The limitations for the production of wood crops are the presence of stones on the surface and a high hazard of erosion. Stones on the surface can influence felling, yarding, and other operations involving the use of equipment. Special care must be taken to minimize erosion when harvesting timber.

This complex is relatively unproductive for vegetation, especially in times of drought, when annual production may be as low as 300 pounds per acre. Rangeland wildlife, such as antelope and scaled quail, can be encouraged by properly managing livestock grazing, installing livestock watering facilities, and reseeding range where needed.

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.

These soils are 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.

These soils have a good potential for homesites. The main limitations, especially on the Peyton soil, are low bearing strength and frost-action potential. Buildings and roads can be designed to overcome these limitations. Access roads should have adequate cut-slope grade and be provided with drains to control surface runoff and keep soil losses to a minimum. Capability subclass VIe.

69—Peyton-Pring complex, 8 to 15 percent slopes. These gently to moderately sloping soils are on valley side slopes and on uplands. Elevation ranges from 6,800 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

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

Included with these soils in mapping are areas of Holderness loam, 8 to 15 percent slopes; Tomah-Crowfoot loamy sands, 8 to 15 percent slopes; Kettle gravelly loamy sand, 8 to 40 percent slopes; and a few areas of Rock outcrop.

The Peyton soil is commonly on the less sloping part of the landscape. It is deep, noncalcareous, and well drained. It formed in alluvium and residuum derived from weathered, arkosic, sedimentary rock. Typically, the surface layer is grayish brown sandy loam about 12 inches thick. The subsoil, about 23 inches thick, is pale brown sandy clay loam in the upper 13 inches and pale brown sandy loam in the lower 10 inches. The substratum is pale brown sandy loam to a depth of 60 inches or more.

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

The Pring soil is deep, noncalcareous, and well drained. It formed in sandy sediment derived from weathered, arkosic, sedimentary rock. Typically, the surface layer is dark grayish brown coarse sandy loam about 4 inches thick. The substratum is dark grayish brown coarse sandy loam about 10 inches thick over pale brown gravelly sandy loam that extends to a depth of 60 inches or more.

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

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

These soils are well suited to the production of native vegetation suitable for grazing. The dominant native species are mountain muhly, bluestem grasses, needleandthread, and blue grama. These soils are subject to invasion of Kentucky bluegrass and Gambel oak. Common forbs are hairy goldenrod, geranium, milkvetch, low larkspur, fringed sage, and buckwheat.

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

Windbreaks and environmental plantings generally are suited to these soils. Soil blowing is the main limitation to 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.

These soils are well suited to wildlife habitat. They are 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.

These soils have good potential for use as homesites. The main limitations are steepness of slope, limited ability to support a load, and frost-action potential. Buildings and roads can be designed to overcome these limitations. These soils also require special site or building designs because of the slope. Access roads should have adequate cut-slope grade, and drains should be provided to control surface runoff and keep soil losses to a minimum. Capability subclass VIe.

70—Pits, gravel. Gravel pits are in nearly level to rolling areas. They are open excavations several feet deep and commonly 5 acres or less in size.

Gravel pits are very low in natural fertility and are highly susceptible to soil blowing. A cover of weeds or straw helps to control erosion.

Windbreaks and environmental plantings generally are not suited to these areas. Onsite investigation is needed to determine if plantings are feasible. Capability subclass VIIIs.

71—Pring coarse sandy loam, 3 to 8 percent slopes. This deep, noncalcareous, well drained soil formed in sandy sediment derived from arkosic sedimentary rock on valley side slopes and on uplands. Elevation ranges from 6,800 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is dark grayish brown coarse sandy loam about 4 inches thick. The substratum is dark grayish brown coarse sandy loam about 10 inches thick over pale brown gravelly sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Alamosa loam, 1 to 3 percent slopes, along drainageways; Cruckton sandy loam, 1 to 9 percent slopes; Peyton sandy loam, 1 to 5 percent slopes; Peyton sandy loam, 5 to 9 percent slopes; and Tomah-Crowfoot loamy sands, 3 to 8 percent slopes. In some places arkose beds of sandstone and shale are at a depth of 0 to 40 inches.

Permeability of this Pring 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.

Almost all areas of this soil are used as rangeland. Some areas previously cultivated have been reseeded to grass. This soil is also used for wildlife habitat and homesites.

This soil is well suited to the production of native vegetation suitable for grazing by cattle and sheep. Rangeland vegetation is mainly mountain muhly, little bluestem, needleandthread, Parry oatgrass, and junegrass.

Deferment of grazing in spring helps to maintain vigor and production of the cool-season bunchgrasses. Fencing and properly locating livestock watering facilities help to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. The hazard of soil blowing is the main limitation to 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.

This soil is well suited for use as homesites. Erosion control practices are needed to control soil blowing and water erosion on construction sites where the ground cover has been removed. Capability subclass IVe.

72—Pring coarse sandy loam, 8 to 15 percent slopes. This deep, noncalcareous, well drained soil formed in sandy sediment derived from arkosic sedimentary rock on valley side slopes and on uplands. Elevation ranges from 6,800 to 7,600 feet. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is dark grayish brown coarse sandy loam about 4 inches thick. The substratum is dark grayish brown coarse sandy loam about 10 inches thick over pale brown gravelly sandy loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Cruckton sandy loam, 1 to 9 percent slopes; Peyton sandy loam, 5 to 9 percent slopes; and Tomah-Crowfoot loamy sands, 8 to 15 percent slopes. Arkose beds of sandstone and shale are at a depth of 0 to 40 inches in some places.

Permeability of this Pring 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. Some gullies have developed along drainageways.

Almost all areas of this soil are used as rangeland. Some areas previously cultivated have been reseeded to grass. This soil is also used for wildlife habitat and as homesites.

This soil is well suited to the production of native vegetation suitable for grazing by cattle and sheep. The native vegetation is mainly mountain muhly, little bluestem, needleandthread, Parry oatgrass, and junegrass.

Deferment of grazing in spring helps to maintain the vigor and production of the cool-season bunchgrasses. Fencing and properly locating livestock watering facilities help to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. The hazard of soil blowing is the main limitation to 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 habitat. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for urban uses. The main limitation is slope. Special site or building designs are needed because of the slope. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Capability subclass VIe.

73—Razor clay loam, 3 to 9 percent slopes. This moderately deep, well drained, clayey soil formed in residuum derived from calcareous shale on uplands. Elevation ranges from 5,300 to 6,100 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 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.

Included with this soil in mapping are small areas of Midway clay loam, 3 to 25 percent slopes; Heldt clay loam, 0 to 3 percent slopes; and Stoneham sandy loam, 3 to 8 percent slopes.

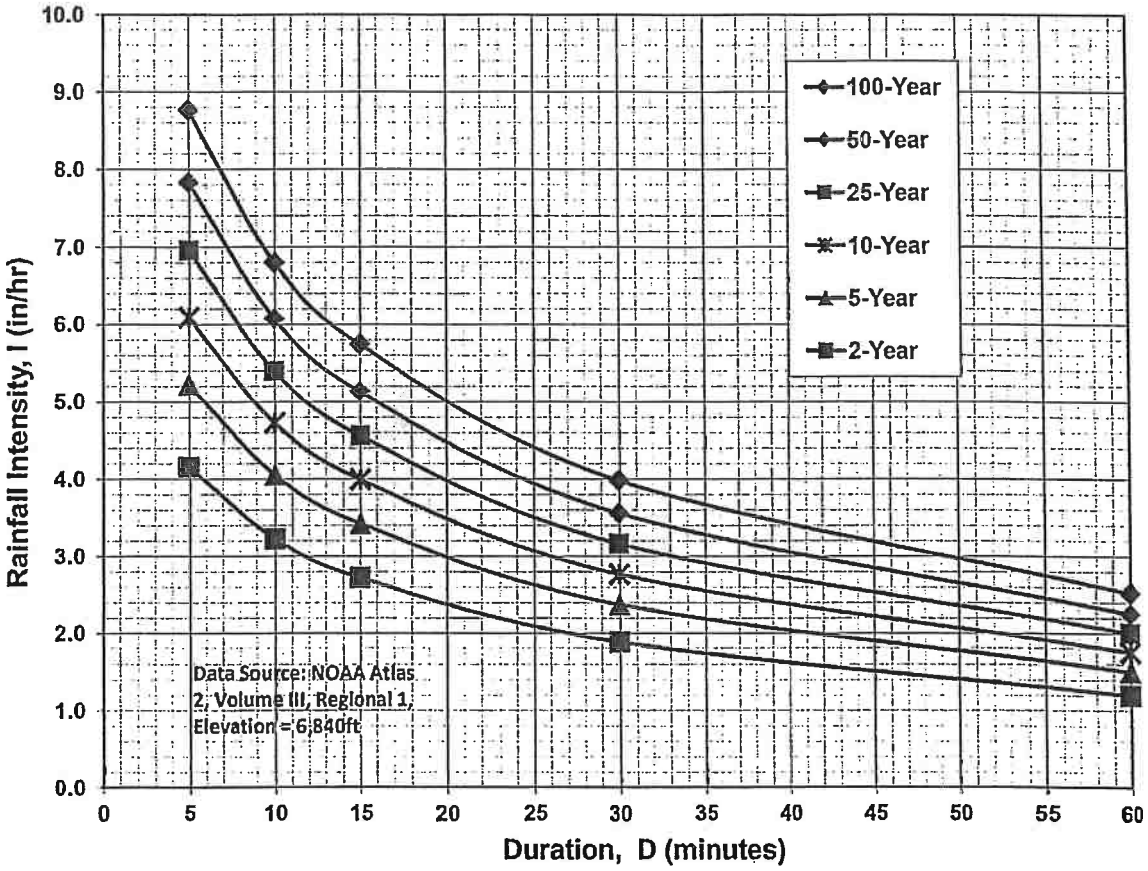
2 Hydrologic Calculations

City of Colorado Springs DCM Runoff Coefficients – Table 6-6
Colorado Springs DCM Rainfall Intensity Duration Frequency – Figure 6-5
Sub-Basin Time of Concentration – Form SF-1
5-yr Sub-Basin and Combined Flows – Form SF-2
100-yr Sub-Basin and Combined Flows – Form SF-2

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

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

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

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

Job No.: **61176** Date: **7/27/2023 10:38**

Project: **Graupner Subdivision** Calcs By: **JO**

Checked By:

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

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		t_c
	Area (Acres)	C_5	C_{100}/CN	% Imp.	L_0 (ft)	S_0 (%)	t_i (min)	L_{0t} (ft)	S_{0t} (ft/ft)	v_{0sc} (ft/s)	t_t (min)	L_{0c} (ft)	S_{0c} (ft/ft)	v_{0c} (ft/s)	t_c (min)	L (min)	$t_{c,alt}$ (min)	(min)
OFFSITE SUB-BASINS																		
OS1	14.79	0.10	0.38	7%	121.7	13%	8.5	630.5	0.078	2.0	5.4	394	0.036	5.0	1.3	1146	N/A	15.22
OS2	26.84	0.10	0.38	7%	136.8	4%	13.0	673.2	0.105	2.3	4.9	1208	0.055	6.5	3.1	2018	N/A	20.98
OS3	30.82	0.09	0.36	3%	139.4	13%	9.3	717.9	0.049	1.5	7.7	1555	0.026	5.0	5.2	2412	N/A	22.18
OS4	13.35	0.09	0.36	2%	90.24	7%	9.3	805.9	0.065	1.8	7.6	1063	0.021	3.7	4.7	1959	N/A	21.59
OS5	2.04	0.08	0.35	0%	246.5	5%	17.2	0	0.000	0.0	0.0	0	0.000	0.0	0.0	246.5	N/A	17.15
OS6	18.33	0.10	0.38	7%	172.9	11%	10.8	568.9	0.060	1.7	5.5	1205	0.022	4.2	4.7	1947	N/A	21.04
OS7	1.31	0.10	0.38	7%	228.1	2%	21.0	92.94	0.032	1.3	1.2	0	0.000	0.0	0.0	321	N/A	22.28
OS8	17.98	0.09	0.37	5%	173.2	7%	12.6	200.8	0.040	1.4	2.4	1317	0.027	4.5	4.9	1691	N/A	19.87
EXISTING ONSITE																		
EX-A1	3.20	0.08	0.35	0%	112	2%	16.1	314	0.025	1.1	4.7	66	0.030	3.0	0.4	492	N/A	21.15
EX-A2	5.43	0.08	0.35	0%	97.93	7%	9.5	95.53	0.042	1.4	1.1	514.7	0.019	3.1	2.8	708.2	N/A	13.44
EX-A3	2.05	0.08	0.35	0%	90.76	7%	9.4	240	0.025	1.1	3.6	0	0.000	0.0	0.0	330.8	N/A	13.02
EX-B	12.87	0.10	0.36	3%	138	9%	10.4	209.7	0.015	0.9	4.0	1259	0.026	2.2	9.6	1606	N/A	24.01
EX-C1	15.78	0.10	0.36	3%	141.2	4%	13.3	428.9	0.026	1.1	6.4	557.7	0.023	4.1	2.3	1128	N/A	21.97
EX-C2	1.68	0.15	0.39	10%	114	7%	9.7	123.4	0.016	0.9	2.3	0	0.000	0.0	0.0	237.4	N/A	11.98
PROPOSED ONSITE																		
A1	3.20	0.08	0.35	0%	112	2%	16.1	314	0.025	1.1	4.7	66	0.030	3.0	0.4	492	N/A	21.15
A2	5.43	0.08	0.35	0%	97.93	7%	9.5	95.53	0.042	1.4	1.1	514.7	0.019	3.1	2.8	708.2	N/A	13.44
A3	2.05	0.08	0.35	0%	90.76	7%	9.4	240	0.025	1.1	3.6	0	0.000	0.0	0.0	330.8	N/A	13.02
B	12.87	0.10	0.38	7%	138	9%	10.4	209.7	0.015	0.9	4.0	1259	0.026	2.2	9.4	1606	N/A	23.88
C1	15.78	0.10	0.38	7%	141.2	4%	13.3	428.9	0.026	1.1	6.4	557.7	0.023	4.1	2.3	1128	N/A	21.94
C2	1.68	0.10	0.38	7%	114	7%	10.1	123.4	0.016	0.9	2.3	0	0.000	0.0	0.0	237.4	N/A	12.44

Job No.: **61176**
Project: **Graupner Subdivision**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **7/27/2023 10:38**
Calcs By: **JO**
Checked By:

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

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C5	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
OFFSITE SUB-BASINS																						
DP1	OS1	14.79	0.10	15.2	1.48	3.50	5.2															
DP2	OS2	26.84	0.10	21.0	2.68	3.02	8.1															
	OS3	30.82	0.09	22.2	2.76	2.93	8.1															
	OS4	13.35	0.09	21.6	1.16	2.97	3.5															
	OS5	2.04	0.08	17.2	0.16	3.32	0.5															
	OS6	18.33	0.10	21.0	1.83	3.01	5.5															
	OS7	1.31	0.10	22.3	0.13	2.93	0.4															
DP3	OS2, OS8	44.81	0.10					25.3	4.39	2.73	12.0											
DP4	OS1, OS3	45.61	0.09					22.8	4.24	2.89	12.2											
DP5	OS1-3, OS8	90.42	0.10					30.0	8.62	2.48	21.4											
EXISTING ONSITE																						
	EX-A1	3.20	0.08	21.1	0.26	3.01	0.8															
	EX-A2	5.43	0.08	13.4	0.43	3.69	1.6															
	EX-A3	2.05	0.08	13.0	0.16	3.73	0.6															
	EX-B	12.87	0.10	24.0	1.26	2.82	3.6															
	EX-C1	15.78	0.10	22.0	1.56	2.95	4.6															
	EX-C2	1.68	0.15	12.0	0.24	3.86	0.9															
EX-DP6	DP5, EX-B	103.29	0.10					37.5	9.89	2.14	21.2											
EX-DP7	OS5, EX-A1	5.23	0.08					20.8	0.42	3.03	1.3											
EX-DP8	OS4, EX-A2	18.78	0.09					24.6	1.60	2.78	4.4											
EX-DP9	OS7, EX-C1	17.10	0.10					29.4	1.70	2.51	4.3											
EX-DP10	OS6, EX-C2	20.01	0.10					21.3	2.08	3.00	6.2											
PROPOSED ONSITE																						
	A1	3.20	0.08	21.1	0.26	3.01	0.8															
	A2	5.43	0.08	13.4	0.43	3.69	1.6															
	A3	2.05	0.08	13.0	0.16	3.73	0.6															
	B	12.87	0.10	23.9	1.29	2.82	3.6															
	C1	15.78	0.10	21.9	1.58	2.95	4.7															
	C2	1.68	0.10	12.4	0.17	3.80	0.6															
DP6	DP5, B	103.29	0.10					37.5	9.91	2.14	21.3											
DP7	OS5, A1	5.23	0.08					20.8	0.42	3.03	1.3											
DP8	OS4, A2	18.78	0.09					24.6	1.60	2.78	4.4											
DP9	OS7, C1	17.10	0.10					29.4	1.71	2.51	4.3											
DP10	OS6, C2	20.01	0.10					21.3	2.00	3.00	6.0											

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

Job No.: **61176**
Project: **Graupner Subdivision**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **DCM**

Date: **7/27/2023 10:38**
Calcs By: **JO**
Checked By:

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

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	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)
OFFSITE SUB-BASINS																						
DP1	OS1	14.79	0.38	15.2	5.62	5.87	33.0															
DP2	OS2	26.84	0.38	21.0	10.20	5.07	51.7															
	OS3	30.82	0.36	22.2	11.22	4.93	55.3															
	OS4	13.35	0.36	21.6	4.82	4.99	24.0															
	OS5	2.04	0.35	17.2	0.71	5.57	4.0															
	OS6	18.33	0.38	21.0	6.96	5.06	35.2															
	OS7	1.31	0.38	22.3	0.50	4.91	2.5															
DP3	OS2, OS8	44.81	0.38					25.3	16.89	4.59	77.5											
DP4	OS1, OS3	45.61	0.37					22.8	16.84	4.85	81.7											
DP5	OS1-3, OS8	90.42	0.37					30.0	33.73	4.16	140.4											
EXISTING ONSITE																						
	EX-A1	3.20	0.35	21.1	1.12	5.05	5.6															
	EX-A2	5.43	0.35	13.4	1.90	6.19	11.8															
	EX-A3	2.05	0.35	13.0	0.72	6.27	4.5															
	EX-B	12.87	0.36	24.0	4.67	4.73	22.1															
	EX-C1	15.78	0.36	22.0	5.73	4.95	28.4															
	EX-C2	1.68	0.39	12.0	0.66	6.48	4.3															
EX-DP6	DP5, EX-B	103.29	0.37					37.5	38.40	3.60	138.2											
EX-DP7	OS5, EX-A1	5.23	0.35					20.8	1.83	5.09	9.3											
EX-DP8	OS4, EX-A2	18.78	0.36					24.6	6.72	4.66	31.3											
EX-DP9	OS7, EX-C1	17.10	0.36					29.4	6.23	4.21	26.3											
EX-DP10	OS6, EX-C2	20.01	0.38					21.3	7.63	5.03	38.4											
PROPOSED ONSITE																						
	A1	3.20	0.35	21.1	1.12	5.05	5.6															
	A2	5.43	0.35	13.4	1.90	6.19	11.8															
	A3	2.05	0.35	13.0	0.72	6.27	4.5															
	B	12.87	0.38	23.9	4.89	4.74	23.2															
	C1	15.78	0.38	21.9	6.00	4.95	29.7															
	C2	1.68	0.38	12.4	0.64	6.38	4.1															
DP6	DP5, B	103.29	0.37					37.5	38.62	3.60	139.0											
DP7	OS5, A1	5.23	0.35					20.8	1.83	5.09	9.3											
DP8	OS4, A2	18.78	0.36					24.6	6.72	4.66	31.3											
DP9	OS7, C1	17.10	0.38					29.4	6.50	4.21	27.4											
DP10	OS6, C2	20.01	0.38					21.3	7.60	5.03	38.3											

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

Offsite Sub-Basin OS1/Design Point 1 Runoff Calculations (DP1)

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	644,215	14.79	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**644,215**	**14.79**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	644215								

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	1,146	79	0.069	-	-	-	
Initial Time	122	16	0.131	-	8.5	N/A	DCM Eq. 6-8
Shallow Channel	631	49	0.078	2.0	5.4	-	DCM Eq. 6-9
Channelized	394	14	0.036	5.0	1.3	-	V-Ditch
				t_c	**15.2**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.80	3.50	4.08	4.67	5.25	5.87
Runoff (cfs)	2.5	**5.2**	12.1	20.0	26.4	**33.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.5	**5.2**	12.1	20.0	26.4	**33.0**

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

Offsite Sub-Basin OS2/Design Point 2 Runoff Calculations (DP2)

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	1,168,999	26.84	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**1,168,999**	**26.84**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	1168999								

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	2,018	144	0.071	-	-	-	
Initial Time	137	6	0.044	-	13.0	N/A	DCM Eq. 6-8
Shallow Channel	673	71	0.105	2.3	4.9	-	DCM Eq. 6-9
Channelized	1,208	67	0.055	6.5	3.1	-	V-Ditch
				t_c	**21.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.41	3.02	3.52	4.02	4.53	5.07
Runoff (cfs)	3.9	**8.1**	18.9	31.3	41.3	**51.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	3.9	**8.1**	18.9	31.3	41.3	**51.7**

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

Offsite Sub-Basin OS-3 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	709,080	16.28	0.02	0.08	0.15	0.25	0.3	0.35	0%
5 Acre	633,487	14.54	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**1,342,567**	**30.82**	**0.04**	**0.09**	**0.17**	**0.27**	**0.32**	**0.36**	**3.3%**
	1342567								

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	2,412	93	0.039	-	-	-	
Initial Time	139	18	0.129	-	9.3	N/A	DCM Eq. 6-8
Shallow Channel	718	35	0.049	1.5	7.7	-	DCM Eq. 6-9
Channelized	1,555	40	0.026	5.0	5.2	-	V-Ditch
				t_c	**22.2 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.35	2.93	3.42	3.91	4.40	4.93
Runoff (cfs)	2.8	**8.1**	18.3	32.4	43.3	**55.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.8	**8.1**	18.3	32.4	43.3	**55.3**
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

Offsite Sub-Basin OS4 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	374,635	8.60	0.02	0.08	0.15	0.25	0.3	0.35	0%
5 Acre	206,934	4.75	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**581,569**	**13.35**	**0.03**	**0.09**	**0.17**	**0.26**	**0.31**	**0.36**	**2.5%**
	581569								

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	1,959	80	0.041	-	-	-	
Initial Time	90	6	0.066	-	9.3	N/A	DCM Eq. 6-8
Shallow Channel	806	52	0.065	1.8	7.6	-	DCM Eq. 6-9
Channelized	1,063	22	0.021	3.7	4.7	-	V-Ditch
				t_c	**21.6**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.38	2.97	3.47	3.97	4.46	4.99
Runoff (cfs)	1.1	**3.5**	7.8	14.0	18.7	**24.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.1	**3.5**	7.8	14.0	18.7	**24.0**

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

Offsite Sub-Basin OS5 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	88,761	2.04	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**88,761**	**2.04**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	88761								

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	247	12	0.049	-	-	-	
Initial Time	247	12	0.049	-	17.2	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**17.2**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.65	3.32	3.87	4.43	4.98	5.57
Runoff (cfs)	0.1	**0.5**	1.2	2.3	3.0	**4.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.5**	1.2	2.3	3.0	**4.0**

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

Offsite Sub-Basin OS6 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	798,281	18.33	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**798,281**	**18.33**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	798281								

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	1,947	80	0.041	-	-	-	
Initial Time	173	19	0.110	-	10.8	N/A	DCM Eq. 6-8
Shallow Channel	569	34	0.060	1.7	5.5	-	DCM Eq. 6-9
Channelized	1,205	27	0.022	4.2	4.7	-	V-Ditch
				t_c	**21.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.41	3.01	3.52	4.02	4.52	5.06
Runoff (cfs)	2.6	**5.5**	12.9	21.4	28.2	**35.2**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.6	**5.5**	12.9	21.4	28.2	**35.2**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Offsite Sub-Basin OS7 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	57,261	1.31	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**57,261**	**1.31**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	57261								

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	321	8	0.025	-	-	-	
Initial Time	228	5	0.022	-	21.0	N/A	DCM Eq. 6-8
Shallow Channel	93	3	0.032	1.3	1.2	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**22.3**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.34	2.93	3.42	3.90	4.39	4.91
Runoff (cfs)	0.2	**0.4**	0.9	1.5	2.0	**2.5**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**0.4**	0.9	1.5	2.0	**2.5**

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

Offsite Sub-Basin OS8 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	580,715	13.33	0.06	0.1	0.2	0.29	0.34	0.38	7%
Pasture/Meadow	202,395	4.65	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**783,110**	**17.98**	**0.05**	**0.09**	**0.19**	**0.28**	**0.33**	**0.37**	**5.2%**
	783110								

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	1,691	55	0.033	-	-	-	
Initial Time	173	12	0.069	-	12.6	N/A	DCM Eq. 6-8
Shallow Channel	201	8	0.040	1.4	2.4	-	DCM Eq. 6-9
Channelized	1,317	35	0.027	4.5	4.9	-	V-Ditch
				t_c	**19.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.48	3.10	3.62	4.13	4.65	5.20
Runoff (cfs)	2.2	**5.3**	12.2	20.8	27.6	**34.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.2	**5.3**	12.2	20.8	27.6	**34.8**
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

Offsite Design Point 3 Combined Sub-Basin Runoff Calculations (DP3)

Includes Basins OS2 OS8

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	1,749,714	40.17	0.06	0.1	0.2	0.29	0.34	0.38	7%
Pasture/Meadow	202,395	4.65	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,952,108**	**44.81**	**0.06**	**0.10**	**0.19**	**0.29**	**0.34**	**0.38**	**6.3%**

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	OS2	-	2,018	144	-	-	-	-	21.0
Channelized-1	V-Ditch	2	1,474	45	52	0	2	5.6	4.4
Channelized-2									
Channelized-3									
Total			3,492	189					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **25.3**

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

Contributing Basins/Areas

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

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

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.19	2.73	3.19	3.65	4.10	4.59
Site Runoff (cfs)	5.48	**12.00**	27.86	46.71	61.75	**77.52**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**12.0**	-	-	-	**77.5**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

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

Offsite Design Point 4 Combined Sub-Basin Runoff Calculations (DP4)

Includes Basins OS1 OS3

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	1,277,702	29.33	0.06	0.1	0.2	0.29	0.34	0.38	7%
Pasture/Meadow	709,080	16.28	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,986,782**	**45.61**	**0.05**	**0.09**	**0.18**	**0.28**	**0.33**	**0.37**	**4.5%**

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	OS1	-	1,146	79	-	-	-	-	15.2
Channelized-1	V-Ditch	2	2,398	82	33	0	2	5.3	7.6
Channelized-2									
Channelized-3									
Total			3,544	161					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **22.8**

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)	2.31	2.89	3.37	3.86	4.34	4.85
Site Runoff (cfs)	4.82	**12.25**	28.03	48.49	64.44	**81.75**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**12.2**	-	-	-	**81.7**

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.

Offsite Design Point 5 Combined Sub-Basin Runoff Calculations (DP5)

Includes Basins OS1 OS2 OS3 OS8

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	3,027,416	69.50	0.06	0.1	0.2	0.29	0.34	0.38	7%
Pasture/Meadow	911,475	20.92	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**3,938,890**	**90.42**	**0.05**	**0.10**	**0.19**	**0.28**	**0.33**	**0.37**	**5.4%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS2	-	2,018	144	-	-	-	-	21.0
Channelized-1	V-Ditch	2	1,474	45	52	0	2	5.6	4.4
Channelized-2	V-Ditch	3	815	21	52	0	2	2.9	4.7
Channelized-3									
Total			4,307	210					

2 = Natural, Winding, minimal vegetation/shallow grass

3 = Natural, Winding, significant vegetation

t_c (min) **30.0**

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)	1.99	2.48	2.89	3.31	3.72	4.16
Site Runoff (cfs)	9.12	**21.39**	49.31	83.97	111.29	**140.42**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**21.4**	-	-	-	**140.4**
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.

Existing Sub-Basin EX-A1 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	139,260	3.20	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**139,260**	**3.20**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	139260								

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	492	12	-	-	-	-	
Initial Time	112	2	0.018	-	16.1	N/A	DCM Eq. 6-8
Shallow Channel	314	8	0.025	1.1	4.7	-	DCM Eq. 6-9
Channelized	66	2	0.030	3.0	0.4	-	V-Ditch
				t_c	**21.1**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.40	3.01	3.51	4.01	4.51	5.05
Runoff (cfs)	0.2	**0.8**	1.7	3.2	4.3	**5.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**0.8**	1.7	3.2	4.3	**5.6**

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 EX-A2 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	236,608	5.43	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**236,608**	**5.43**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	236608								

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	708	21	-	-	-	-	
Initial Time	98	7	0.071	-	9.5	N/A	DCM Eq. 6-8
Shallow Channel	96	4	0.042	1.4	1.1	-	DCM Eq. 6-9
Channelized	515	10	0.019	3.1	2.8	-	V-Ditch
				t_c	**13.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.94	3.69	4.30	4.91	5.53	6.19
Runoff (cfs)	0.3	**1.6**	3.5	6.7	9.0	**11.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**1.6**	3.5	6.7	9.0	**11.8**
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 Sub-Basin EX-A3 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	89,481	2.05	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**89,481**	**2.05**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	89481								

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	331	12	-	-	-	-	
Initial Time	91	6	0.066	-	9.4	N/A	DCM Eq. 6-8
Shallow Channel	240	6	0.025	1.1	3.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**13.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.98	3.73	4.36	4.98	5.60	6.27
Runoff (cfs)	0.1	**0.6**	1.3	2.6	3.5	**4.5**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.6**	1.3	2.6	3.5	**4.5**

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

Existing Sub-Basin EX-B Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	543,434	12.48	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	10,200	0.23	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	6,950	0.16	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**560,584**	**12.87**	**0.04**	**0.10**	**0.17**	**0.26**	**0.31**	**0.36**	**2.6%**
	560584								

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	1,606	48	-	-	-	-	
Initial Time	138	12	0.087	-	10.4	N/A	DCM Eq. 6-8
Shallow Channel	210	3	0.015	0.9	4.0	-	DCM Eq. 6-9
Channelized	1,259	33	0.026	2.2	9.6	-	V-Ditch
				t_c	**24.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.25	2.82	3.28	3.75	4.22	4.73
Runoff (cfs)	1.1	**3.6**	7.1	12.8	17.1	**22.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.1	**3.6**	7.1	12.8	17.1	**22.1**
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 EX-C1 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	662,715	15.21	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	22,000	0.51	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	2,100	0.05	0.71	0.73	0.75	0.78	0.8	0.81	90%
Paved	700	0.02	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**687,515**	**15.78**	**0.04**	**0.10**	**0.17**	**0.27**	**0.31**	**0.36**	**2.9%**

687515

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	1,128	30	-	-	-	-	
Initial Time	141	6	0.043	-	13.3	N/A	DCM Eq. 6-8
Shallow Channel	429	11	0.026	1.1	6.4	-	DCM Eq. 6-9
Channelized	558	13	0.023	4.1	2.3	-	V-Ditch
				t_c	**22.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.36	2.95	3.44	3.93	4.42	4.95
Runoff (cfs)	1.5	**4.6**	9.1	16.5	21.9	**28.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.5	**4.6**	9.1	16.5	21.9	**28.4**

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

Existing Sub-Basin EX-C2 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	63,901	1.47	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	9,375	0.22	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**73,276**	**1.68**	**0.09**	**0.15**	**0.21**	**0.30**	**0.35**	**0.39**	**10.2%**
	73276								

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	237	10	-	-	-	-	
Initial Time	114	8	0.070	-	9.7	N/A	DCM Eq. 6-8
Shallow Channel	123	2	0.016	0.9	2.3	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**12.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.08	3.86	4.50	5.14	5.79	6.48
Runoff (cfs)	0.5	**0.9**	1.6	2.6	3.4	**4.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.5	**0.9**	1.6	2.6	3.4	**4.3**
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 Design Point 6 Combined Sub-Basin Runoff Calculations (EX-DP6)

Includes Basins OS1 OS2 OS3 OS8 EX-B

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	3,027,416	69.50	0.06	0.1	0.2	0.29	0.34	0.38	7%
Pasture/Meadow	1,454,908	33.40	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	10,200	0.23	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	6,950	0.16	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**4,499,474**	**103.29**	**0.05**	**0.10**	**0.19**	**0.28**	**0.33**	**0.37**	**5.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS2	-	2,018	144	-	-	-	-	21.0
Channelized-1	V-Ditch	2	1,474	45	52	0	2	5.6	4.4
Channelized-2	V-Ditch	2	855	21	52	0	2	5.2	2.7
Channelized-3	V-Ditch	3	1,458	27	52	0	2	2.6	9.5
Total			5,804	237					

2 = Natural, Winding, minimal vegetation/shallow grass,
2 = Natural, Winding, minimal vegetation/shallow grass
3 = Natural, Winding, significant vegetation

t_c (min) **37.5**

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)	1.72	2.14	2.50	2.86	3.22	3.60
Site Runoff (cfs)	8.77	**21.20**	48.01	82.34	109.22	**138.19**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**21.2**	-	-	-	**138.2**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

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

Existing Design Point 7 Combined Sub-Basin Runoff Calculations (EX-DP7)

Includes Basins OS5 EX-A1

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	228,021	5.23	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**228,021**	**5.23**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS5	-	247	12	-	-	-	-	17.2
Channelized-1	V-Ditch	2	654	21	4	0	2	3.0	3.6
Channelized-2									
Channelized-3									
Total			901	33					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **20.8**

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)	2.43	3.03	3.54	4.05	4.55	5.09
Site Runoff (cfs)	0.25	**1.27**	2.78	5.29	7.15	**9.33**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**1.3**	-	-	-	**9.3**

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

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

Notes

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

Existing Design Point 8 Combined Sub-Basin Runoff Calculations (EX-DP8)

Includes Basins OS4 EX-A2

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	611,243	14.03	0.02	0.08	0.15	0.25	0.3	0.35	0%
5 Acre	206,934	4.75	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**818,177**	**18.78**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**1.8%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS4	-	1,959	80	-	-	-	-	21.6
Channelized-1	V-Ditch	2	760	17	24	0	2	4.1	3.1
Channelized-2									
Channelized-3									
Total			2,719	97					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **24.6**

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)	2.22	2.78	3.24	3.70	4.17	4.66
Site Runoff (cfs)	1.26	**4.44**	9.90	18.09	24.26	**31.30**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**4.4**	-	-	-	**31.3**

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

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

Notes

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

Existing Design Point 9 Combined Sub-Basin Runoff Calculations (EX-DP9)

Includes Basins OS7 EX-C1

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	662,715	15.21	0.02	0.08	0.15	0.25	0.3	0.35	0%
5 Acre	57,261	1.31	0.06	0.1	0.2	0.29	0.34	0.38	7%
Gravel	22,000	0.51	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	2,100	0.05	0.71	0.73	0.75	0.78	0.8	0.81	90%
Paved	700	0.02	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**744,775**	**17.10**	**0.04**	**0.10**	**0.17**	**0.27**	**0.32**	**0.36**	**3.2%**

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	OS7	-	321	8	-	-	-	-	22.3
Channelized-1	V-Ditch	2	1,055	27	2	0	2	2.5	7.1
Channelized-2									
Channelized-3									
Total			1,376	35					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **29.4**

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)	2.01	2.51	2.93	3.35	3.77	4.21
Site Runoff (cfs)	1.45	**4.26**	8.54	15.30	20.37	**26.26**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**4.3**	-	-	-	**26.3**

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

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

Notes

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

Existing Design Point 10 Combined Sub-Basin Runoff Calculations (EX-DP10)

Includes Basins OS6 EX-C2

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	798,281	18.33	0.06	0.1	0.2	0.29	0.34	0.38	7%
Pasture/Meadow	63,901	1.47	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	9,375	0.22	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**871,557**	**20.01**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.3%**

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	OS6	-	1,947	80	-	-	-	-	21.0
Channelized-1	V-Ditch	2	75	3	35	0	2	5.7	0.2
Channelized-2									
Channelized-3									
Total			2,022	83					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **21.3**

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

Contributing Basins/Areas

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

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

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.40	3.00	3.50	4.00	4.50	5.03
Site Runoff (cfs)	3.00	**6.23**	14.06	23.28	30.66	**38.38**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**6.2**	-	-	-	**38.4**

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.

Proposed Sub-Basin A1 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	139,260	3.20	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**139,260**	**3.20**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	139260								

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	492	12	-	-	-	-	
Initial Time	112	2	0.018	-	16.1	N/A	DCM Eq. 6-8
Shallow Channel	314	8	0.025	1.1	4.7	-	DCM Eq. 6-9
Channelized	66	2	0.030	3.0	0.4	-	V-Ditch
				t_c	**21.1**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.40	3.01	3.51	4.01	4.51	5.05
Runoff (cfs)	0.2	**0.8**	1.7	3.2	4.3	**5.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**0.8**	1.7	3.2	4.3	**5.6**

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

Proposed Sub-Basin A2 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	236,608	5.43	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**236,608**	**5.43**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	236608								

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	708	21	-	-	-	-	
Initial Time	98	7	0.071	-	9.5	N/A	DCM Eq. 6-8
Shallow Channel	96	4	0.042	1.4	1.1	-	DCM Eq. 6-9
Channelized	515	10	0.019	3.1	2.8	-	V-Ditch
				t_c	**13.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.94	3.69	4.30	4.91	5.53	6.19
Runoff (cfs)	0.3	**1.6**	3.5	6.7	9.0	**11.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**1.6**	3.5	6.7	9.0	**11.8**
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

Proposed Sub-Basin A3 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	89,481	2.05	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**89,481**	**2.05**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	89481								

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	331	12	-	-	-	-	
Initial Time	91	6	0.066	-	9.4	N/A	DCM Eq. 6-8
Shallow Channel	240	6	0.025	1.1	3.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**13.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.98	3.73	4.36	4.98	5.60	6.27
Runoff (cfs)	0.1	**0.6**	1.3	2.6	3.5	**4.5**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.6**	1.3	2.6	3.5	**4.5**

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

Proposed Sub-Basin B Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	560,584	12.87	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**560,584**	**12.87**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	560584								

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	1,606	48	-	-	-	-	
Initial Time	138	12	0.087	-	10.4	N/A	DCM Eq. 6-8
Shallow Channel	210	3	0.015	0.9	4.0	-	DCM Eq. 6-9
Channelized	1,259	33	0.026	2.2	9.4	-	V-Ditch
				t_c	**23.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.26	2.82	3.29	3.77	4.24	4.74
Runoff (cfs)	1.7	**3.6**	8.5	14.1	18.5	**23.2**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.7	**3.6**	8.5	14.1	18.5	**23.2**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Proposed Sub-Basin C1 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	687,515	15.78	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**687,515**	**15.78**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	687515								

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	1,128	30	-	-	-	-	
Initial Time	141	6	0.043	-	13.3	N/A	DCM Eq. 6-8
Shallow Channel	429	11	0.026	1.1	6.4	-	DCM Eq. 6-9
Channelized	558	13	0.023	4.1	2.3	-	V-Ditch
				t_c	**21.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.36	2.95	3.44	3.93	4.43	4.95
Runoff (cfs)	2.2	**4.7**	10.9	18.0	23.8	**29.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.2	**4.7**	10.9	18.0	23.8	**29.7**
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

Proposed Sub-Basin C2 Runoff Calculations

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	73,276	1.68	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**73,276**	**1.68**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**
	73276								

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	237	10	-	-	-	-	
Initial Time	114	8	0.070	-	10.1	N/A	DCM Eq. 6-8
Shallow Channel	123	2	0.016	0.9	2.3	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**12.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.03	3.80	4.44	5.07	5.70	6.38
Runoff (cfs)	0.3	**0.6**	1.5	2.5	3.3	**4.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**0.6**	1.5	2.5	3.3	**4.1**

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

Proposed Design Point 6 Combined Sub-Basin Runoff Calculations (DP6)

Includes Basins OS1 OS2 OS3 OS8 B

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	3,588,000	82.37	0.06	0.1	0.2	0.29	0.34	0.38	7%
Pasture/Meadow	911,475	20.92	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**4,499,474**	**103.29**	**0.05**	**0.10**	**0.19**	**0.28**	**0.33**	**0.37**	**5.6%**

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	OS2	-	2,018	144	-	-	-	-	21.0
Channelized-1	V-Ditch	2	1,474	45	52	0	2	5.6	4.4
Channelized-2	V-Ditch	2	855	21	52	0	2	5.2	2.7
Channelized-3	V-Ditch	3	1,458	27	52	0	2	2.6	9.5
Total			5,804	237					

2 = Natural, Winding, minimal vegetation/shallow grass,
2 = Natural, Winding, minimal vegetation/shallow grass
3 = Natural, Winding, significant vegetation

t_c (min) **37.5**

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)	1.72	2.14	2.50	2.86	3.22	3.60
Site Runoff (cfs)	9.22	**21.25**	49.07	83.27	110.30	**138.99**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**21.3**	-	-	-	**139.0**
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.

Proposed Design Point 7 Combined Sub-Basin Runoff Calculations (DP7)

Includes Basins OS5 A1

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	228,021	5.23	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**228,021**	**5.23**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS5	-	247	12	-	-	-	-	17.2
Channelized-1	V-Ditch	2	654	21	4	0	2	3.0	3.6
Channelized-2									
Channelized-3									
Total			901	33					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **20.8**

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)	2.43	3.03	3.54	4.05	4.55	5.09
Site Runoff (cfs)	0.25	**1.27**	2.78	5.29	7.15	**9.33**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**1.3**	-	-	-	**9.3**

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

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

Notes

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

Proposed Design Point 8 Combined Sub-Basin Runoff Calculations (DP8)

Includes Basins OS4 A2

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	611,243	14.03	0.02	0.08	0.15	0.25	0.3	0.35	0%
5 Acre	206,934	4.75	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**818,177**	**18.78**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**1.8%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS4	-	1,959	80	-	-	-	-	21.6
Channelized-1	V-Ditch	2	760	17	24	0	2	4.1	3.1
Channelized-2									
Channelized-3									
Total			2,719	97					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **24.6**

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)	2.22	2.78	3.24	3.70	4.17	4.66
Site Runoff (cfs)	1.26	**4.44**	9.90	18.09	24.26	**31.30**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**4.4**	-	-	-	**31.3**

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

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

Notes

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

Proposed Design Point 9 Combined Sub-Basin Runoff Calculations (DP9)

Includes Basins OS7 C1

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	744,775	17.10	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**744,775**	**17.10**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS7	-	321	8	-	-	-	-	22.3
Channelized-1	V-Ditch	2	1,055	27	2	0	2	2.5	7.1
Channelized-2									
Channelized-3									
Total			1,376	35					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **29.4**

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)	2.01	2.51	2.93	3.35	3.77	4.21
Site Runoff (cfs)	2.06	**4.29**	10.02	16.60	21.89	**27.37**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**4.3**	-	-	-	**27.4**

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.

Proposed Design Point 10 Combined Sub-Basin Runoff Calculations (DP10)

Includes Basins OS6 C2

Job No.:	**61176**	Date:	**7/27/2023 10:38**
Project:	**Graupner Subdivision**	Calcs by:	**JO**
		Checked by:	
Jurisdiction	**6**	Soil Type	**B**
Runoff Coefficient	**Surface Type**	Urbanization	**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
5 Acre	871,557	20.01	0.06	0.1	0.2	0.29	0.34	0.38	7%
Combined	**871,557**	**20.01**	**0.06**	**0.10**	**0.20**	**0.29**	**0.34**	**0.38**	**7.0%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	OS6	-	1,947	80	-	-	-	-	21.0
Channelized-1	V-Ditch	2	75	3	35	0	2	5.7	0.2
Channelized-2									
Channelized-3									
Total			2,022	83					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **21.3**

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

Contributing Basins/Areas

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

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

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.40	3.00	3.50	4.00	4.50	5.03
Site Runoff (cfs)	2.88	**6.00**	14.00	23.19	30.59	**38.26**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**6.0**	-	-	-	**38.3**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

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

3 Hydraulic Calculations

Proposed Drainage Channels Hydraulic Calculations

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 26 2023

Sub-Basin A2: 0+00 to 7+31

User-defined

Invert Elev (ft)	= 7246.00
Slope (%)	= 0.98
N-Value	= 0.035

Calculations

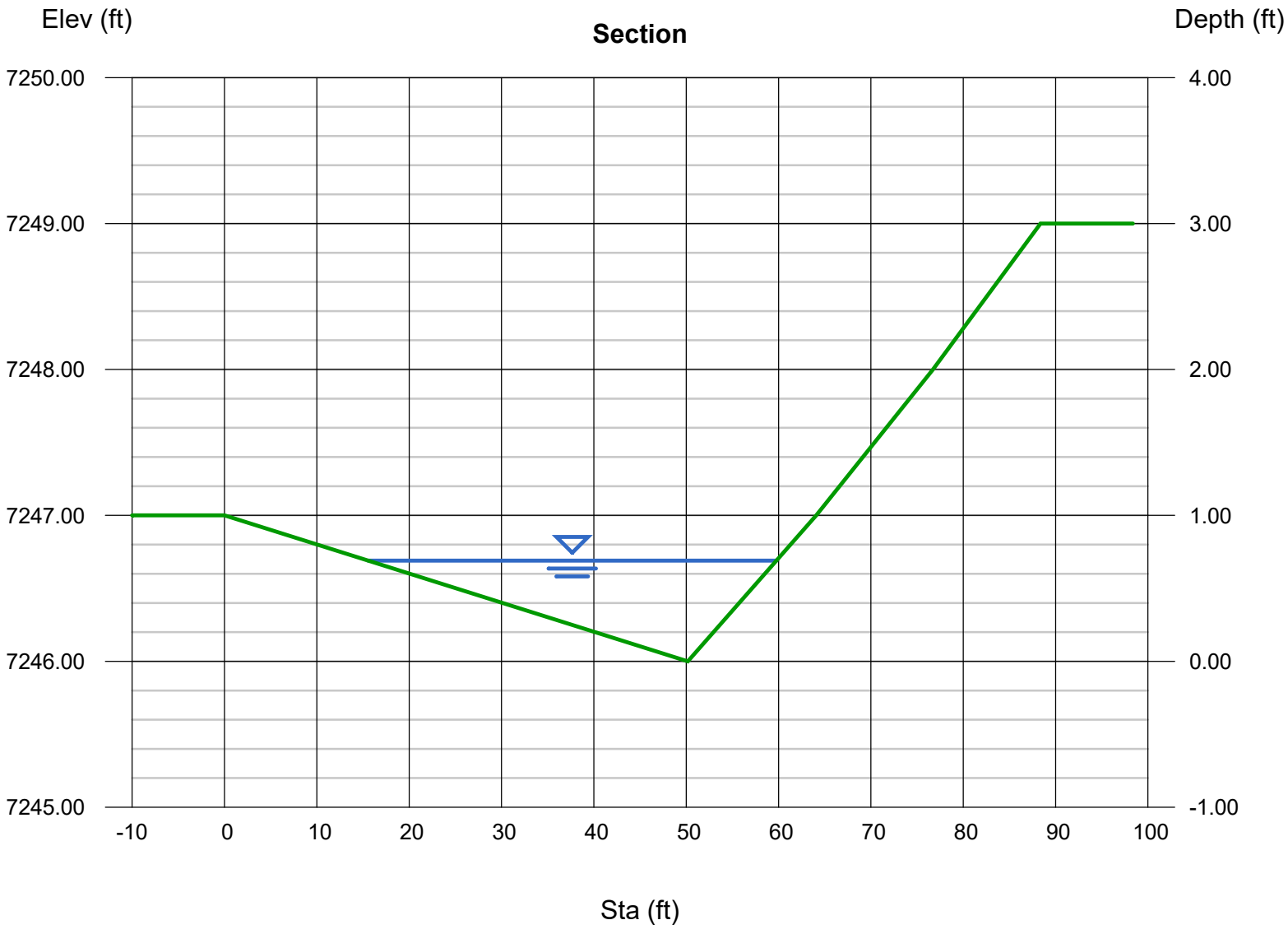
Compute by:	Known Q
Known Q (cfs)	= 31.34

Highlighted

Depth (ft)	= 0.69
Q (cfs)	= 31.34
Area (sqft)	= 15.25
Velocity (ft/s)	= 2.05
Wetted Perim (ft)	= 44.24
Crit Depth, Yc (ft)	= 0.57
Top Width (ft)	= 44.21
EGL (ft)	= 0.76

(Sta, El, n)-(Sta, El, n)...

(0.00, 7247.00)-(50.18, 7246.00, 0.035)-(64.08, 7247.00, 0.035)-(76.72, 7248.00, 0.035)-(88.37, 7249.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 26 2023

Sub-basin B Drainage Channel - 0+00 to 4+10

User-defined

Invert Elev (ft)	= 7272.00
Slope (%)	= 2.67
N-Value	= 0.035

Calculations

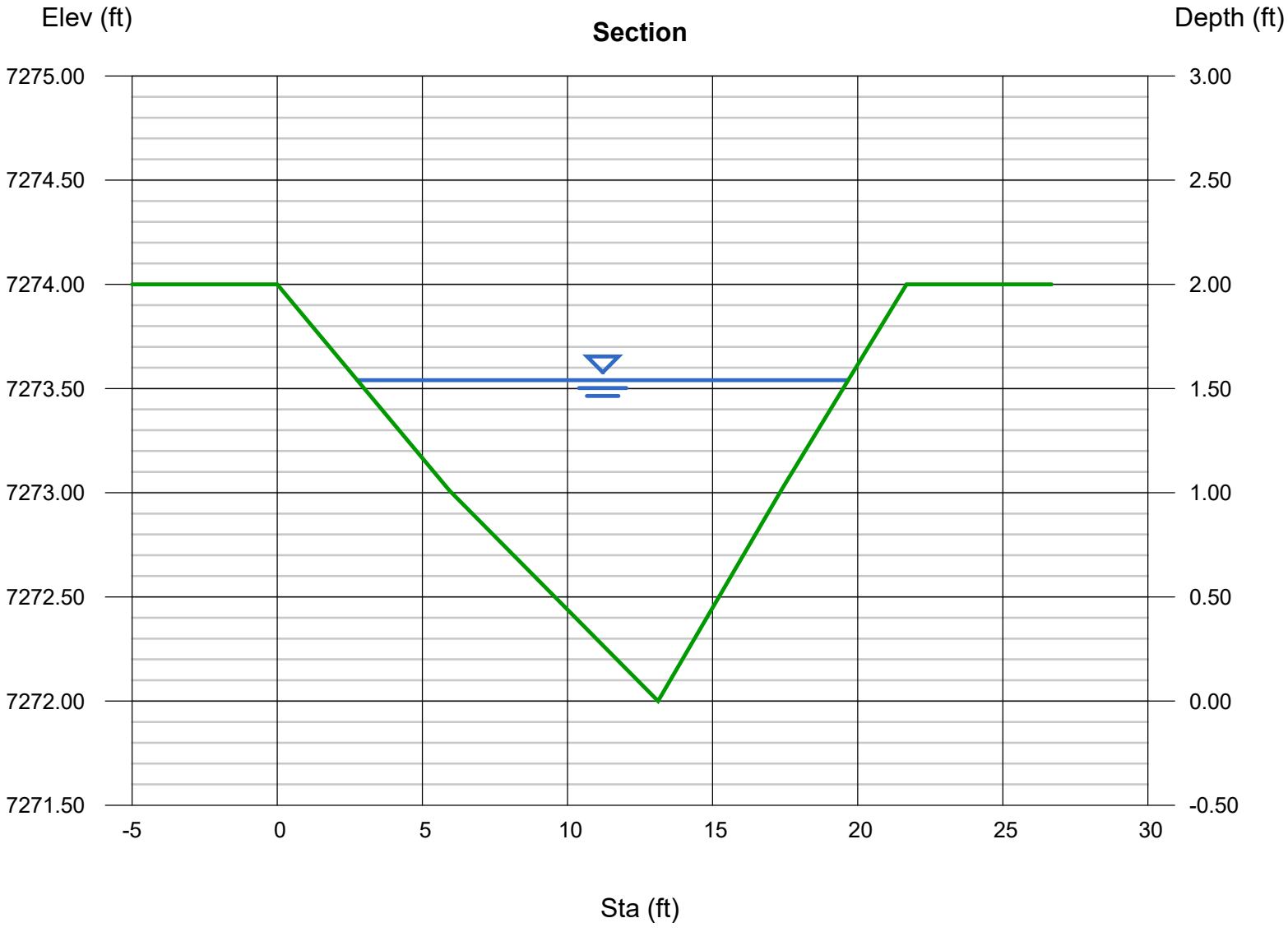
Compute by:	Known Q
Known Q (cfs)	= 77.50

Highlighted

Depth (ft)	= 1.54
Q (cfs)	= 77.50
Area (sqft)	= 13.27
Velocity (ft/s)	= 5.84
Wetted Perim (ft)	= 17.21
Crit Depth, Yc (ft)	= 1.64
Top Width (ft)	= 16.91
EGL (ft)	= 2.07

(Sta, El, n)-(Sta, El, n)...

(0.00, 7274.00)-(5.94, 7273.01, 0.035)-(13.12, 7272.00, 0.035)-(17.40, 7273.02, 0.035)-(21.68, 7274.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 26 2023

Sub-basin B Drainage Channel: 4+10 to 7+17

User-defined

Invert Elev (ft)	= 7263.76
Slope (%)	= 0.60
N-Value	= 0.035

Calculations

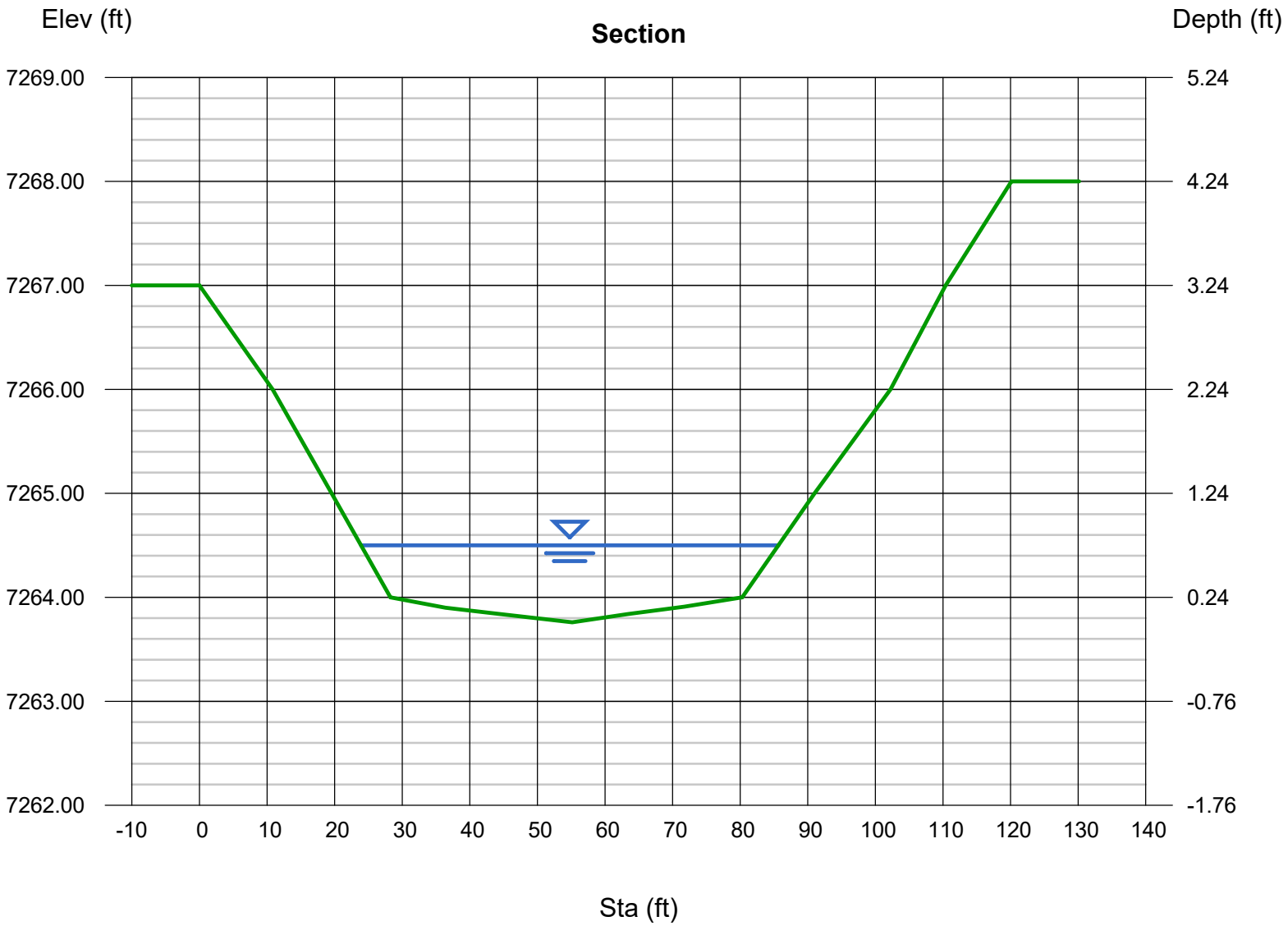
Compute by:	Known Q
Known Q (cfs)	= 77.50

Highlighted

Depth (ft)	= 0.74
Q (cfs)	= 77.50
Area (sqft)	= 35.12
Velocity (ft/s)	= 2.21
Wetted Perim (ft)	= 61.80
Crit Depth, Yc (ft)	= 0.53
Top Width (ft)	= 61.75
EGL (ft)	= 0.82

(Sta, El, n)-(Sta, El, n)...

(0.00, 7267.00)-(10.83, 7266.00, 0.035)-(19.54, 7265.00, 0.035)-(28.26, 7264.00, 0.035)-(36.39, 7263.90, 0.035)-(43.08, 7263.85, 0.035)-(55.14, 7263.76, 0.035)-(63.40, 7263.84, 0.035)-(71.75, 7263.91, 0.035)-(80.30, 7264.00, 0.035)-(91.00, 7265.00, 0.035)-(102.24, 7266.00, 0.035)-(110.39, 7267.00, 0.035)-(120.13, 7268.0



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 26 2023

Sub-basin B: 7+17 to 14+32

User-defined

Invert Elev (ft)	= 7247.97
Slope (%)	= 2.52
N-Value	= 0.035

Calculations

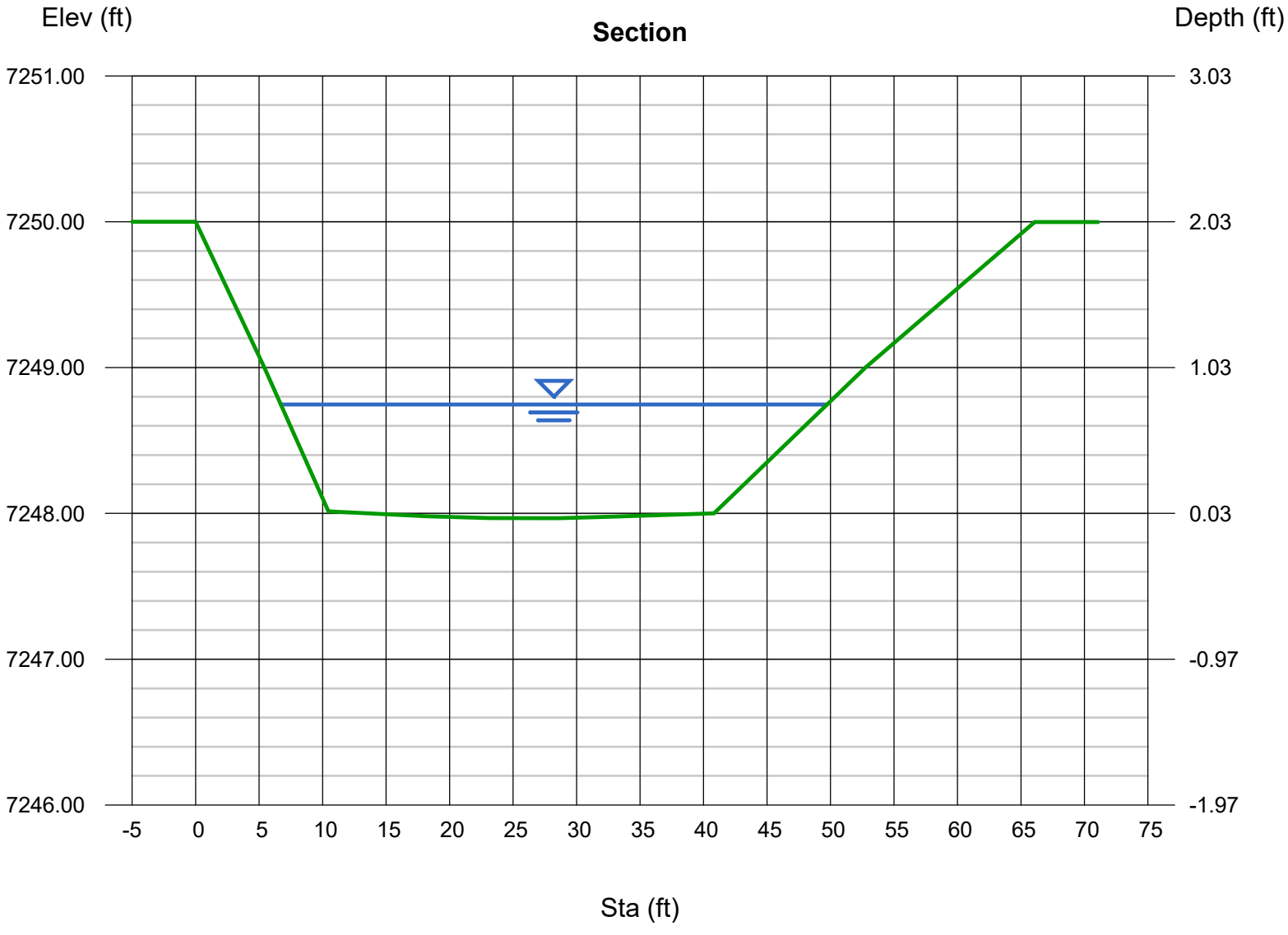
Compute by:	Known Q
Known Q (cfs)	= 140.40

Highlighted

Depth (ft)	= 0.78
Q (cfs)	= 140.40
Area (sqft)	= 27.90
Velocity (ft/s)	= 5.03
Wetted Perim (ft)	= 43.12
Crit Depth, Yc (ft)	= 0.83
Top Width (ft)	= 43.02
EGL (ft)	= 1.17

(Sta, El, n)-(Sta, El, n)...

(0.00, 7250.00)-(5.43, 7249.00, 0.035)-(10.46, 7248.01, 0.035)-(18.13, 7247.98, 0.035)-(23.12, 7247.97, 0.035)-(28.60, 7247.97, 0.035)-(32.60, 7247.98, 0.035)-(40.82, 7248.00, 0.035)-(52.75, 7249.00, 0.035)-(66.08, 7250.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 26 2023

Sub-Basin B: 18+25 to 22+81

User-defined

Invert Elev (ft)	= 7233.91
Slope (%)	= 1.75
N-Value	= 0.035

Calculations

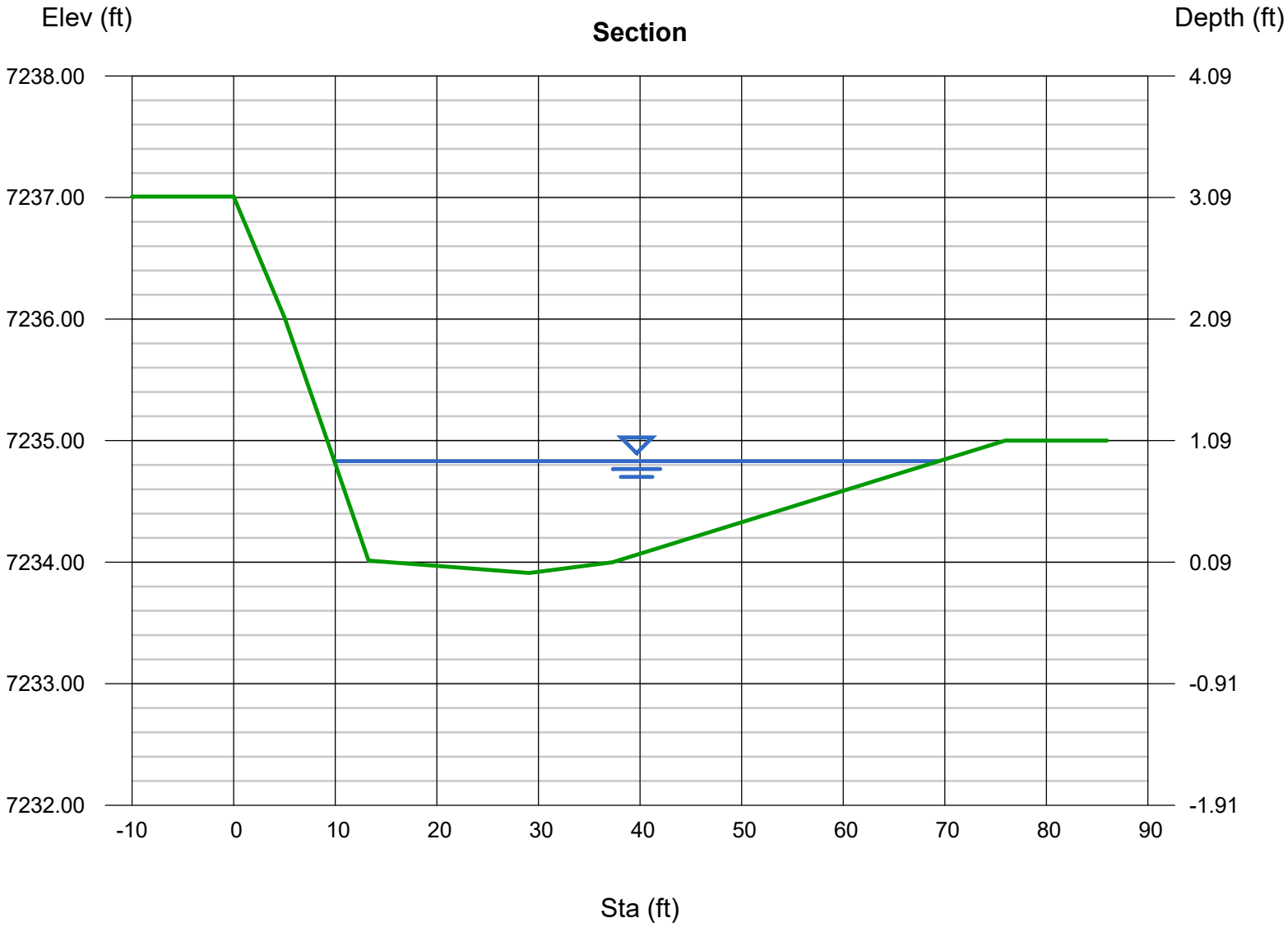
Compute by:	Known Q
Known Q (cfs)	= 140.40

Highlighted

Depth (ft)	= 0.92
Q (cfs)	= 140.40
Area (sqft)	= 35.66
Velocity (ft/s)	= 3.94
Wetted Perim (ft)	= 59.63
Crit Depth, Yc (ft)	= 0.88
Top Width (ft)	= 59.52
EGL (ft)	= 1.16

(Sta, El, n)-(Sta, El, n)...

(0.00, 7237.01)-(4.99, 7236.01, 0.035)-(9.18, 7235.01, 0.035)-(13.28, 7234.01, 0.035)-(29.08, 7233.91, 0.035)-(37.27, 7234.00, 0.035)-(75.96, 7235.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 26 2023

Sub-basin C1: 0+00 to 10+65

User-defined

Invert Elev (ft)	= 7264.00
Slope (%)	= 1.00
N-Value	= 0.035

Calculations

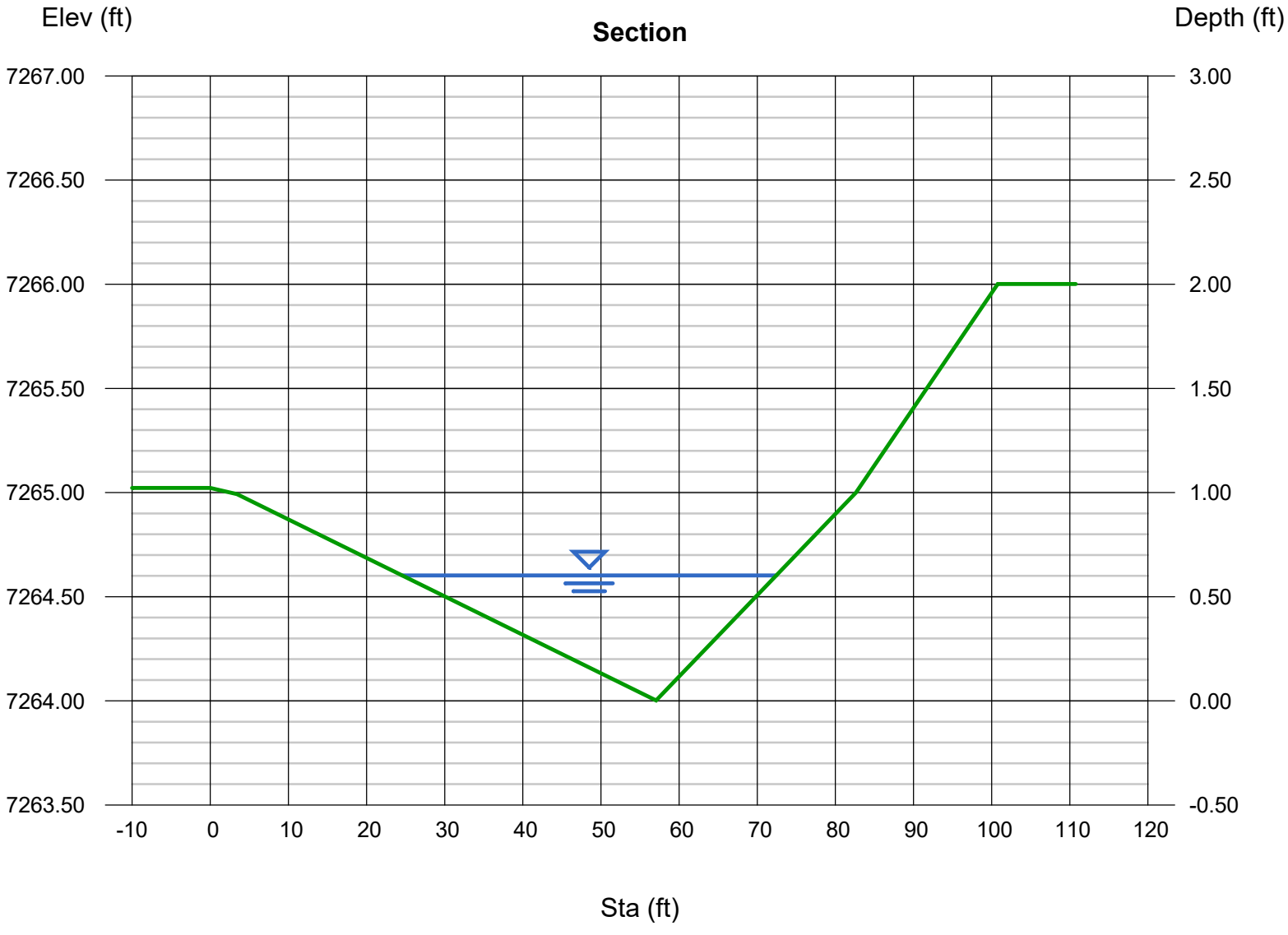
Compute by:	Known Q
Known Q (cfs)	= 26.30

Highlighted

Depth (ft)	= 0.60
Q (cfs)	= 26.30
Area (sqft)	= 14.37
Velocity (ft/s)	= 1.83
Wetted Perim (ft)	= 47.90
Crit Depth, Yc (ft)	= 0.49
Top Width (ft)	= 47.88
EGL (ft)	= 0.65

(Sta, El, n)-(Sta, El, n)...

(0.00, 7265.02)-(3.42, 7264.99, 0.035)-(57.06, 7264.00, 0.035)-(82.63, 7265.00, 0.035)-(100.77, 7266.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 26 2023

Sub-basin C2

User-defined

Invert Elev (ft)	= 7283.02
Slope (%)	= 2.65
N-Value	= 0.035

Calculations

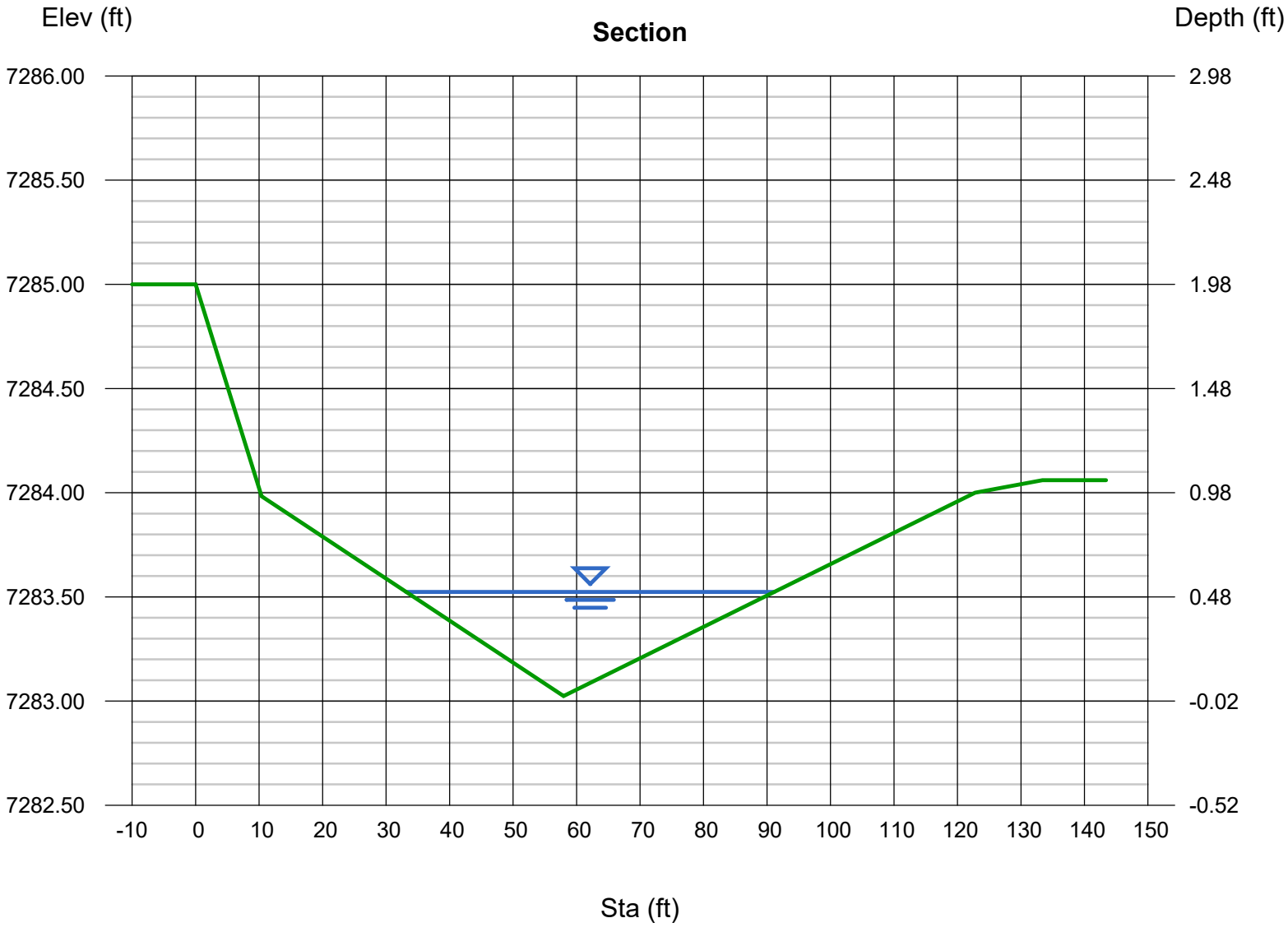
Compute by:	Known Q
Known Q (cfs)	= 38.40

Highlighted

Depth (ft)	= 0.50
Q (cfs)	= 38.40
Area (sqft)	= 14.50
Velocity (ft/s)	= 2.65
Wetted Perim (ft)	= 58.01
Crit Depth, Yc (ft)	= 0.49
Top Width (ft)	= 58.00
EGL (ft)	= 0.61

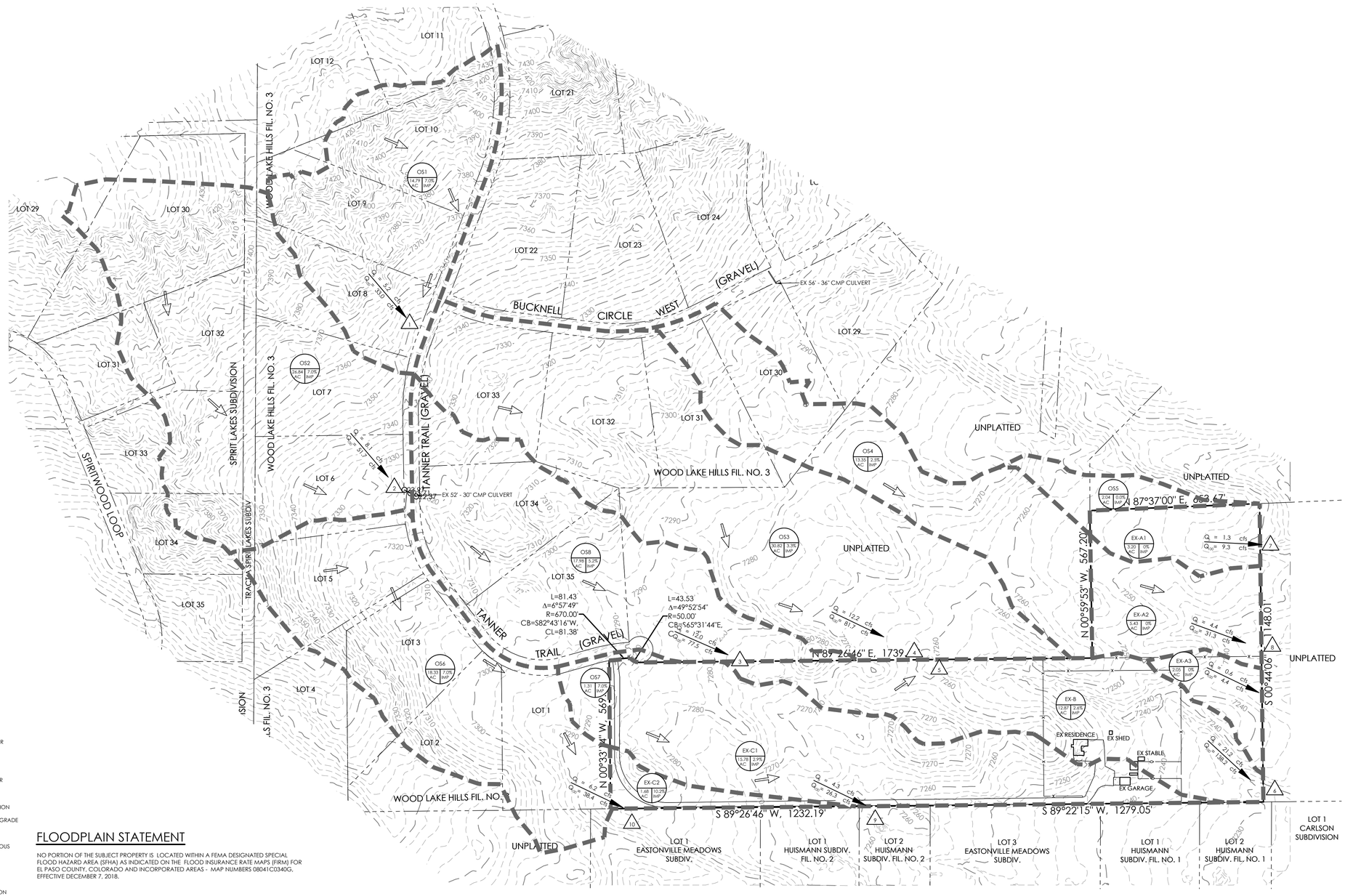
(Sta, El, n)-(Sta, El, n)...

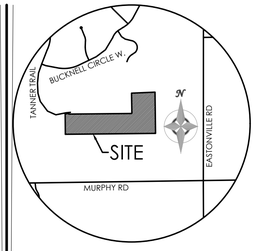
(0.00, 7285.00)-(10.39, 7283.98, 0.035)-(57.95, 7283.02, 0.035)-(122.77, 7284.00, 0.035)-(133.39, 7284.06, 0.035)



4 Drainage Maps

Existing Conditions Drainage Map (Map Pocket)
Proposed Conditions Drainage Map (Map Pocket)





VICINITY MAP

NOT TO SCALE

BENCHMARK

1" = 200' 1:2,400

LEGEND

- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

EXISTING

- 5985 — INDEX CONTOUR
- 84 — INTERMEDIATE CONTOUR

PROPOSED

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

FLOODPLAIN STATEMENT

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAPS (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBERS 08041C0340G, EFFECTIVE DECEMBER 7, 2018.

EXISTING DRAINAGE SUMMARY

OFFSITE DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
DP1 (1)	OS1	14.79	15.2	5.2	33.0	RATIONAL
DP2 (2)	OS2	26.84	21.0	8.1	51.7	RATIONAL
	OS3	30.82	22.2	8.1	55.3	RATIONAL
	OS4	13.35	21.6	3.5	24.0	RATIONAL
	OS5	2.04	17.2	0.5	4.0	RATIONAL
	OS6	18.33	21.0	5.5	35.2	RATIONAL
	OS7	1.31	22.3	0.4	2.5	RATIONAL
	OS8	17.98	19.9	5.3	34.8	RATIONAL
DP3 (3)	OS2, OS8	44.81	25.3	12.0	77.5	RATIONAL
DP4 (4)	OS1, OS3	45.61	22.8	12.2	81.7	RATIONAL
DP5 (5)	OS1-3, 8	90.42	30.0	21.4	140.4	RATIONAL

ONSITE DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
	EX-A1	3.20	21.1	0.8	5.6	RATIONAL
	EX-A2	5.43	13.4	1.6	11.8	RATIONAL
	EX-A3	2.05	13.0	0.6	4.5	RATIONAL
	EX-B	12.87	24.0	3.6	22.1	RATIONAL
	EX-C1	15.78	22.0	4.6	28.4	RATIONAL
	EX-C2	1.68	12.0	0.9	4.3	RATIONAL

DESIGN POINTS SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
EX-DP6 (6)	DP5, EX-B	103.29	37.5	21.2	138.2	RATIONAL
EX-DP7 (7)	OS5, EX-A1	5.23	20.8	1.3	9.3	RATIONAL
EX-DP8 (8)	OS4, EX-A2	18.78	24.6	4.4	31.3	RATIONAL
EX-DP9 (9)	OS7, EX-C1	17.10	29.4	4.3	26.3	RATIONAL
EX-DP10 (10)	OS6, EX-C2	20.01	21.3	6.2	38.4	RATIONAL

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

REVISIONS

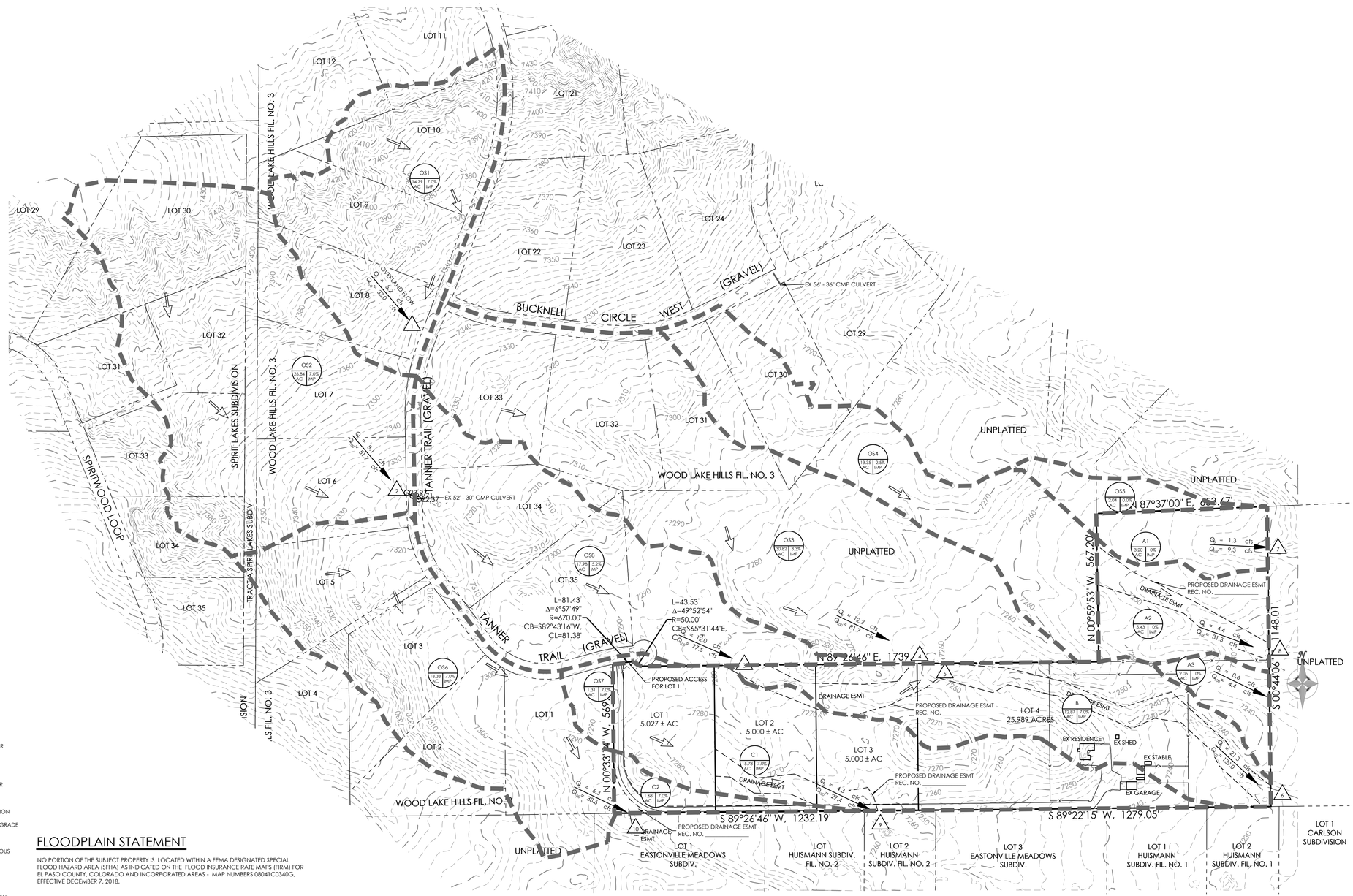
DESIGNED BY
DRAWN BY JO
CHECKED BY
AS-BUILTS BY
CHECKED BY

GRAUPNER SUBDIVISION
FINAL PLAT

EXISTING DRAINAGE MAP

MVE PROJECT **61176**
MVE DRAWING **EX-DRN**

AUGUST 2, 2023
SHEET 1 OF 1



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PROPOSED DRAINAGE SUMMARY

OFFSITE DRAINAGE SUMMARY TABLE

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DP1 (1)	OS1	14.79	15.2	5.2	33.0	RATIONAL
DP2 (2)	OS2	26.84	21.0	8.1	51.7	RATIONAL
	OS3	30.82	22.2	8.1	55.3	RATIONAL
	OS4	13.35	21.6	3.5	24.0	RATIONAL
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DP3 (3)	OS2, OS8	44.81	25.3	12.0	77.5	RATIONAL
DP4 (4)	OS1, OS3	45.61	22.8	12.2	81.7	RATIONAL
DP5 (5)	OS1-3, 8	90.42	30.0	21.4	140.4	RATIONAL

ONSITE DRAINAGE SUMMARY TABLE

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	B	12.87	23.9	3.6	23.2	RATIONAL
	C1	15.78	21.9	4.7	29.7	RATIONAL
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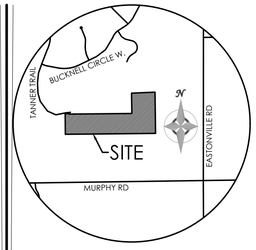

VICINITY MAP

NOT TO SCALE

BENCHMARK

N

50 0 100 200 400

1" = 200' 1:2,400

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DRAWN BY JO
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GRAUPNER SUBDIVISION
FINAL PLAT

PROPOSED DRAINAGE MAP

MVE PROJECT **61176**
MVE DRAWING **PP-DRN**

AUGUST 2, 2023
SHEET 1 OF 1