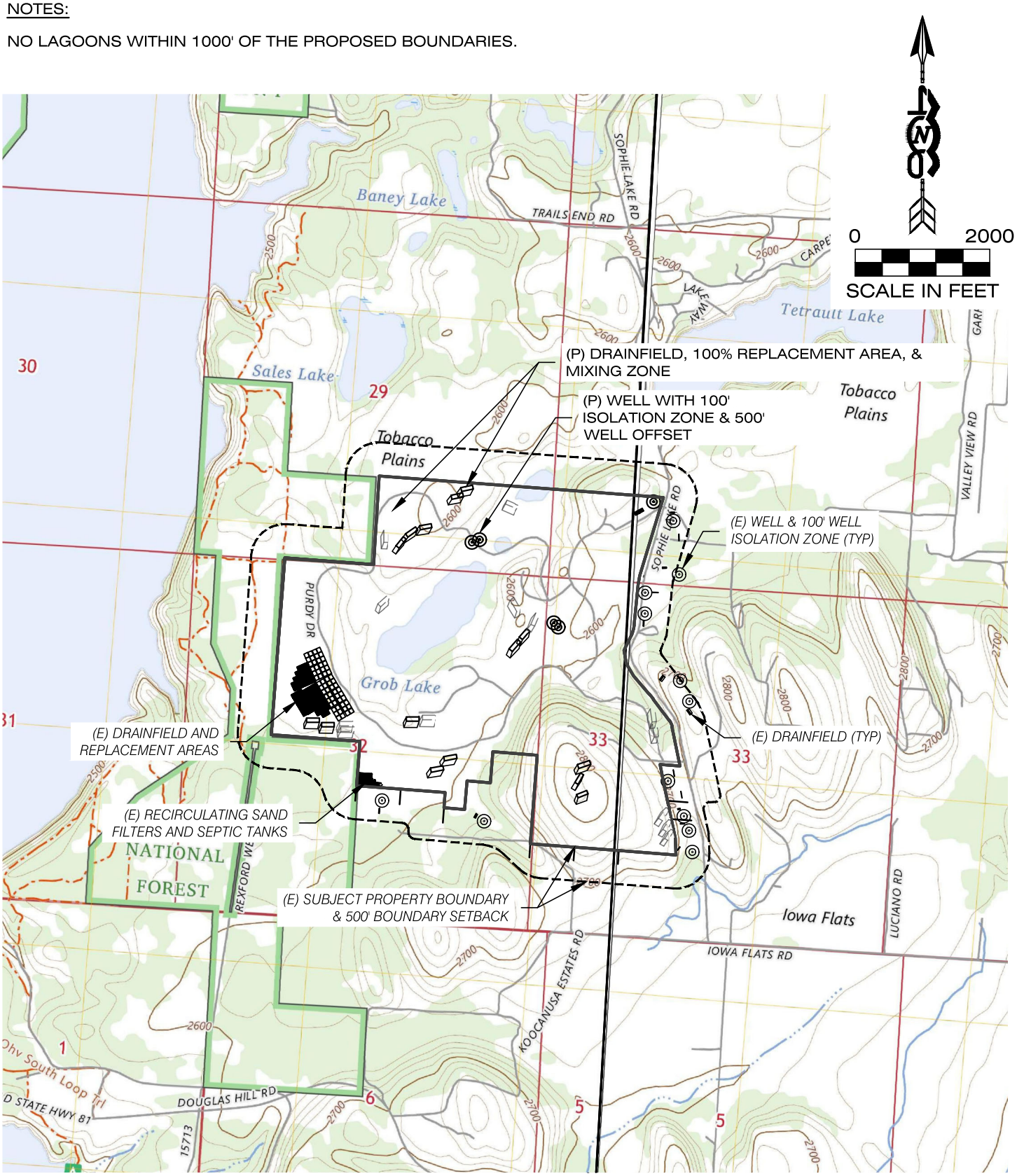
NOTES:

NO LAGOONS WITHIN 1000' OF THE PROPOSED BOUNDARIES.




406 ENGINEERING
CIVIL ENGINEERING
LAND USE CONSULTING

1201 S. 6th St. W.
Missoula, MT 59801
(406) 317-1131

35 8th St. E.
Kalispell, MT 59901
(406) 257-0679

www.406engineeringinc.com

# DEQ VICINITY MAP
## ESCALANTE WILDERNESS PRESERVE
## SEC 28, 29, 32, & 33, T37N, R27W PMM
## COS 4389
## LINCOLN COUNTY

PRO#:21-007K
TAB: DEQ VIC
DRAFTER:BC
DATE: 7/20/26
SHEET 1 OF 1

PLOT DATE: 7/20/2026 9:04 AM DWG LOCATION: C:\USERS\BENCAMPBELL\406\406 ENGINEERING - DOCUMENTS\406 WORK\1_PROJECTS\2021 PROJECTS\21-007K ESCALANTE WILDERNESS PRESERVE\8_DRAFTING\8.1_DRAWINGS\DEQ-21-007K.DWG

# Water and Sanitation Summary

PREPARED IN ACCORDANCE WITH STATE LAW (MCA 76-3-622)

for

**Escalante Wilderness Preserve Subdivision**

On property located on a portion of property located along Sophie Lake Road, Eureka, MT legally described Wilderness Club Phase 1, Open Space, and Golf Course Excepting Therefrom the Lots in Phases 1-7 & 9 in Sections 28, 29, 32 & 33, Township 37 North, Range 27 West, PMM, Lincoln County

Published: July 15, 2026

**Prepared For:**
Escalante Wilderness Preserve US LLC
1885 Sophie Lake Road
Eureka, MT 59917

**Prepared By:**
406 Engineering, Inc.
35 8th Street East
Kalispell, MT 59901

## 1.0 APPLICABILITY

All subdivisions shall provide information regarding water and sanitation information to accompany a preliminary plat in accordance with MCA 76-3-622. The following information has been developed to meet the requirements of the subdivision regulations and state law.

## 2.0 LOT LAYOUT AND MAPS

Department of Environmental Quality lot layouts for Phases 11-15 are attached with this packet meeting the requirements of MCA 76-3-622.

## 3.0 DESCRIPTION OF WATER SYSTEMS

Attached is a report completed by HDR detailing the proposed public water system. As the proposal is within 500 feet of an existing public system per ARM 17.36.123, a will serve letter from the Wilderness Club Public Water Supply System (PWS MT 0004748) authorizing connection to the existing system is included. The existing public water supply consists of four on-site wells, a 150,000 gallon storage stank, and water distribution system. The proposed water system includes the extension of the existing Wilderness Club water distribution system including the construction of additional storage as required by the DEQ. Extensions of the existing system will be completed with every phase as described in the Phasing Plan and detailed within exhibits throughout this application.

## 4.0 DESCRIPTION OF SEWER SYSTEMS

Attached is a report completed by HDR detailing the proposed onsite wastewater treatment systems. As the proposal is located within 500 feet of an existing public system per ARM 17.36.123, a will serve letter from the Wilderness Club has been provided, denying connection to the existing system. The

reason for the denial is based on the limited storage capacity within the existing wastewater treatment system which is why multiple phased systems are proposed for this subdivision. The proposed wastewater improvements include a small diameter pressure sewer system (similar to the existing collection system) and approximately 15 elevated sand mound treatment and disposal systems. The sand mound systems are dedicated to each phase of the project rather than utilizing one large system for all five phases combined.

**5.0 NON-DEGRADATION**

Within the Wastewater Facility report prepared by HDR, a non-degradation analysis has been completed for all proposed wastewater treatment locations with passing results. The non-degradation evaluation for this project includes a nitrate sensitivity analysis and phosphorus breakthrough analysis. The proposed wastewater treatment systems are greater than ½ mile from high-quality state surface water therefore a Trigger Analysis was not completed. Standard 100' mixing zones are proposed.

**6.0 DESCRIPTION OF SOLID WASTE**

Evergreen Disposal provides contracting hauling for disposal of solid waste.

**7.0 DESCRIPTION OF STORM WATER DRAINAGE PLAN**

Storm water will be managed with positive drainage away from structures and roadways, vegetative cover, roadside ditches and check dams, retention ponds, infiltration sumps, and culverts under roadways to pass storm water flows. The Storm Drainage Report has been prepared meeting Lincoln County Subdivision and DEQ requirements as seen within the attached Stormwater report.

*Monday, July 20, 2026, 4:19 PM*



# Escalante Wilderness Preserve

Water System Preliminary Plat Report

HDR Project No. 10406703

*Lincoln County, MT*

October 28, 2025

# Escalante Wilderness Preserve

## Lincoln County, Montana

## October 2025

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of Montana.




Zachary Maassen, PE
HDR Engineering, Inc.
220 S. Complex Drive, Ste 105
Kalispell, MT 59901

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# Introduction

This report provides the technical requirements for the proposed water system improvements to serve the Escalante Wilderness Preserve development.

## 1.0. General Information

This development is located on the formerly developed Wilderness Club Subdivision. The entire site is approximately 140 acres with the current development, Escalante Wilderness Preserve, planned to include 234 single-family residential lots. Previously the Wilderness Club Subdivision completed the development of Phase 1-10, including 320 lots in total. Figure 1 depicts the project locations of the existing and proposed development.

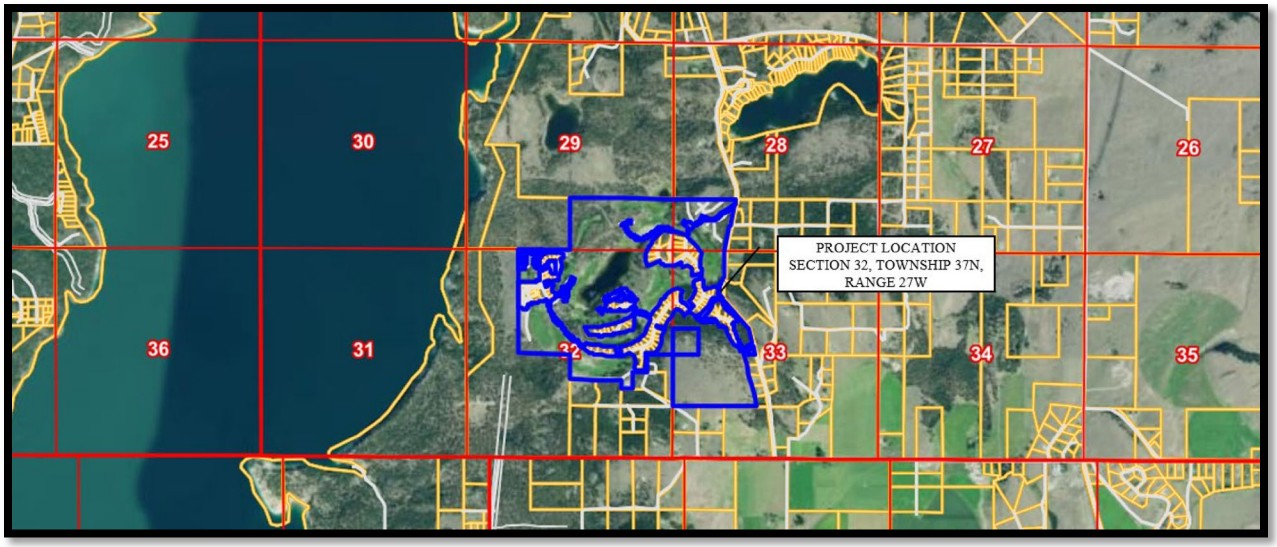



**Figure 1 - Project Location**

The site includes the following existing water system infrastructure.

- The existing water system in the Wilderness Club has been seized to provide peak flows to 271 residential lots, 1 residential lodge lot, 47 cabin pods and the club house facility.
- All golf course irrigation is handled by an independent system not connected to the water distribution system used for domestic and irrigation uses on the lots.
- The public water supply, storage and distribution systems was reviewed and approved by DEQ as EQ#06-3006. The entire water supply and storage system as well as a portion of the water distribution system have been installed and are in operation. Water rights have been permitted.

- Four wells have been developed to supply domestic water to the subdivision. Wells No.1 and No. 2 are located in the open space to the west of Lots 166 to 170. Wells No.1 and No. 2 each have a designed flow of 70 gpm. Wells No. 4 and No. 5 are located in the open space southeast of Lots 81 and 82. Well No. 4 has a design flow of 70 gpm, and Well No. 5 has a design flow of 140 gpm. Submersible pumps located in all 4 wells pump water via 6” DR 11 HDPE fusion joined waterline to a wood framed pump house and 150,000-gallon reservoir.
- The entire water distribution system is fed by the existing 150,000-gallon cast-in-place concrete storage reservoir. The reservoir is sized to store adequate water to meet the fire flow of 1,000 gpm for two hours, requiring a total volume of 120,000 gallons and still meets the average daily demand of 89 gpm and the maximum day demand of 138 gpm at full buildout.
- Water distribution mains required to serve all existing lots in Phases 1 through 4 have been installed and are in operation. The existing water distribution system serving phases 1, 2, 3, and 4 consists of 8” (nominal) DR 11 HDPE fusion joined transmission lines with all fittings being flange type fittings. Fire hydrant leads are 6” DR 11 HDPE. Individual PE service lines have been installed in each lot in previous phases with individual curb stops at each service. 1-inch individual service lines previously installed for Lots 48-70 are utilized for service to the townhouse lots. Four additional 1-inch water service lines were installed off the existing 8-inch water distribution main so that two 1-inch service lines will be extended into each townhouse group. Each 1-inch service line will serve two townhouse units. Once inside the townhouse building, the 1-inch service line will branch off to each of the two individual units in each building that it will serve.
- Phase 4 lots are served by the site irrigation system installed within the development/golf course. The domestic public water supply system will not be serving irrigation demands for the townhouse lots shown herein.

This water system will be expanded to serve the Escalante Wilderness Preserve Subdivisions (Phases 11-15).

# 2.0. Proposed Project

The proposed water system generally includes the extension of the existing Wilderness Club water distribution system including the construction of additional storage as described in greater detail below. The extent of the development and proposed water system are attached in Appendix B and are generally shown in Figure 2 and 3 below.

Figure 2. Proposed Development Layout

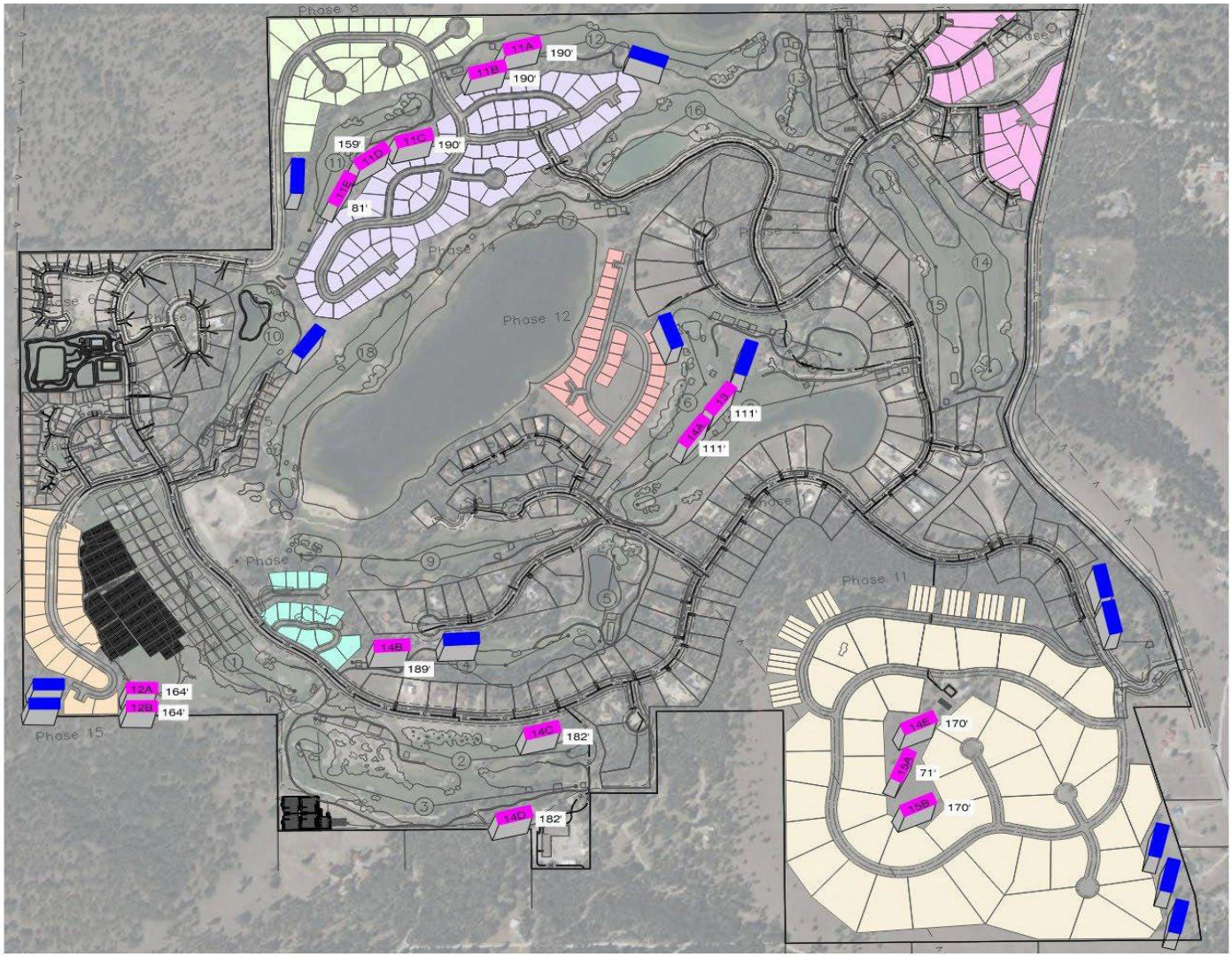
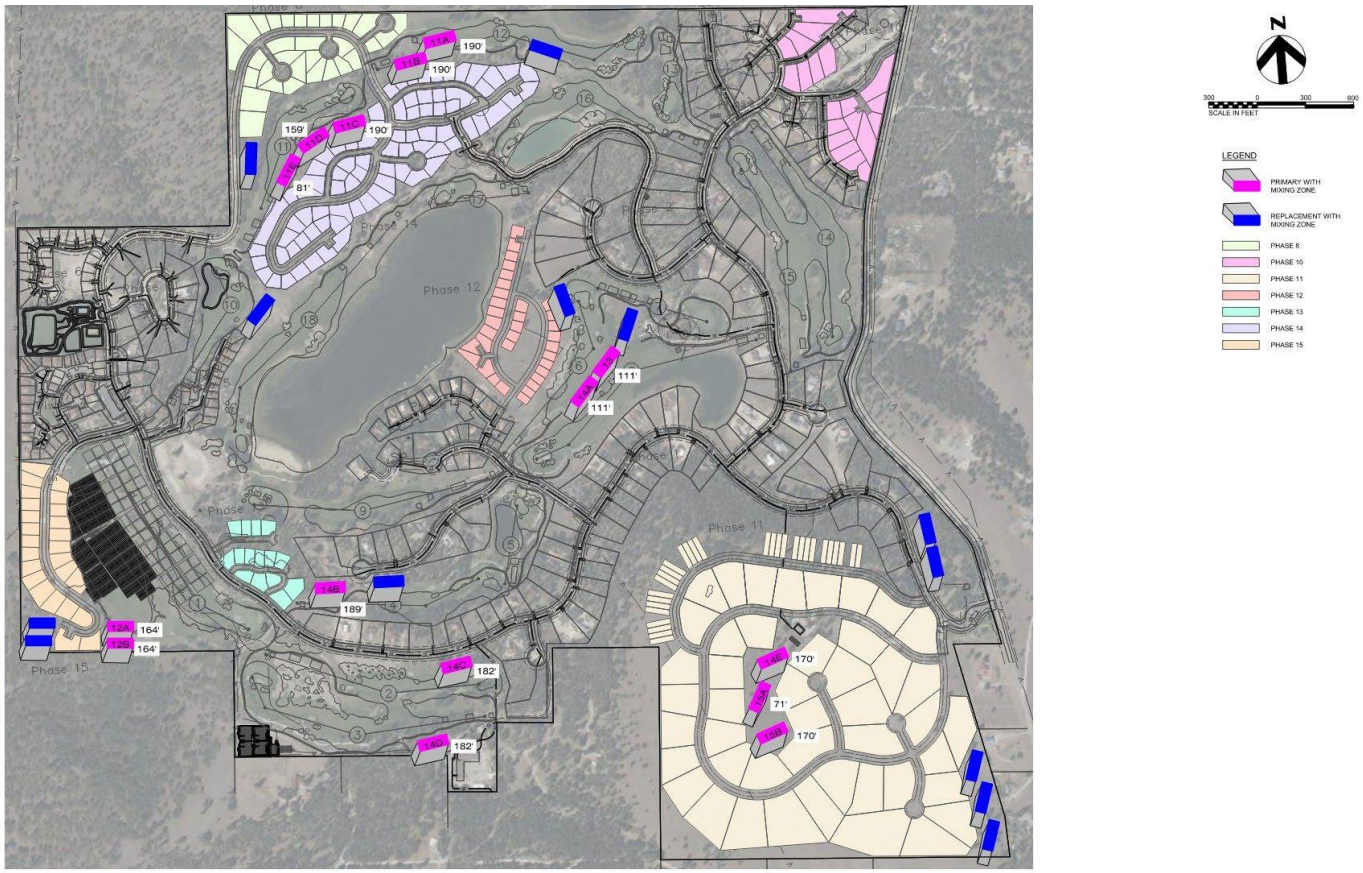


Figure 3. Proposed Water System Layout




# 3.0. Water Use Data

## 3.1. Projected Population Served and Domestic Water Demand

The proposed Escalante Wilderness Club development includes 234 single family homes developed in five phases. To estimate projected population, 2.5 people per dwelling[1] were assumed consistent with MDEQ Circular 1, resulting in a total service population of 585 people

To calculate projected water supply requirements, the cumulative population of 585 and a projected 100 gallon per capita per day (GPCD) were used. This per capita value assumes no irrigation (irrigation is provided via a separate system) and as a result the per capita domestic wastewater flow provided in MDEQ Circular 1 is assumed to be sufficient at this stage of the project.

The developed water demands for the projected development are shown below in Table 1. Based on the residential inputs, the cumulative average day demand, maximum day demand (1.8 x average daily demand), and peak hour (1.5 x maximum daily demand) are estimated for the project build out.

| Cumulative Population | Projected Residential Demand (gpm) | Maximum Day Demand (gpm) | Peak Hour Demand (gpm) |
|---|---|---|---|
| 585 | 40.6 | 73.1 | 109.6 |

1. *Assuming 2.5people per dwelling per Montana Circular DEQ-4, Section 1.2.56*
2. *All water demand was assumed to be residential at this time.*
3. *Assuming 100 gallons per capita per day per Montana Circular DEQ-2*

*The following multipliers were used to estimate max and peak hour demand of the proposed new development:*

- *Max day demand (1.8 x average daily demand)*
- *Peak hour (1.5 x maximum daily demand)*

**Table 1. Projected Residential Water Demand for New Escalante Wilderness Preserve development**

## 3.2. Cumulative Future Water Demand

The existing water system for the Wilderness Club will be expanded to accommodate the proposed Escalante Wilderness Preserve development. Table 2 summarizes the cumulative future fire flow, maximum day demand, and storage demands of the Wilderness Club and Escalante Wilderness Preserve combined subdivisions.

| Development Phase | Fire Flow Requirements (gpm, 2hr duration) | Maximum Day Demand (gpm) | Storage Demand (gallons) |
|---|---|---|---|
| Wilderness Club Subdivision | 1,000 | 73.1 | 150,000 |
| Escalante Wilderness Preserve | 1,000 | 138 | 113,000 [3] |
| **Cumulative Demand Required[1,2]** | | **211.1** | **300,000** |

1. *Existing well capacity with the largest well out of service, 323gpm, exceeds the cumulative max day demand of both subdivisions. Therefore, additional capacity will not be required.*
2. *Additional storage capacity will be required to accommodate the fire flow requirements of the Escalante Wilderness Preserve as only 150,000gallons of storage currently exist.*
3. *Reference the following section, Flow Requirements, for calculated storage requirement analysis.*

**Table 2. Cumulative Demand for Total Development**

# 4.0. Flow Requirements

## 4.1. Fire Flow

Fire flow is the largest demand on a system and is critical in the evaluation of storage capacity. According to Montana Department of Environmental Quality Circular-1, fire flow should meet the recommendations of the fire protection agency in which the water system is being developed, or in the absence of such a recommendation, the fire code adopted by the State of Montana.

This project is located in Lincoln County with the local authority having jurisdiction for determining fire flow being Lincoln County and Eureka Fire Department. Residential fire flow is based on square footage of the house and the presence of an automatic sprinkler system. According to the Lincoln County Subdivision Regulations[2], Section VI-P-5- Water Requirements for Fire Suppression, the required water supply for one- and two-family dwellings that do not exceed 3,600 square feet shall be 1,000 gallons per minute for a minimum duration of 30 minutes. At this time, it is assumed that the largest building would be less than 3,600 square feet. However, the assumed fire flow for this project will be 1,000gpm for 2 hours (120 minutes). This assumption matches that of the original Wilderness Club development and exceeds the required fire flow requirements specified in the 2018 International Fire Code and the 2020 Lincoln County Subdivision Regulations.

# 5.0. Source of Supply

## 5.1. Ground Water Sources and Capacity

Water for the Escalante Wilderness Preserve development will be supplied by the four existing deep production wells, Well 1, 2, 4 and 5. The existing water supply wells, as outlined in Table 3, have a total capacity of 533 GPM or 767,520 GPD, if run continuously. The capacity of the system per MDEQ Circular 1 must equal or exceed the design maximum day demand with the largest producing well out of service. The capacity of the system with the largest well out of service (Well 5) is 323gpm or 465,120 gpd. Comparing these values with demands outlined in Table 2 shows that the currently available capacity exceeds the maximum day demand. Therefore, no additional source of supply will be required to adequately source the proposed development. Additionally, according to EQ #12-1529, Wilderness Club Phase 3 submittal to MDEQ, Well 1 and 2 are housed in a heated pumphouse. According to the current water operator, none of the wells are currently serviced by a backup generator as required by MDEQ Circular 1, Section 6.6.6. Therefore, the addition of a backup generator or auxiliary power to all of the supply wells must be

[2]https://lincolncountymt.us/wp-content/uploads/2016/05/LincolnCountySubRegs_Final_2020.pdf

addressed in the scope of this project. The location of the existing wells and well logs are attached in Appendix A.

| Well | Well 1 (WL002) | Well 2 (WL003) | Well 4 (WL004) | Well 5 (WL005) |
|---|---|---|---|---|
| **GWIC Well ID** | 235636 | 235637 | 243760 | 243807 |
| **Yield (gpm)** | 98 | 150 | 75.37 | 210 |
| **Static Water Level** | 85 | 81 | 45.34 | 57.65 |
| **Pumping Water Level** | 300 | 250 | 125 | 115 |
| **Drawdown** | | 151.4 | 75.37 | 4.29 |
| **Well Depth** | 320 | 265 | 180 | 140 |
| **Casing Depth** | 280 | 270 | 132 | 120 |

**Table 3. Existing Source Water Well Characteristics**

## 5.2. Water Storage Requirements

MDEQ Circular 1 requires the water storage facility to meet maximum day demands plus fire flow minus firm water supply capacity. Water storage requirements are typically categorized as follows:

- Operational storage. The purpose of operational storage (or equalization storage) is to provide supply to meet peak hour water demands. Over any 24-hour period, water demands will vary, and operational storage helps the system meet these normal daily diurnal fluctuations in demand. During periods of high demand, the water level in a storage facility will typically drop as water flows into the system to meet the demand. During periods of low demand, such as nighttime hours, reservoirs are filled in preparation for the diurnal high demand flow conditions of the next day.
- Emergency storage. The purpose of emergency storage is to meet short-term emergency supply needs. An emergency is an unforeseen or unplanned event that may cause a water shortage in the system.
- Fire storage is the volume of water required to meet firefighting needs and varies depending upon the type of development or land use that is served in each pressure zone. For this project, single family residential development will require 1,000 gpm for 2 hours which equates to 120,000 gallons of fire storage.

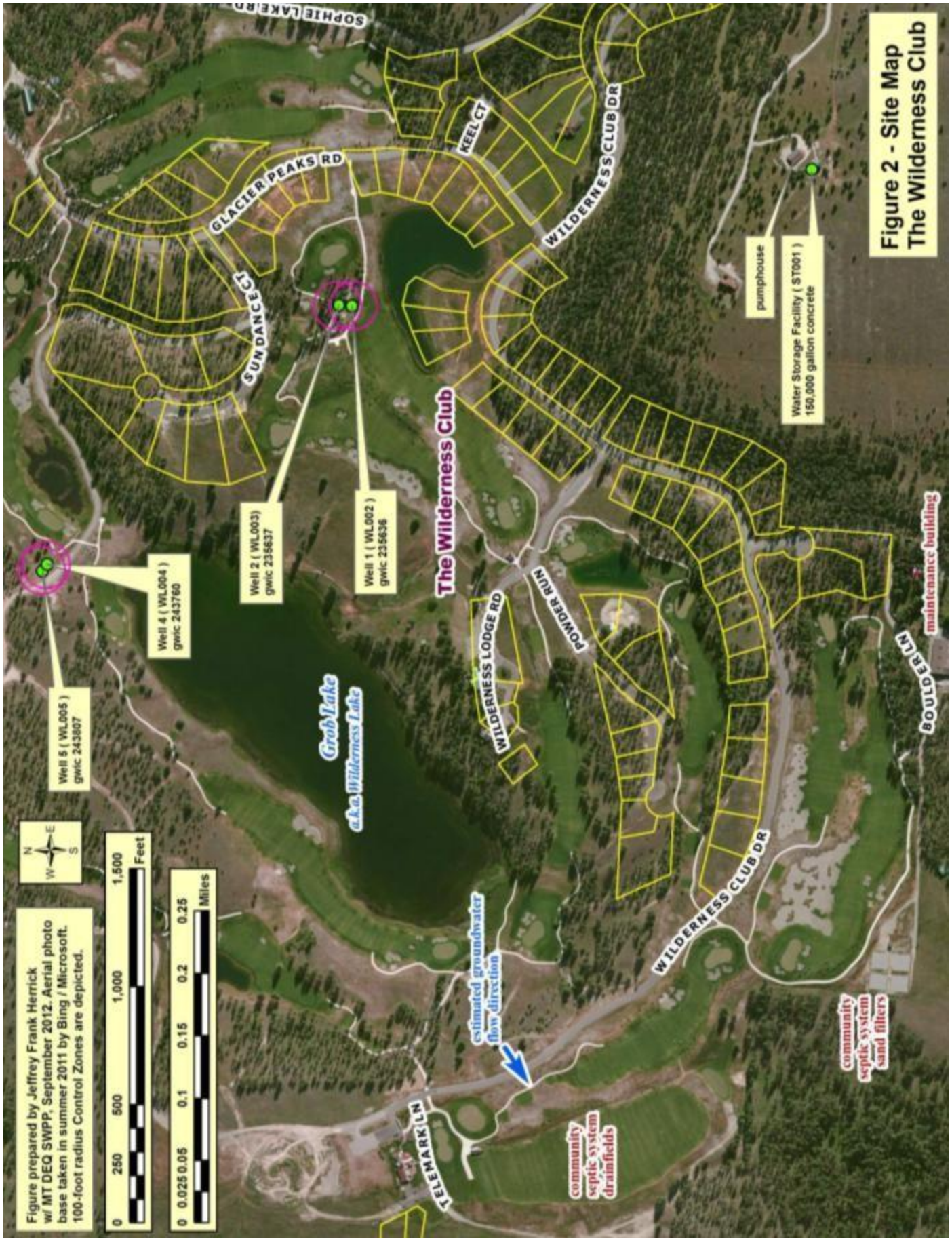
| Development | NFF (gpm) | Run Time (Hours) | Average Day Demand (gpm) | Maximum Day Demand (gpm) | Total Demand [Max Day+ NFF+5%dead storage]- Firm Capacity (gallons, 2 hour) | Water Storage Required: Net Demand+ 25% Equalization (Gallons) |
|---|---|---|---|---|---|---|
| Escalante Wilderness Preserve | 1,000 | 2 | 40.6 | 73.1 | 90,450 | 113,063 |
| Wilderness Club | 1,000 | 2 | 88.5 | 137.8 | 98,602 | 123,253 |
| **Cumulative** | **2,000** | **2** | **129.1** | **210.9** | **227,813** | **284,766** |

**Table 4 . Projected Additional Storage Required**

Based on the projected population and water use analysis above, utilizing the existing onsite 150,000-gallon storage tanks would not be adequate for the proposed development build out and additional storage will be required.

Additionally, at least one hydropneumatic tank system will be required for servicing Phase 11 since this phase is located above the reservoir elevation.

# Appendix A. Existing Well Logs and Locations


Figure 2 - Site Map
The Wilderness Club
Figure prepared by Jeffrey Frank Herrick
w/ MT DEQ SWPP, September 2012. Aerial photo
base taken in summer 2011 by Bing / Microsoft.
100-foot radius Control Zones are depicted.
0 250 500 1,000 1,500 Feet
0 0.025 0.05 0.1 0.15 0.2 0.25 Miles
N
W
E
S
SOPHIE LAKE RD
GLACIER PEAKS RD
KEEL CT
WILDERNESS CLUB DR
SUNDANCE CT
pumphouse
Water Storage Facility ( ST001 )
150,000 gallon concrete
Well 2 ( WL003)
gwic 235637
Well 1 ( WL002 )
gwic 235636
Well 4 ( WL004 )
gwic 243760
Well 5 ( WL005 )
gwic 243807
The Wilderness Club
Grob Lake
a.k.a. Wilderness Lake
WILDERNESS LODGE RD
POWDER RUN
BOULDER LN
maintenance building
estimated groundwater
flow direction
community
septic system
drainfields
community
septic system
sand filters
TELEMARK LN

## Well 1 gwic 235636 (WL002)

**Site Name: THE WILDERNESS CLUB-EAST WELL#1**
**GWIC Id: 235636**

**Section 1: Well Owner**

| Owner Name | | |
|---|---|---|
| THE WILDERNESS CLUB-EAST WELL#1 | | |
| **Mailing Address** | | |
| SUITE 260, 3015 12TH STREETR NE | | |
| **City** | **State** | **Zip Code** |
| CALGARY | AB | T2E 7 J2 |
| **Well Address** | | |
| 1885 SOPHIA LAKE ROAD | | |
| **City** | **State** | **Zip Code** |
| EUREKA | MT | 59917 |

**Section 2: Location**

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 37N | 27W | 33 | |
| **County** | | **Geocode** | |
| LINCOLN | | | |
| **Latitude** | **Longitude** | **Geomethod** | **Datum** |
| 48.0993 | 115.1296 | NAV-GPS | WGS84 |
| **Altitude** | **Method** | **Datum** | **Date** |
| | | | |
| **Addition** | **Block** | **Lot** | |
| | | | |

**Section 3: Proposed Use of Water**
PUBLIC WATER SUPPLY (1)

**Section 4: Type of Work**
Drilling Method: BARBER RIG

**Section 5: Well Completion Date**
Date well completed: Sunday, October 08, 2006

**Section 6: Well Construction Details**
**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 75 | 16 |
| 75 | 320 | 12 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 280 | 12 | 0.25 | | WELDED | A53B STEEL |
| 275 | 280 | 10 | 0.25 | | WELDED | A53B STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 280 | 320 | 12 | | | SCREEN-CONTINUOUS-STAINLESS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 75 | BENONITE CHIPS | |

**Section 7: Well Test Data**

Total Depth: 320
Static Water Level: 85
Water Temperature:

**Air Test** *

98 gpm with drill stem set at 300 feet for 120 hours.
Time of recovery 1 hours.
Recovery water level 85 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

**Section 8: Remarks**

**Section 9: Well Log**
**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 98 | SILTY GRAVELS |
| 98 | 105 | HARD ROCK LAYER |
| 105 | 155 | GRAVELS AND SILT DAMP |
| 155 | 174 | GRAVELS, SAND AND WATER |
| 174 | 180 | GRAVELS AND SILT |
| 180 | 185 | SILT WITH WELL GRADED SAND |
| 185 | 190 | FINE GRAVELS, WITH SILT AND SAND |
| 190 | 195 | COARSE MEDIUM TO FINE GRAVELS |
| 195 | 210 | COARSE FINE GRAVELS WITH SAND |
| 210 | 215 | COARSE MEDUIM TO FINE GRAVELS, SOME WELL GRADED SANDS |
| 215 | 225 | WELL GRADED SANDS WITH FINE GRAVELS |
| 225 | 230 | FINE SANDS, WELL GRADED |
| 230 | 235 | MEDIUM TO FINE GRAVELS, SOME CLAY AND SAND |
| 235 | 270 | SILT, CLAY AND GRAVELS |
| 270 | 275 | WELL GRADED SAND |

**Driller Certification**
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** DAN OKEEFE
**Company:** OKEEFE DRILLING CO
**License No:** WWC-462
**Date Completed:** 10/8/2006

**Site Name: THE WILDERNESS CLUB-EAST WELL#1**
**GWIC Id: 235636**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 275 | 320 | SAND AND GRAVEL |

| | | |
|---|---|---|
| 320 | 330 | CLAY, SILT AND GRAVEL |

## Well 2 gwic 235637 (WL003)

**Site Name: THE WILDERNESS CLUB-WEST WELL#2**
**GWIC Id: 235637**

**Section 1: Well Owner**

**Owner Name**
THE WILDERNESS CLUB-WEST WELL#2
**Mailing Address**
SUITE 260, 3015 12TH STREETR NE

| City | State | Zip Code |
|---|---|---|
| CALGARY | AB | T2E 7 J2 |

**Well Address**
1885 SOPHIA LAKE ROAD

| City | State | Zip Code |
|---|---|---|
| EUREKA | MT | 59917 |

**Section 2: Location**

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 37N | 27W | 33 | |

**County** LINCOLN **Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 48.9326 | 115.1296 | NAV-GPS | WGS84 |

| Altitude | Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

**Section 3: Proposed Use of Water**
PUBLIC WATER SUPPLY (1)

**Section 4: Type of Work**
Drilling Method: BARBER RIG

**Section 5: Well Completion Date**
Date well completed: Friday, October 27, 2006

**Section 6: Well Construction Details**

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 65 | 16 |
| 65 | 265 | 12 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| -2 | 270 | 12 | 0.25 | | WELDED | A53B STEEL |
| 265 | 270 | 10 | 0.25 | | WELDED | A53B STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 270 | 310 | 12 | | | SCREEN-CONTINUOUS-STAINLESS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 65 | BENONITE CHIPS | |

**Section 7: Well Test Data**

Total Depth: 265
Static Water Level: 81
Water Temperature:

**Pump Test ***

Depth pump set for test 250 feet.
150 gpm pump rate with 151.4 feet of drawdown after 21 hours of pumping.
Time of recovery 1 hours.
Recovery water level 81 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

**Section 8: Remarks**

**Section 9: Well Log**
**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 85 | SILTY GRAVELS |
| 85 | 90 | FINE GRAVEL, TRACE OF SILT AND SAND, WET |
| 90 | 95 | MEDIUM TO FINE GRAVELS |
| 95 | 100 | GRAVELY CLAY WITH SAND |
| 100 | 130 | GRAVELS, SILT AND CLAY |
| 130 | 140 | ORGANIC CLAY AND SILT WITH GRAVEL |
| 140 | 150 | FINE GRAVELS, WITH SILT AND SAND |
| 150 | 160 | SILTY GRAVEL, GRAVEL SAND AND SILT |
| 160 | 170 | GRAVEL, SILT AND SAND |
| 170 | 175 | MEDIUM TO FINE GRAVEL |
| 175 | 180 | SILTY SAND AND GRAVEL |
| 180 | 184 | CLAY, SILTY SAND AND GRAVEL |
| 184 | 200 | FINE GRAVELS,SAND AND CLAY |
| 200 | 215 | GRAVEL AND SAND |
| 215 | 220 | SAND, CLAY AND FINE GRAVELS |

**Driller Certification**
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:** DAN OKEEFE
**Company:** OKEEFE DRILLING CO
**License No:** WWC-462
**Date Completed:** 10/27/2006

**Site Name: THE WILDERNESS CLUB-WEST WELL#2**
**GWIC Id: 235637**
**Additional Lithology Records**

| From | To | Description |
|---|---|---|
| 220 | 240 | CLAY, SILT, SAND AND GRAVEL |
| 240 | 250 | CLAY, SAND AND GRAVEL |
| 250 | 255 | GRAVEL AND SAND |
| 255 | 260 | SAND AND WATER |
| 260 | 305 | GRAVEL AND SAND |
| 305 | 325 | SAND |

## Well 4 gwic 243760 (WL004)

**Site Name: THE WILDERNESS CLUB - WELL #4**
**GWIC Id: 243760**

**Section 1: Well Owner**

**Owner Name**
THE WILDERNESS CLUB,

**Mailing Address**
3015 12TH STREET N.E., SUITE 260

| City | State | Zip Code |
|---|---|---|
| CALGARY | ALBERTA | T2E 7J2 |

**Well Address**
1885 SOPHIE LAKE ROAD

| City | State | Zip Code |
|---|---|---|
| EUREKA | MONTANA | 59917 |

**Section 2: Location**

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 37N | 27W | 29 | SW¼ SE¼ SE¼ |

**County**
LINCOLN

**Geocode**

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 48.935632 | 115.133966 | TRS-SEC | NAD83 |

| Altitude | Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

**Section 3: Proposed Use of Water**
PUBLIC WATER SUPPLY (1)

**Section 4: Type of Work**
Drilling Method: ROTARY

**Section 5: Well Completion Date**
Date well completed: Friday, April 25, 2008

**Section 6: Well Construction Details**

**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 40 | 12 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 132 | 8 | 0.25 | | WELDED | A53B STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 132 | 140 | 8 | | 150 | SCREEN-CONTINUOUS-STAINLESS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|

**Section 7: Well Test Data**

Total Depth: 180
Static Water Level: 45.34
Water Temperature:

**Pump Test ***

Depth pump set for test 125 feet.
115 gpm pump rate with 75.37 feet of drawdown after 9 hours of pumping.
Time of recovery 0.15 hours.
Recovery water level 45.34 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

**Section 8: Remarks**

**Section 9: Well Log**

**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 1 | SILTY LOAM |
| 1 | 30 | PALE BROWN 10 YR 6/3 VERY FINE SILTY SAND, DRY |
| 30 | 35 | PALE BROWN 10 YR 6/3 VERY FINE SILTY SAND, DAMP |
| 35 | 40 | BROWN 10 YR 5/3 CLAYEY SILT, DRY |
| 40 | 50 | VERY COARSE GRAVEL, DRY |
| 50 | 55 | COARSE TO VERY COARSE GRAVEL, DRY |
| 55 | 65 | COARSE TO VERY COARSE GRAVEL, WATER |
| 65 | 75 | FINE SAND TO COARSE GRAVEL, WATER |
| 75 | 80 | FINE SAND TO MEDIUM GRAVEL, WATER |
| 80 | 95 | VERY FINE TO FINE SAND, WATER |
| 95 | 100 | SILTY VERY FINE SAND, WATER |
| 100 | 120 | SILTY CLAY, DAMP |
| 120 | 150 | VERY COARSE GRAVEL, WATER |
| 150 | 160 | MEDIUM GRAVEL AND COBBLES, WATER |
| 160 | 180 | SANDY GRAVEL, WATER |

**Driller Certification**
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**JOE LISS
**Company:**JOE LISS WATER WELLS,INC.
**License No:**WWC-625
**Date Completed:**4/25/2008

| | | | |
|---|---|---|---|
| 0 | 40 | GROUT | |

## Well 5 gwic 243807 (WL005)

**Site Name: THE WILDERNESS CLUB - WELL #5**
**GWIC Id: 243807**

**Section 1: Well Owner**

**Owner Name**
THE WILDERNESS CLUB,
**Mailing Address**
3015 12TH STREET N.E., SUITE 260

| City | State | Zip Code |
|---|---|---|
| CALGARY | ALBERTA | T2E 7J2 |

**Well Address**
1885 SOPHIE LAKE ROAD

| City | State | Zip Code |
|---|---|---|
| EUREKA | MONTANA | 59917 |

**Section 2: Location**

| Township | Range | Section | Quarter Sections |
|---|---|---|---|
| 37N | 27W | 29 | SW¼ SE¼ SE¼ |

| County | Geocode |
|---|---|
| LINCOLN | |

| Latitude | Longitude | Geomethod | Datum |
|---|---|---|---|
| 48.935632 | 115.133966 | TRS-SEC | NAD83 |

| Altitude | Method | Datum | Date |
|---|---|---|---|
| | | | |

| Addition | Block | Lot |
|---|---|---|
| | | |

**Section 3: Proposed Use of Water**
PUBLIC WATER SUPPLY (1)

**Section 4: Type of Work**
Drilling Method: ROTARY

**Section 5: Well Completion Date**
Date well completed: Monday, March 10, 2008

**Section 6: Well Construction Details**
**Borehole dimensions**

| From | To | Diameter |
|---|---|---|
| 0 | 40 | 12 |

**Casing**

| From | To | Diameter | Wall Thickness | Pressure Rating | Joint | Type |
|---|---|---|---|---|---|---|
| 0 | 120 | 8 | 0.25 | | WELDED | A53B STEEL |

**Completion (Perf/Screen)**

| From | To | Diameter | # of Openings | Size of Openings | Description |
|---|---|---|---|---|---|
| 120 | 135 | 8 | | 150 | SCREEN-CONTINUOUS-STAINLESS |

**Annular Space (Seal/Grout/Packer)**

| From | To | Description | Cont. Fed? |
|---|---|---|---|
| 0 | 40 | GROUT | |

**Section 7: Well Test Data**

Total Depth: 140
Static Water Level: 57.65
Water Temperature:

**Pump Test** *

Depth pump set for test 115 feet.
210 gpm pump rate with 4.29 feet of drawdown after 72 hours of pumping.
Time of recovery 1 hours.
Recovery water level 57.65 feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

**Section 8: Remarks**

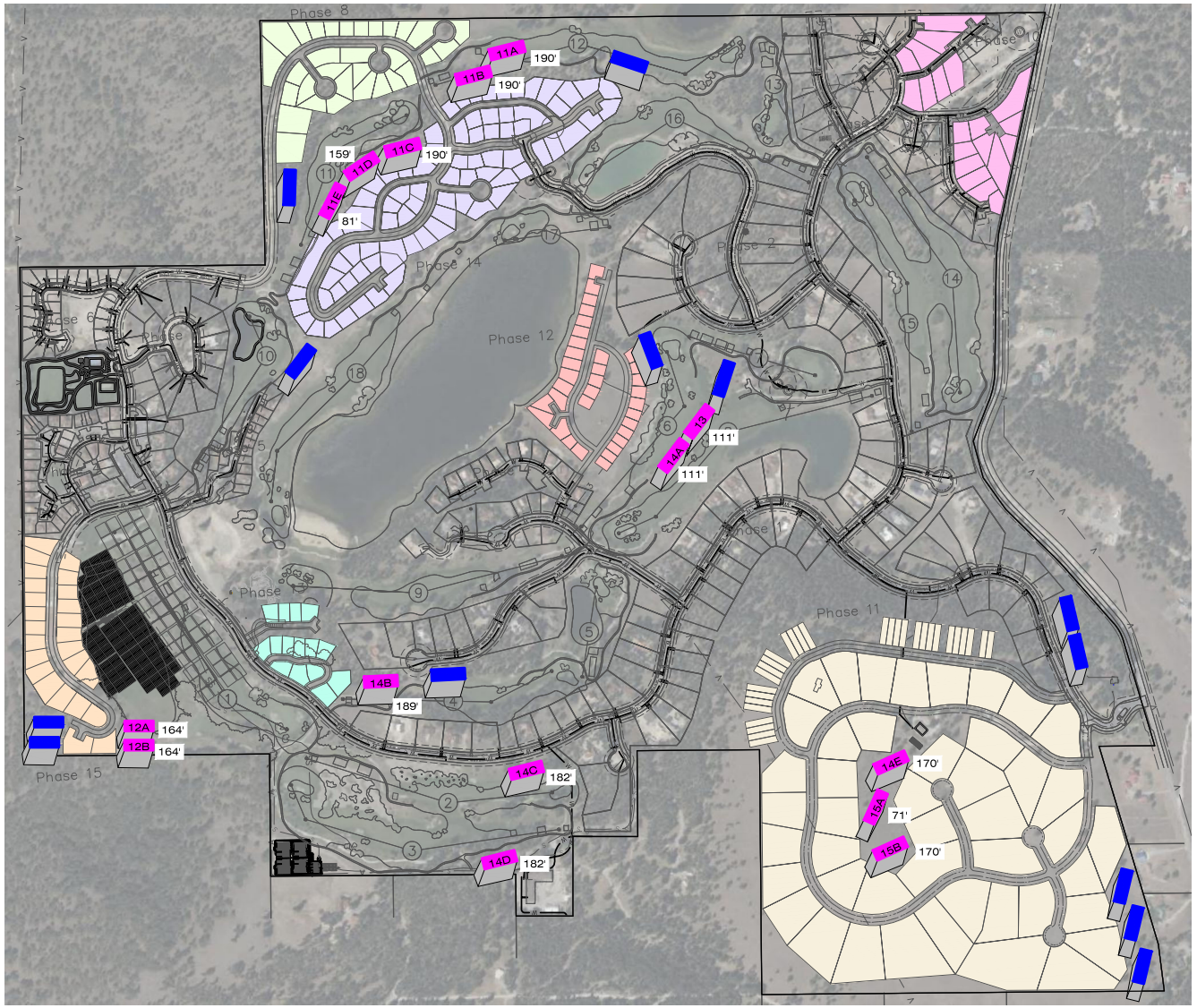
**Section 9: Well Log**
**Geologic Source**
Unassigned

| From | To | Description |
|---|---|---|
| 0 | 1 | SILTY LOAM |
| 1 | 10 | YELLOWISH BROWN 2.5 YR 6/3 VERY FINE SILT, DRY |
| 10 | 15 | LIGHT OLIVE BROWN 2.5 YR 5/3 VERY FINE SANDY SILT, DRY |
| 15 | 25 | GRAYISH BROWN 2.5 YR 5/2 VERY FINE SILTY SAND, DRY |
| 25 | 40 | LIGHT GRAY 2.5 YR 7/2 SILT HARDPAN, DRY |
| 40 | 50 | DARK GRAY 7.5 YR 4/1 FINE SAND WITH MEDIUM TO COARSE GRAVEL, DRY |
| 50 | 55 | MEDIUM SAND TO VERY COARSE GRAVEL, DAMP |
| 55 | 85 | FINE SAND TO MEDIUM GRAVEL, DAMP |
| 85 | 90 | SILTY FINE TO MEDIUM SAND, DAMP |
| 90 | 105 | SILTY FINE SAND, DAMP |
| 105 | 110 | MEDIUM SAND TO VERY COARSE GRAVEL, WATER |
| 110 | 117 | MEDIUM TO VERY COARSE GRAVEL, WATER 100 GPM |
| 117 | 118 | TAN CLAY, DAMP |
| 118 | 135 | POORLY SORTED SANDY GRAVEL AND COBBLES, WATER 200 GPM |
| 135 | 140 | SILTY CLAY WITH MEDIUM TO COARSE GRAVEL MATRIX, DAMP |

**Driller Certification**
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

**Name:**JOE LISS
**Company:**JOE LISS WATER WELLS,INC.
**License No:**WWC-625
**Date Completed:**3/10/2008

# Appendix B. Preliminary Plat Layouts




C:\zworking\wesd01\d4245648\Preliminary SS Layout.dwg, 10/22/2025 2:41 PM, WRIGHT, JOEL

| ISSUE | DATE | DESCRIPTION |
|---|---|---|

PROJECT MANAGER

PROJECT NUMBER

**WILDERNESS CLUB**
**MONTANA**

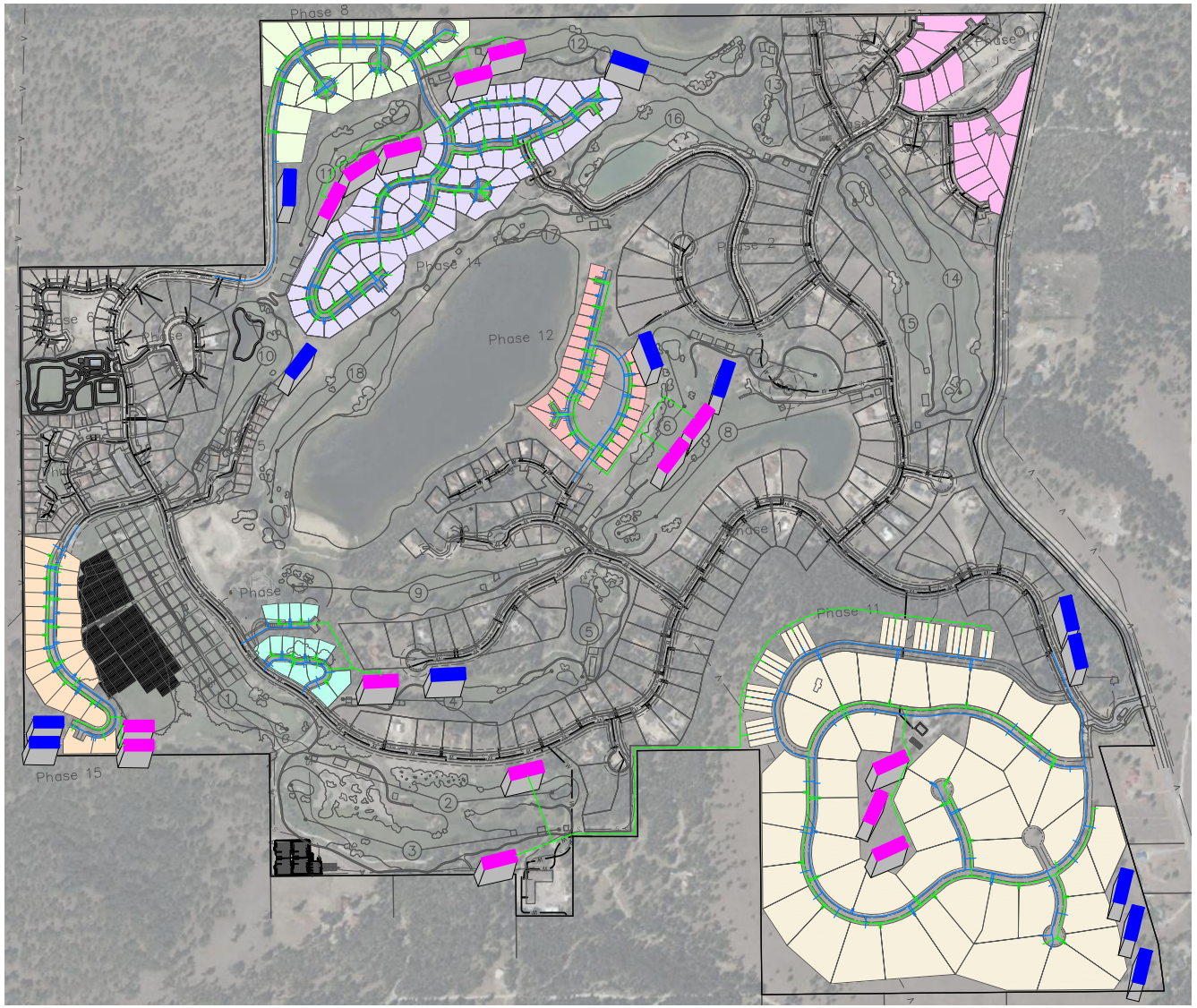
**PRELIMINARY SEWER**
**CONCEPTUAL SITE LAYOUT**

0 1" 2"

FILENAME

SCALE 1" = 300'

SHEET **EX-1**




N

300 0 300 600
SCALE IN FEET

LEGEND

- PRIMARY WITH MIXING ZONE
- REPLACEMENT WITH MIXING ZONE
- PHASE 8
- PHASE 10
- PHASE 11
- PHASE 12
- PHASE 13
- PHASE 14
- PHASE 15
- PROPOSED SEWER
- PROPOSED WATER

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| ISSUE | DATE | DESCRIPTION |
|---|---|---|

PROJECT MANAGER

PROJECT NUMBER

**WILDERNESS CLUB**
**MONTANA**

**PRELIMINARY SEWER**
**SEWER AND WATER SCHEMATIC**

0 1" 2"

FILENAME

SCALE 1" = 300'

SHEET
**EX-2**

# References

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Environmental Protection Agency (EPA). “National Primary Drinking Water Regulations.” *EPA 816-F-09-004*, Office of Ground Water and Drinking Water, May 2009, https://www.epa.gov/sites/default/files/2016-06/documents/npwdr_complete_table.pdf.



# Escalante Wilderness Preserve

Wastewater Facility Preliminary Plat Report

HDR Project No. 10406703

*Lincoln County, Montana*

October 28, 2025

# Escalante Wilderness Preserve

## Lincoln County, Montana

## October 2025

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of Montana.




Zachary Maassen, PE
HDR Engineering, Inc.
220 S. Complex Drive, Ste 105
Kalispell, MT 59901

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# Introduction

This report provides the technical requirements for the proposed wastewater facility improvements to serve at the Escalante Wilderness Preserve development. Additionally, this report provides a non-degradation analysis of the proposed development. The non-degradation evaluation for this project includes a nitrate sensitivity analysis, phosphorus breakthrough analysis, and trigger analysis.

## General Information

This development is located on the formerly developed Wilderness Club Subdivision. The entire site is approximately 140 acres with the current development, Escalante Wilderness Preserve, planned to include 234 single-family residential lots. Previously the Wilderness Club Subdivision completed the development of Phase 1-10, including 320 lots in total. The site includes the following existing wastewater infrastructure.

- Each single-family lot, each condominium, and the clubhouse have an individual E/one GP 2010 grinder pump station, pump raw sewage into a pressure sewer (force main) collection system. Kitchen and associated wastewater from the clubhouse, restaurant, and bar pass through a grease trap prior to the grinder pump station and prior to entering the collection system.
- Wastewater from the collection system is routed to one 215,000-gallon (cast-in-place) concrete community septic tank with four outlets. The septic tank provided primary anaerobic treatment as well as removing floatable and settleable solids. Wastewater gravity flows from the community septic tank to a 145,000-gallon, 4-compartment cast-in-place concrete recirculation tank. Each chamber of the recirculation tank doses separate recirculation sand filters (RSFs). There are four (4) RSFs, each 68 feet x 72 feet.
- Level II wastewater treatment occurs in the RSFs. Each RSF has 6 zones, with each zone having an area of 12 feet x 68 feet. A splitter valve in the recirculation tank sends 3/4ths of the effluent back to the recirculation tank and 1/4$^{th}$ to a 5,000-gallon dose tank. Effluent from the RSFs is routed to one of five dose tanks, which pressure-dose each of the 5 groups of 10 total subsurface drain fields. Each of the 10 subsurface drain fields has six zones. Each zone has an area of 52 feet x 67 feet with eight (8) 67-foot-long laterals in 3-foot standard trenches.
- The site is permitted to discharge a maximum of 96,650 gallons per day (gpd) from a RSF treatment system to a subsurface drain field (Outfall 001), located in the west-southwestern portion of the proposed development.

## Proposed Project

The proposed wastewater improvements include a small diameter pressure sewer system (similar to the existing collection system) and approximately 15 elevated sand mound treatment and disposal systems. The sand mound systems are dedicated to each phase of the project rather than utilizing one large system for all five phases combined. The proposed project is located in Lincoln County west of Hwy. 93, between

Indian Springs and Lake Koocanusa in Northwest ¼ of Section 32, Township 37N, Range 27W, as seen in Figure 1.

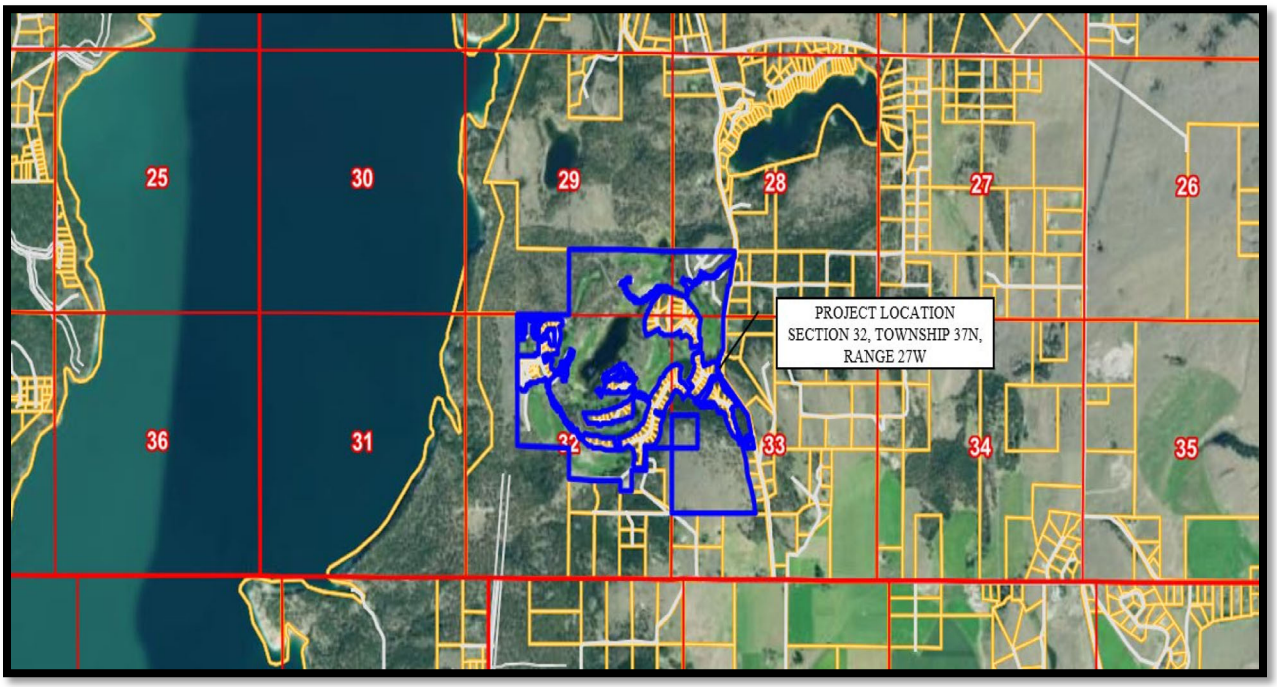



**Figure 1 - Project Location**

## Design Conditions

The proposed Escalante Wilderness Preserve development will serve 234 lot spaces, divided into 5 phases, Phases 11-15, respectively.

To calculate the projected wastewater loadings, 2.5 persons per dwelling and a projected flow rate of 100 gpcd were assumed, consistent with MDEQ Circular 4, Section 3.1.2.B.

The developed wastewater flows loadings for the projected development are shown in Table 1.

| Cumulative Population[1] | Total Flow (gpd)[2] | Total Flow (mgd)[2] | $BOD_5$ (lb/day) | TSS (lb/day) | TN (lb/day) | TP (lb/day) |
|---|---|---|---|---|---|---|
| **585** | 58,500 | 0.059 | 117 | 128.7 | 19.305 | 5.265 |

1. ***Assuming 2.5people per dwelling per Montana Circular DEQ-4, Section 1.2.56***
2. ***Assuming 100 gallons per capita per day per Montana Circular DEQ-2***
3. ***The following values were used for calculation per MDEQ Circular 2, Section 11.253 Organic Capacity of Wastewater Treatment Facilities to Serve New Collection Systems:***

- ***Assuming 0.2 BOD5 lb/capita/day***
- ***Assuming 0.22 TSS lb/capita/day***
- ***Assuming 0.033 TN lb/capita/day***
- ***Assuming 0.009 TP lb/capita/day***

**Table 1 - Wastewater Flow & Loading**

The projected total wastewater production for the project buildout is approximately 0.06MGD.

Impact on Existing Wastewater Facilities: Currently, no existing wastewater facilities are in proximity to the new proposed lots. Therefore, the proposed collection system, lift stations, and elevated sand mounds will all be newly installed as part of this proposed project.

## Project Description

Layout of the new proposed wastewater facility within the 5 associated phases that will collect wastewater from the 234 lots is shown in Figure 2. Flow from each collection system will be distributed to designated septic tanks and treated and discharged utilizing elevated sand mounds.

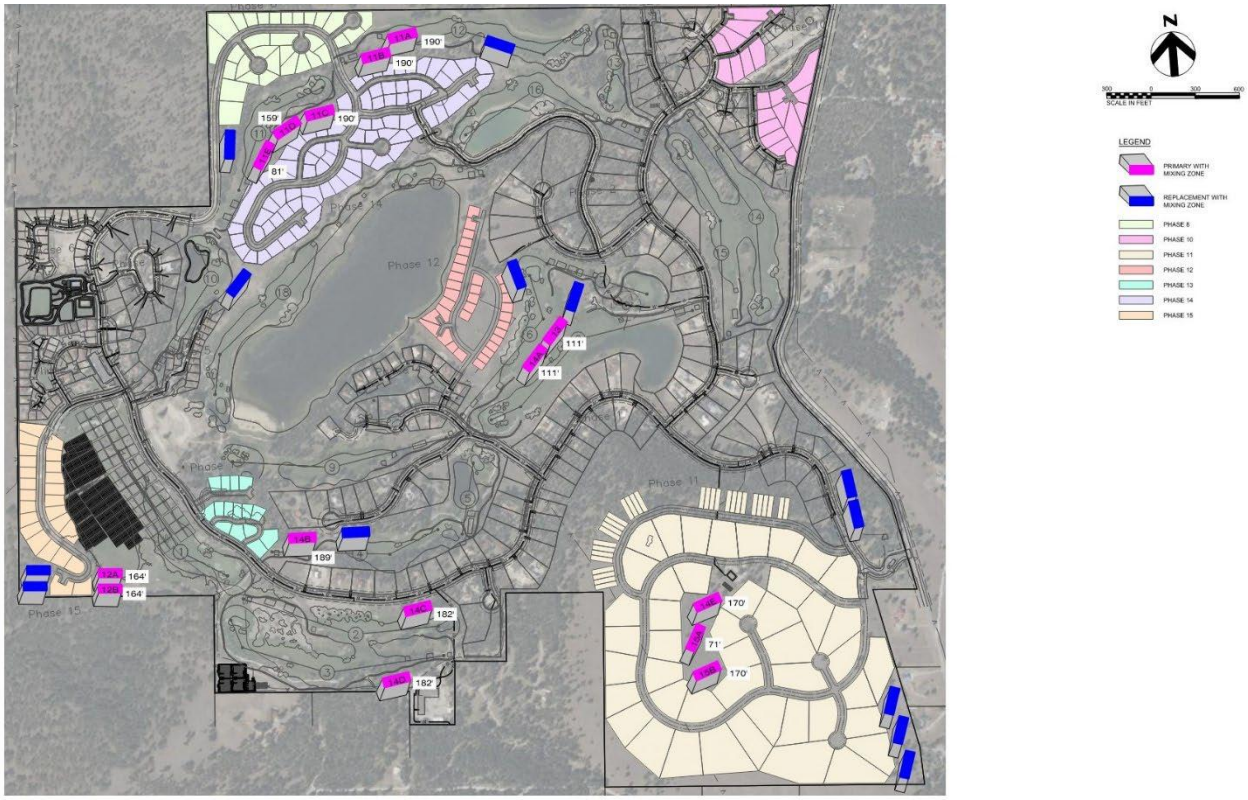



**Figure 2 – Proposed Project Layout**

## Drawings

Drawings of the project site, including the location and alignment of proposed wastewater facilities can be found in Appendix A.

# Design Criteria

Design flow was determined by accounting for the total number of lots, multiplying by the assumed population per dwelling, and then multiplying by the associated typical wastewater flows reference in Table 3.1-2 of MDEQ Circular 4. Each zone capacity was then designed to accommodate the typical flow capacity. Table 3, below, details the breakdown of the total number of lots and units for the wastewater collection system in addition to the total average day flow for each zone in the system. Further details of the proposed design criteria are documented in the following subsections:

## Septic Tank Sizing

According to DEQ 4 and, the minimum capacity of a septic tank is 2.5 times the design flow, resulting in following minimum septic storage capacities shown in Table 2:

| Phase | Design Flow (gpd) | Minimum Storage Capacity (gal)[1] |
|---|---|---|
| **11A - SFH** | 5,250 | 13,125 |
| **11B - SFH** | 5,250 | 13,125 |
| **11C - SFH** | 5,250 | 13,125 |
| **11D - Condo** | 5,600 | 14,000 |
| **11E - Condo** | 4,900 | 12,250 |
| **12A** | 5,950 | 14,875 |
| **12B** | 5,950 | 14,875 |
| **13** | 5,250 | 13,125 |
| **14A** | 5,950 | 14,875 |
| **14B** | 5,950 | 14,875 |
| **14C** | 5,950 | 14,875 |
| **14D** | 5,950 | 14,875 |
| **14E** | 5,950 | 14,875 |
| **15A** | 4,550 | 11,375 |
| **15B** | 4,200 | 10,500 |

**Table 2. Septic Tank Sizing**

As a result, it is anticipated that multiple septic tanks in series will be utilized in accordance with DEQ-4 and Lincoln County standards for each phase.

## Elevated Sand Mound Sizing

The sizing of an elevated sand mound is based on the application rate of the native soil below the mound. In September 2025, site analysis consisting of an 8-foot-deep test pit was completed for each proposed sand mound location. The soils information can be found in Appendix B.

The basal area of the sand mound was sized based on the soil profile in each zone which was predominately loam or sandy loam for all zones and no limiting layers such as groundwater or bedrock were identified. Based on this soil type for each zone, an average application rate of 0.5 gallons per day per square foot of basal area (gpd/ft2) was used for all zones in the system as required by

MDEQ Circular-4, Table 2.1-1. The sizing criteria of the proposed sand mounds are summarized below in Table 3.

| Phase | Number of Lots | Total Wastewater Flow (gpd) | Application Rate (gpd/ft$^2$) | Sand Mound Basal Area (ft$^2$) | Basal L/W Ratio | Basal Length (ft) | Basal Width (ft) |
|---|---|---|---|---|---|---|---|
| **11A - SFH** | 15 | 5,250 | 0.5 | 10,500 | 3:1 | 177 | 59 |
| **11B - SFH** | 15 | 5,250 | 0.5 | 10,500 | 3:1 | 177 | 59 |
| **11C - SFH** | 15 | 5,250 | 0.5 | 10,500 | 3:1 | 177 | 59 |
| **11D - Condo** | 16 | 5,600 | 0.5 | 11,200 | 3:1 | 183 | 61 |
| **11E - Condo** | 14 | 4,900 | 0.5 | 9,800 | 3:1 | 171 | 57 |
| **12A** | 17 | 5,950 | 0.5 | 11,900 | 3:1 | 189 | 63 |
| **12B** | 17 | 5,950 | 0.5 | 11,900 | 3:1 | 189 | 63 |
| **13** | 15 | 5,250 | 0.5 | 10,500 | 3:1 | 177 | 59 |
| **14A** | 17 | 5,950 | 0.5 | 11,900 | 3:1 | 189 | 63 |
| **14B** | 17 | 5,950 | 0.5 | 11,900 | 3:1 | 189 | 63 |
| **14C** | 17 | 5,950 | 0.5 | 11,900 | 3:1 | 189 | 63 |
| **14D** | 17 | 5,950 | 0.5 | 11,900 | 3:1 | 189 | 63 |
| **14E** | 17 | 5,950 | 0.5 | 11,900 | 3:1 | 189 | 63 |
| **15A** | 13 | 4,550 | 0.5 | 9,100 | 3:1 | 165 | 55 |
| **15B** | 12 | 4,200 | 0.5 | 8,400 | 3:1 | 159 | 53 |

**Table 3. WWTS Sizing Criteria**

### Collection System Sizing

The collection system for each phase will consist of a pressurized small diameter system utilizing individual grinder pumps at each house. The final size of the collection system will vary per phase and will be dictated by detailed hydraulic analysis, but it is anticipated that the collection mains will be 3 and 4-inches in diameter, which matches the size of the collection system serving the Wilderness Club development.

## Non-degradation Analysis

This section provides an analysis of the non-degradation requirements as defined in the Administrative Rules of Montana (ARM) 17.30.715(1) for the proposed Escalante Wilderness Preserve development. The non-degradation evaluation for this project includes a nitrate sensitivity analysis, phosphorus breakthrough analysis, and trigger analysis. Discussion on each of these items, including how the various parameters were determined, is presented below.

## Groundwater Flow and Gradient

The direction of groundwater flow and hydraulic gradient was developed using the MBMG Ground Water Open-File Report 24 - Montana Bureau of Mines and Geology Preliminary Potentiometric Surface and Location of Selected Wells, Tobacco Plains Aquifer System, Eureka, Montana. See Figure 3 below. This document illustrates the groundwater flow direction as being generally southwest. This groundwater flow direction is consistent with the determination of Kendy and Tresch (1996)[1] which estimates the groundwater flow may generally flow subparallel to the river north to south and possibly northeast to southwest.

Using Equation 1 below, the hydraulic gradient was calculated by dividing the groundwater elevation at two points, by the distance between the elevation contours. Using this equation and the potentiometric surface map shown in Figure 3, the hydraulic gradient is calculated to be 0.006 ft/ft.

**Equation 1. Hydraulic Gradient**

$$Hydraulic\ Gradient = \frac{(h1 - h2)}{L} = (\frac{2514ft - 2500ft}{2300ft}) = 0.006ft/ft$$

*where:*

- *h1 represents the elevation at the starting point*
- *h2 represents the elevation at the ending point*
- *L represents the length of the flow path between the two points.*

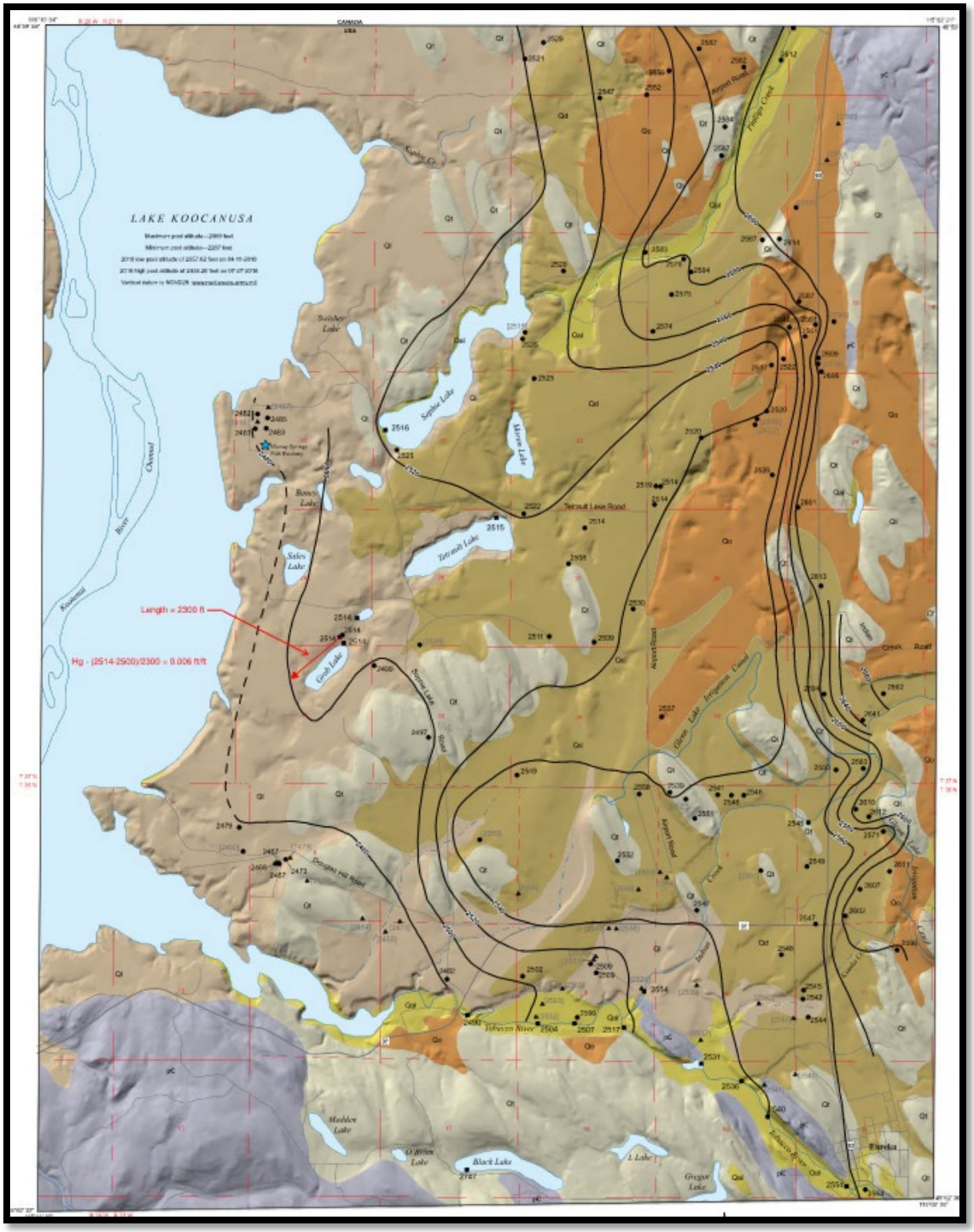



**Figure 3. Preliminary Potentiometric Surface Map**

[1] Kendy, Eloise, and Ruth E Tresch. "GEOGRAPHIC, GEOLOGIC, AND HYDROLOGIC SUMMARIES OF INTERMONTANE BASINS OF THE NORTHERN ROCKY MOUNTAINS, MONTANA." *US Geological Survey*, Aug. 1996, GEOGRAPHIC, GEOLOGIC, AND HYDROLOGIC SUMMARIES OF INTERMONTANE BASINS OF THE NORTHERN ROCKY MOUNTAINS, MONTANA.

## Hydraulic Conductivity, K, Determination

The hydraulic conductivity was calculated using information from three wells in the immediate vicinity of the project site. Table 4 below illustrates the well information used in this calculation. The K value calculations and supporting well logs can be found in Appendix C.

| Well | WC North Well 4 | WC South Well 3 | WC Well 5 |
|---|---|---|---|
| **GWIC Well ID** | 235581 | 235580 | 243807 |
| **Yield (gpm)** | 1000 | 1000 | 210 |
| **Static Water Level** | 11.37 | 14.15 | 57.65 |
| **Pumping Water Level** | 40 | 40 | 115 |
| **Drawdown** | 28.63 | 25.85 | 57.35 |
| **Transmissivity** | 12326.44 | 13199.56 | 2720.05 |
| **Well Depth** | 54 | 58 | 140 |
| **Casing Depth** | 54 | 58 | 120 |
| **Slot Length** | N/A | N/A | 15 |
| **Open Bottom** | 10 | 10 | N/A |
| **Aquifer Depth** | 10 | 10 | 15 |

**Table 4. Project Vicinity Well Summary**

Equation 2 and 3 below were used in the calculation of hydraulic conductivity:

**Equation 2. Razack- Huntley Equation:**

$$T = 33.6\left(\frac{Q * 192.5}{s}\right)^{0.67}$$

where:

- *T= transmissivity ($ft^2$/day)*
- *Q= pumping rate (gallons per minute)*
- *s= drawdown (feet)*
- *192.5= pumping rate unit conversion factor to convert from gallons per minute to $ft^3$ /day*
- *33.6=constant*

**Equation 3. Converting T to Hydraulic Conductivity, K:**

$$K = \frac{T}{b}$$

where:

- *K= hydraulic conductivity (ft/day)*
- *T= transmissivity ($ft^2$/day)*
- *b= aquifer thickness (ft)*

Based on the information provided, hydraulic conductivity is estimated to be 911.31 feet per day. The calculations of the K values and supporting well log documentation are included in Appendix C.

**Nitrate Sensitivity Analysis**

The nitrate sensitivity analysis estimates the nitrate concentration at the end of an established mixing zone downgradient from a subsurface wastewater treatment system. A mixing zone is defined by State law and by the Administrative Rules of Montana as an area of wastewater discharge as it enters the receiving groundwater. The mixing zones can range from 100 to 500 feet; however, source specific mixing zone lengths can be requested.

The nitrate concentration at the end of the mixing zone cannot exceed 5.00 mg/L. Should the nitrate concentration exceed this value, additional treatment will be required to reduce the strength of the wastewater (i.e. reduce the influent nitrate concentration) prior to discharge to the ground. If additional treatment is provided, the allowable nitrate concentration at the end of the mixing zone increases to 7.5 mg/L.

The nitrate sensitivity analysis is completed using a spreadsheet provided by Montana DEQ. The variables or required inputs into the spreadsheet are listed below:

- Hydraulic conductivity, K (ft/day) = 911 ft/day (Appendix C)
- Hydraulic gradient, I (ft/ft) = 0.006ft/ft (Equation 1, Section 11.11.1)
- Background Nitrate, Ng (mg/L) = 0.065 (Appendix D)
- Number of Single-Family Homes= varies per phase (Appendix E, WWTS Sizing)
- Mixing Zone Length (ft) = 100 ft

Using the nitrate sensitivity analysis spreadsheet and the input values noted above, the resulting nitrate concentration at the end of each mixing zone for each phase is summarized in Table 5 below.

| Phase | End of Mixing Zone Nitrate Concentration (mg/L) |
|---|---|
| **11A** | 1.78 |
| **11B** | 1.78 |
| **11C** | 1.78 |
| **11D** | 2.06 |
| **11E** | 2.83 |
| **12A** | 2.11 |
| **12B** | 2.11 |
| **13** | 2.46 |
| **14A** | 2.69 |
| **14B** | 1.94 |
| **14C** | 1.98 |
| **14D** | 1.98 |
| **14E** | 2.06 |
| **15A** | 2.90 |
| **15B** | 1.66 |

**Table 5. End of Mixing Zone Nitrate Concentrations per Phase**

Additionally, it is important to consider the impact of cumulative effects, or the effect of an upgradient treatment system on a downgradient mixing zone within a separate phase. The nitrate concentrations taking into consideration the potential cumulative effects are summarized in Table 6 below.

| Phase | End of Mixing Zone Cumulative Nitrate Concentration (mg/L) |
|---|---|
| **11A** | 1.52 |
| **11B** | 2.64 |
| **11C** | 1.78 |
| **11D** | 1.64 |
| **11E** | 3.12 |
| **12A** | 1.90 |
| **12B** | 3.32 |
| **13** | 1.80 |
| **14A** | 3.79 |
| **14B** | 1.94 |
| **14C** | 1.50 |
| **14D** | 2.81 |
| **14E** | 1.66 |
| **15A** | 3.87 |
| **15B** | 1.66 |

**Table 6. End of Mixing Zone Cumulative Nitrate Concentrations per Phase**

The detailed nitrate calculation spreadsheets are included as Appendix F.

### Phosphorus Breakthrough Analysis

The Phosphorus Breakthrough Analysis determines if there is sufficient soil adsorption capacity prior to the effluent from the subsurface wastewater treatment system reaches surface water and is measured in breakthrough time (years). The phosphorus breakthrough time cannot be less than 50 years.

The phosphorus breakthrough analysis uses the same assumptions as the nitrate sensitivity analysis. The one fundamental difference is distance to surface water. Also, the calculation is made using the phosphorus breakthrough analysis spreadsheet provided by Montana DEQ.

Two of the surface water bodies in question include ponds located to the northeast and southwest of Grob Lake which are downgradient of Phases 11C, 11D, 11E, 13, and 14A. These ponds are man-made surface water bodies. As required by MDEQ Public Water and Subdivisions Bureau[2] in Section 3.4 of "How to Perform a Non-degradation Analysis for Subsurface Wastewater Treatment Systems (SWTS) Under the Subdivision Review Process", if a man-made water body is constructed and lined with an impermeable liner, which does not allow the effluent to enter the pond, then the non-degradation analysis does not have to assess impact to the water body.

The downgradient water bodies that have been considered in the phosphorus breakthrough analysis include (Kootenai River, Northwest Lined Pond, Southeast Lined Pond). Table 7 summarizes the breakthrough time for each phase for each controlling water body.

| Phase | Closest Water Body in Proximity of Groundwater Flow | Distance to Water Body in Direction of Groundwater Flow (ft) | Breakthrough Time to Surface Water (years) |
|---|---|---|---|
| **11A** | Kootenai River | 11,800 | 1,507 |
| **11B** | Kootenai River | 11,500 | 1,438 |
| **11C** | Kootenai River | 11,200 | 1,370 |
| **11D** | Kootenai River | 11,000 | 1,211 |
| **11E** | Kootenai River | 10,600 | 1,200 |
| **12A** | Kootenai River | 7,400 | 1,111 |
| **12B** | Kootenai River | 7,300 | 1,085 |
| **13** | Kootenai River | 10,000 | 2,055 |
| **14A** | Kootenai River | 10,000 | 1,815 |
| **14B** | Kootenai River | 8,600 | 754 |
| **14C** | Kootenai River | 9,000 | 1,608 |
| **14D** | Kootenai River | 8,200 | 1,361 |
| **14E** | Kootenai River | 9,800 | 934 |
| **15A** | Kootenai River | 9,500 | 1,038 |
| **15B** | Kootenai River | 10,000 | 1,366 |

**Table 7. Phosphorus Breakthrough Analysis**

[2] Montana Department of Environmental Quality. "HOW TO PERFORM A NONDEGRADATION ANALYSIS FOR SUBSURFACE WASTEWATER TREATMENT SYSTEMS (SWTS) UNDER THE SUBDIVISION REVIEW PROCESS." *Public Water and Subdivision Bureau*, Oct. 2015, How to Perform a Nondegradation Analysis

Based on the phosphorus breakthrough analysis, all phases meet the minimum requirements of 50 years or more to breakthrough. The detailed phosphorus breakthrough analysis spreadsheets for each phase as are included in Appendix G.

According to Montana DEQ, if any part of two drain fields overlaps, as measured in the direction of ground-water flow, cumulative impacts must be addressed. To determine the cumulative effects for two drain fields, the phosphorous equation should be completed using the distance from the upgradient drain field through the downgradient drain field as the “distance from drain field to surface water” in the equation. If breakthrough is greater than 50 years, there is no cumulative effect, and the phosphorous equation should be run as usual from the downgradient drain field. If breakthrough is greater than 50 years, the additional difference is NOT applied to the next set of drain field calculations. However, if breakthrough from the first to the second drain field is less than 50 years, the calculations for the downgradient drain field must account for the cumulative effects. For example, if the breakthrough from the upgradient to downgradient drain field is 35 years, then the breakthrough from the downgradient drain field to surface water must account for the additional 15 years. Therefore, the breakthrough for the downgradient drain field must be at least 65 years (50 years plus the 15 years left over from the first drain field) to the surface water to be nonsignificant degradation of state waters

As shown in the attached worksheets and Table 8, cumulative breakthrough time from all drain fields is summarized below:

| Phosphorus Breakthrough Calculation | Phase | Breakthrough Time between Mounds (years) | Distance Mound to Mound (ft) | Distance to Surface Water (ft) | Breakthrough Time to Surface Water (years) | Cumulative Breakthrough Time to Surface Water (years) |
|---|---|---|---|---|---|---|
| **Mound to Mound** | 11A to 11B | 26.70 | 507.00 | | | |
| **Mound to Mound** | 11B to 11C | 37.52 | 846.00 | | | |
| **Mound to Surface Water** | 11C to SW | | | 11200.00 | 1370.92 | |
| **Cumulative** | 11A-11C | | | | | **1435.14** |
| **Mound to Mound** | 11D to 11E | 27.75 | 543.00 | | | |
| **Mound to Surface Water** | 11E to SW | | | 10600.00 | 1200.08 | |
| **Cumulative** | 11D- 11E | | | | | **1227.83** |
| **Mound to Mound** | 12A to 12B | 20.94 | 293.00 | | | |
| **Mound to Surface Water** | 12B to SW | | | 7300.00 | 1085.02 | |
| **Cumulative** | 12A-12B | | | | | **1105.96** |
| **Mound to Mound** | 13 to 14A | 27.46 | 533.00 | | | |
| **Mound to Surface Water** | 14A to SW | | | 10000.00 | 1815.73 | |
| **Cumulative** | 13-14A | | | | | **1843.19** |
| **Mound to Surface Water** | 14B | | | 8600.00 | 754.06 | |
| **Mound to Mound** | 14C to 14D | 34.55 | 759.00 | | | |
| **Mound to Surface Water** | 14D to SW | | | 8200.00 | 1361.93 | |
| **Cumulative** | 14C-14D | | | | | **1396.48** |
| **Mound to Mound** | 14E to 15A | 27.40 | 531.00 | | | |
| **Mound to Surface Water** | 15A to SW | | | 9500.00 | 1038.25 | |
| **Cumulative** | 14E-15A | | | | | **1065.65** |
| **Mound to Surface Water** | 15B | | | 10000.00 | 1366.75 | |

**Table 8. Cumulative Phosphorus Breakthrough Analysis**

In each cumulative scenario, the breakthrough from the first to the second drain field was less than 50 years and the calculations for the downgradient drain field had to account for the cumulative effects. However, for all scenarios, the phosphorus breakthrough exceeded the threshold value of 50 years.

### Trigger Analysis

Under MDEQ guidance, the proposed wastewater treatment systems are greater than ½ mile from a stream or river. Therefore, the project is exempt from a Trigger Analysis.

# APPENDIX A

# Wilderness Club Record Drawings, April 2010

# THE WILDERNESS CLUB
# FOR
# WILDERNESS DEVELOPMENT L.L.C.




SITE PLAN
SCALE 1" = 4000'


GENERAL
G-1 SHEET INDEX, SITE VICINITY MAP
G-2 GENERAL NOTES, LEGEND

DRAINAGE & ROAD PLANS
C-100 SITE ROAD AND DRAINAGE PLAN

SANITARY SEWER COLLECTION AND TREATMENT SYSTEM
C-200 SITE SANITARY SEWER PLAN
C-201A SEWER FORCEMAIN TO COLLECTION PLAN & PROFILE 0+00 to 13+00
C-201B SEWER FORCEMAIN TO COLLECTION PLAN & PROFILE 13+00 TO 19+92.40
C-202 WILDERNESS CLUB DRIVE_A SEWER PLAN & PROFILE 0+00 TO 15+00
C-203 WILDERNESS CLUB DRIVE_A SEWER PLAN & PROFILE 15+00 TO 23+47.78
WILDERNESS CLUB DRIVE_B SEWER PLAN & PROFILE 0+00 TO 5+00
C-204 WILDERNESS CLUB DRIVE_B SEWER PLAN & PROFILE 5+00 TO 18+00
C-205 WILDERNESS CLUB DRIVE_B SEWER PLAN & PROFILE 18+00 TO 21+74.74

C-211 GLACIER PEAKS SEWER PLAN & PROFILE 0+00 TO 15+00
C-212 GLACIER PEAKS SEWER PLAN & PROFILE 15+00 TO 30+00

C-214 COLD CREEK PLACE SEWER PLAN & PROFILE
C-215 KEEL COURT SEWER PLAN & PROFILE

C-216 POWDER RUN SEWER PLAN & PROFILE 0+00 TO 15+00
C-217 POWDER RUN SEWER PLAN & PROFILE 15+00 TO 17+56.45
WILDERNESS LODGE SEWER PLAN & PROFILE

C-219 WILDERNESS CLUB DRIVE_C SEWER PLAN & PROFILE 0+00 TO 15+00
C-220 WILDERNESS CLUB DRIVE_C SEWER PLAN & PROFILE 15+00 TO 30+00

C-226 GIBRALTER RIDGE COURT SEWER PLAN & PROFILE

C-227 TELEMARK LANE SEWER PLAN & PROFILE

C-230 SEWER COLLECTION DETAILS
C-231 SEPTIC TANK-RECIRCULATING SAND FILTER LAYOUT
C-232 RECIRCULATING SAND FILTER DETAILS
C-233A DRAINFIELD LAYOUT, 72 ZONE LAYOUT
C-233B DRAINFIELD LAYOUT, 6 ZONE LAYOUT
C-234 DRAINFIELD DETAIL
C-235A SEPTIC TANK PLAN AND SECTION DETAIL
C-235B SEPTIC TANK DETAILS
C-236A RECIRCULATING TANK PLAN AND SECTION DETAIL
C-236B RECIRCULATING TANK DETAILS
C-237 SEWER FACILITY SITE DETAILS


Located in :
Sections 28,29,32 and 33, T 37N, R 27W,
Lincoln County, Montana.


SUBDIVIDER:
WILDERNESS DEVELOPMENT L.L.C.
SUITE 260,3015 12 TH. ST NE
CALGARY AB, CANADA T2E7J2
TEL. 403.291.3010

ENGINEER:
APEC INC.
100 FINANCIAL DRIVE, SUITE # 120
KALISPELL, MT 59901
TEL. 406-755-1333



WATER SYSTEM
C-300 WATER SITE PLAN
C-301 WILDERNESS CLUB DIRVE WATER PLAN & PROFILE 0+00 TO 14+00
C-302 WILDERNESS CLUB DRIVE WATER PLAN & PROFILE 14+00 TO 29+00
C-303 WILDERNESS CLUB DRIVE WATER PLAN & PROFILE 29+00 TO 44+00
C-304 WILDERNESS CLUB DRIVE WATER PLAN & PROFILE 44+00 TO 58+00
C-305 WILDERNESS CLUB DRIVE WATER PLAN & PROFILE 58+00 TO 73+00

C-310 GLACIER PEAK WATER PLAN & PROFILE 0+00 TO 14+00
C-311 GLACIER PEAK WATER PLAN & PROFILE 14+00 TO 28+00

C-313 COLD CREEK PLACE WATER PLAN & PROFILE

C-315 POWDER RUN WATER PLAN & PROFILE 0+00 TO 15+00
C-316 POWDER RUN WATER PLAN & PROFILE 15+00 TO END
WILDERNESS LODGE ROAD WATER PLAN & RPOFILE

C-318 BOULDER LANE/MAINT. BLDG. ROAD WATER PLAN & PROFILE 15+00 TO 23+00

C-321 TELEMARK LANE WATER PLAN & PROFILE
C-322 GIBRALTER RIDGE ROAD WATER PLAN & PROFILE
WHITEWATER PLACE WATER PLAN & PROFILE

C-324 BIG CANYON WATER PLAN & PROFILE

C-325 BIG CANYON WATER PLAN & PROFILE 7+00 TO 22+00
C-326 BIG CANYON WATER PLAN & PROFILE 22+00 TO 25+00
WELL TO PUMP HOUSE WATER SUPPLY PLAN & PROFILE 0+00 TO 9+00
C-327 WELL TO PUMP HOUSE WATER SUPPLY PLAN & PROFILE 9+00 TO 21+00
C-328 WELL TO PUMP HOUSE WATER SUPPLY PLAN & PROFILE 21+00 TO 28+00

C-334 WATER DETAILS_A
C-335 PUMP HOUSE DETAILS

C-337 WATER STORAGE RESERVOIR PLAN DETAIL
C-338 WATER STORAGE RESERVOIR SECTIOIN DETAILS
C-339 WATER STORAGE RESERVOIR SECTIOIN DETAILS


RECORD DRAWINGS

REVISIONS

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Kalispell, Montana - 406.755.1333 - www.apec-mt.com

THE WILDERNESS CLUB
FOR
WILDERNESS DEVELOPMENT L.L.C.
SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

TITLE SHEET & SHEET INDEX

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

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# GENERAL NOTES :

1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE DRAWINGS FOR "THE WILDERNESS CLUB" SHEETS DATED MARCH 12, 2007
2. CONTRACTOR SHALL SUBMIT TO THE ENGINEER A SCHEDULE OF CONSTRUCTION OPERATIONS PRIOR TO INITIATION OF IMPROVEMENTS AND DURING CONSTRUCTION.
3. CONTRACTOR SHALL OBTAIN ANY REQUIRED AIR QUALITY PERMITTING PRIOR TO CONDUCTING OPERATIONS. AN APPROACH PERMIT WILL BE REQUIRED FOR THE APPROACHES TO SOPHIE LAKE ROAD.
4. EACH STREET, ALLEY, AND DRIVEWAY SHALL BE AVAILABLE FOR PUBLIC USE AT THE END OF EACH DAY.
5. ANY DAMAGE DONE TO OFF SITE EXISTING IMPROVEMENTS AS A RESULT OF CONSTRUCTION SHALL BE REPAIRED OR REPLACED AT THE CONTRACTORS EXPENSE.
6. ALL TREES, SHRUBS, LAWN AREAS, ETC., OTHER THAN THOSE MARKED FOR REMOVAL WHICH ARE DAMAGED OR DESTROYED DURING CONSTRUCTION OPERATIONS SHALL BE REPLACED OR REPAIRED TO THE SATISFACTION OF THE PROPERTY OWNER AT NO ADDITIONAL COST TO THE OWNER.
7. CONTRACTOR SHALL PROVIDE AND MAINTAIN ALL NECESSARY WARNING SIGNS, BARRICADES, HAZARD LIGHTING SYSTEMS AND TRAFFIC DELINEATORS FOR PUBLIC SAFETY AND TRAFFIC CONTROL AT ALL TIMES.
8. QUANTITIES SHOWN ON THE PLANS ARE FOR ESTIMATES ONLY. ACTUAL QUANTITIES TO BE USED FOR THE PURPOSE OF PAYMENT SHALL BE FIELD MEASURED AND VERIFIED AS HAVING BEEN CONSTRUCTED IN PLACE.
9. THE CONTRACTOR IS REQUIRED TO FURNISH BACKFILL MATERIAL BY IMPORTING FROM A SOURCE APPROVED BY THE ENGINEER.
10. ALL WASTE AND UNACCEPTABLE EXCESS MATERIALS SHALL BE DISPOSED OF BY THE CONTRACTOR. DISPOSAL AREAS ARE TO BE PROVIDED BY THE CONTRACTOR. THE HAUL ROUTE SHALL BE APPROVED BY THE MONTANA DEPARTMENT OF HIGHWAYS, COUNTY, CITY AND THE ENGINEER. ALL ACCEPTABLE EXCESS MATERIAL SHALL BE PLACED ONSITE AS INDICATED IN THE PLANS.
11. CONTRACTOR SHALL AT ALL TIMES CONDUCT HIS OPERATIONS SO THAT THERE IS A MINIMUM INTERRUPTION IN THE USE OF STREETS ROADS, ALLEYS AND ANY HIGHWAY INVOLVED.
12. CONTRACTOR SHALL CONDUCT ALL HIS OPERATIONS ENTIRELY WITHIN THE LAND AND RIGHT-OF-WAY PROVIDED, UNLESS HE RECEIVES WRITTEN PERMISSION FROM ANY ENCROACHED UPON PROPERTY OWNER SO INDICATING HE HAS AUTHORITY TO DO OTHERWISE.
13. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGES, FIRE OR THEFT RESULTING FROM THE PERFORMANCE OF CONSTRUCTION OPERATIONS.
14. LOCATION OF UTILITIES SHOWN ON THESE PLANS ARE APPROXIMATE. UTILITIES SHOWN MAY NOT BE COMPREHENSIVE, COMPLETE, OR ACCURATE. UNDERGROUND UTILITIES WERE NOT LOCATED FOR THIS PLAN. IT IS THE RESPONSIBILITY OF CONTRACTOR TO CONTACT THE APPROPRIATE UTILITY COMPANY AND VERIFY THE EXACT LOCATION OF THE UTILITIES WITHIN THE CONSTRUCTION LIMITS. ANY DAMAGE TO EXISTING UTILITIES SHALL BE REPAIRED OR REPLACED AT CONTRACTORS EXPENSE.
15. ANY COST ASSOCIATED WITH RELOCATION OR REINSTALLATION OF ANY EXISTING UTILITIES OR PRIVATE PROPERTY IMPROVEMENT, CULVERTS IN DRIVEWAYS OR WATER SERVICE LINES AND/OR CURB STOPS TO ELIMINATE CONFLICTS THAT BECOME APPARENT IN PERFORMANCE OF THE WORK ASSOCIATED WITH THIS CONTRACT SHALL BE DEEMED INCIDENTAL AND INCLUDED IN THE UNIT PRICE SO INDICATED IN THE APPROPRIATE ITEMS. NO EXTRA COMPENSATION WILL BE ALLOWED.
16. WHERE SEWER MAIN AND/OR SERVICE CONNECTIONS REQUIRE EXCAVATION ACROSS OR WITHIN A GRAVEL ROAD, THE MATERIAL SHALL BE STOCKPILED FOR REUSE.
17. SIZES OF ANY WOOD MEMBER CALL-OUTS ARE NOMINAL, e.g. 2" x 6" (ACTUAL = 1-1/2" x 5-1/2").
18. ONLY DRAWINGS STAMPED "APPROVED FOR CONSTRUCTION" IN RED INK, DATED AND INITIALED BY THE ENGINEER ON THE FIRST DRAWINGS SHEET SHALL BE ACCEPTABLE FOR CONSTRUCTION. CONTRACTORS SHALL BE RESPONSIBLE FOR VERIFYING THAT THE DRAWINGS FROM WHICH THEY ARE WORKING ARE CURRENT.
19. GENERAL CONTRACTORS AND SUBCONTRACTORS SHALL ONLY ACCEPT FULL SETS OF DRAWINGS. PHASE 1 & 2 CONSTRUCTION INCLUDES SHEETS ILLUSTRATED IN BOLD LISTED IN THE SHEET INDEX. ITALIC SHEETS ARE RESERVED FOR FUTURE PHASES OF CONSTRUCTION.
20. WATER AND SEWER SERVICE / WATER AND SEWER MAIN CONNECTIONS AT EACH PROPERTY LINE SHALL BE SEPARATED BY A MINIMUM OF 10' (TEN) FEET HORIZONTALLY AND 18" (INCHES) VERTICALLY AT ALL CROSSINGS.
21. THE BUILDING AND SITE DEVELOPMENT SHALL COMPLY WITH THE LATEST EDITIONS OF ALL NATIONAL CODES AND STANDARDS INCLUDING ANY ADDENDA, SUPPLEMENTS, AMENDMENTS, OR MODIFICATIONS BY NATIONAL, STATE, OR LOCAL AUTHORITIES HAVING JURISDICTION AS FOLLOWS:
    - A INTERNATIONAL BUILDING CODE (IBC), INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS.
    - B UNIFORM PLUMBING CODE (UPC), INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS.
    - C INTERNATIONAL MECHANICAL CODE (IMC), INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS.
    - D NATIONAL ELECTRIC CODE (NEC), OF THE NATIONAL FIRE PROTECTION ASSOCIATION.
    - E LIFE SAFETY CODE (LSC), NATIONAL FIRE PROTECTION ASSOCIATION.
    - F INTERNATIONAL FIRE CODE (IFC), INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS AND WESTERN FIRE CHIEFS ASSOCIATION, INC.
    - G NATIONAL FIRE CODE (NFC), NATIONAL FIRE PROTECTION ASSOCIATION.
    - H SNOW LOAD ANALYSIS FOR MONTANA, THE STRUCTURAL ENGINEERS OF MONTANA.
    - I AMERICANS WITH DISABILITIES ACT OF 1994.
    - J ALL LOCAL AND STATES CODES.
    - K INTERNATIONAL ENERGY CONSERVATION CODE
22. ALL UTILITY WORK SHALL COMPLY WITH THE LATEST EDITION OF THE MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS, AND LINCOLN COUNTY STANDARDS FOR DESIGN AND CONSTRUCTION.
23. ALL CONCRETE TO BE A MINIMUM OF 3,500 PSI AFTER 28 DAYS, SLAB TO BE 4,000 PSI CONCRETE.
24. ALL CONSTRUCTION TO CONFORM WITH APPLICABLE COVENANTS AND SUBDIVISION REGULATIONS.

## LEGEND

- SEWER LINE
- WATER LINE
- DRAINAGE EASEMENT
- PROPERTY LINE
- ROAD CENTER LINE
- DRAINAGE DIRECTION
- RIP RAP LINED DRAINAGE SWALE
- 12 SEWER ZONE DESIGNATION
- (9) GOLF HOLE NUMBER
- PROPOSED CABIN SITE
- SEWER FLOW DIRECTION
- FIRE HYDRANT
- WATER GATE VALVE
- WATER OR SEWER REDUCER
- DRAINFIELD PRIMARY ZONE
- DRAINFIELD REPLACEMENT ZONE

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THE WILDERNESS CLUB
FOR
WILDERNESS DEVELOPMENT L.L.C.
SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

GENERAL NOTES, LEGEND

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

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RECORD DRAWINGS - APRIL 2010

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# THE WILDERNESS CLUB
FOR
# WILDERNESS DEVELOPMENT L.L.C.

SEC. 28, 29, 32 & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

ROAD SITE PLAN

JOB NUMBER 1213.05
DRAWING REF. A1.0
DATE 8-15-2007

C

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RECORD DRAWINGS - APRIL 2010

SITE PLAN
SCALE 1" = 300'

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THE WILDERNESS CLUB
FOR
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SEC. 28, 29, 32, & 33, T32N, R27W, LINCOLN COUNTY, STATE OF MONTANA

SITE SEWER PLAN

JOB NUMBER: 1321/05
DRAWN BY: AJM
DATE: 3/12/2007

C

200

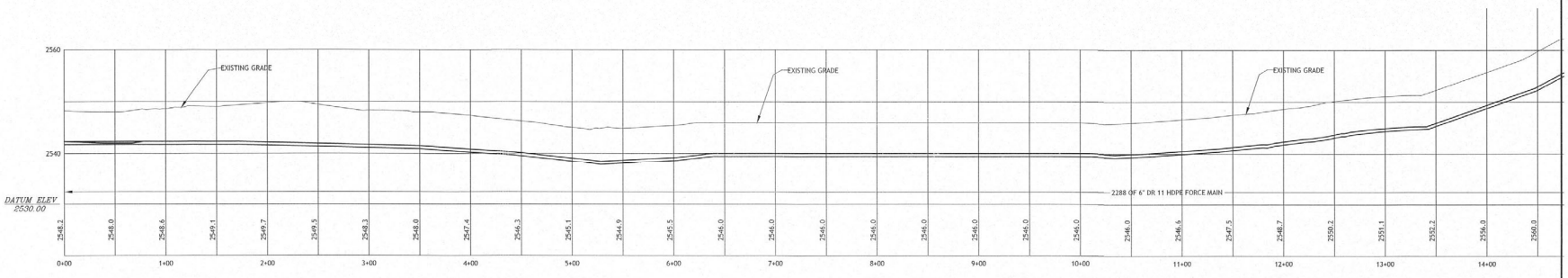
SCALE: 1" = 200'




N
W E
S

SEWER FORCEMAIN TO COLLECTION PLAN

SCALE 1" = 50 '




SEWER FORCEMAIN TO COLLECTION PROFILE

HORIZONTAL SCALE 1" = 50 '
VERTICAL SCALE 1" = 10'

REVISIONS
1 AJM 1.15.2007

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THE WILDERNESS CLUB
FOR
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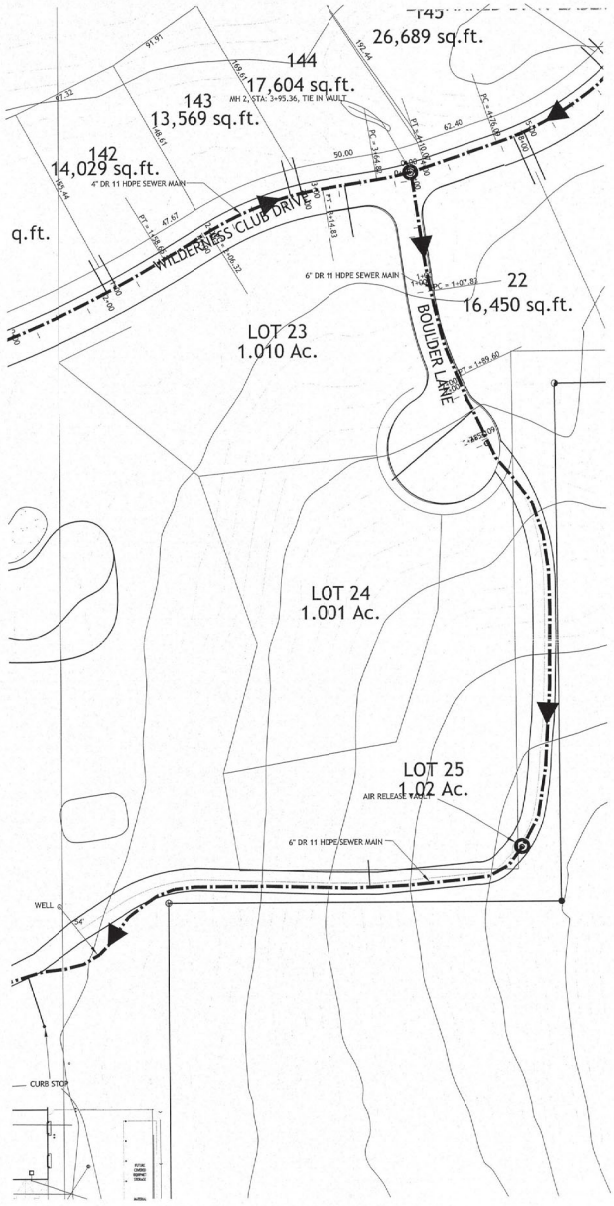
SEWER TO COLLECTION PLAN & PROFILE 0+00 - 12+00

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

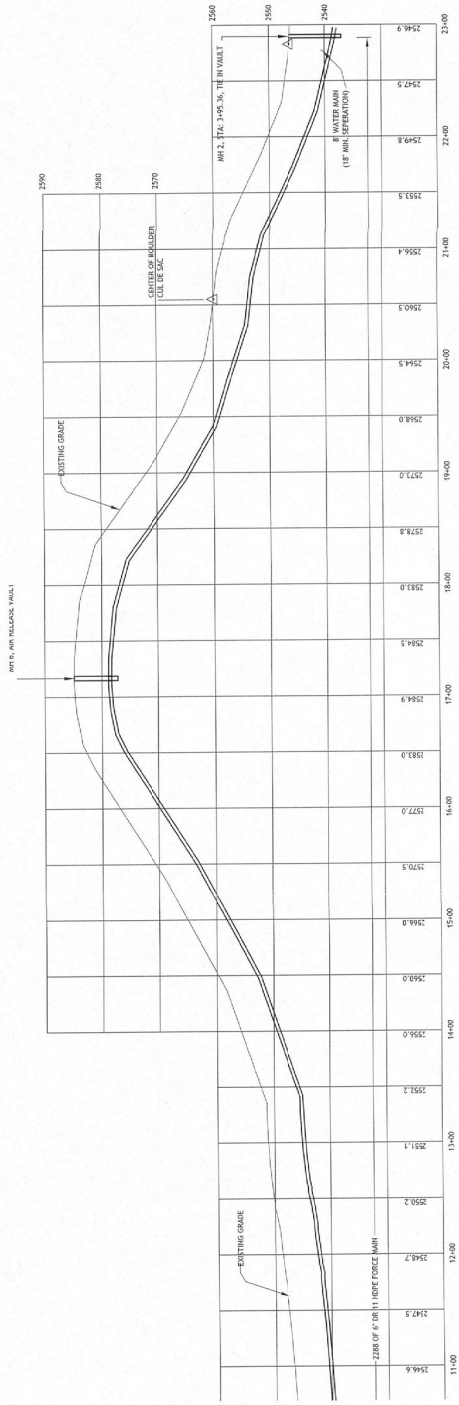
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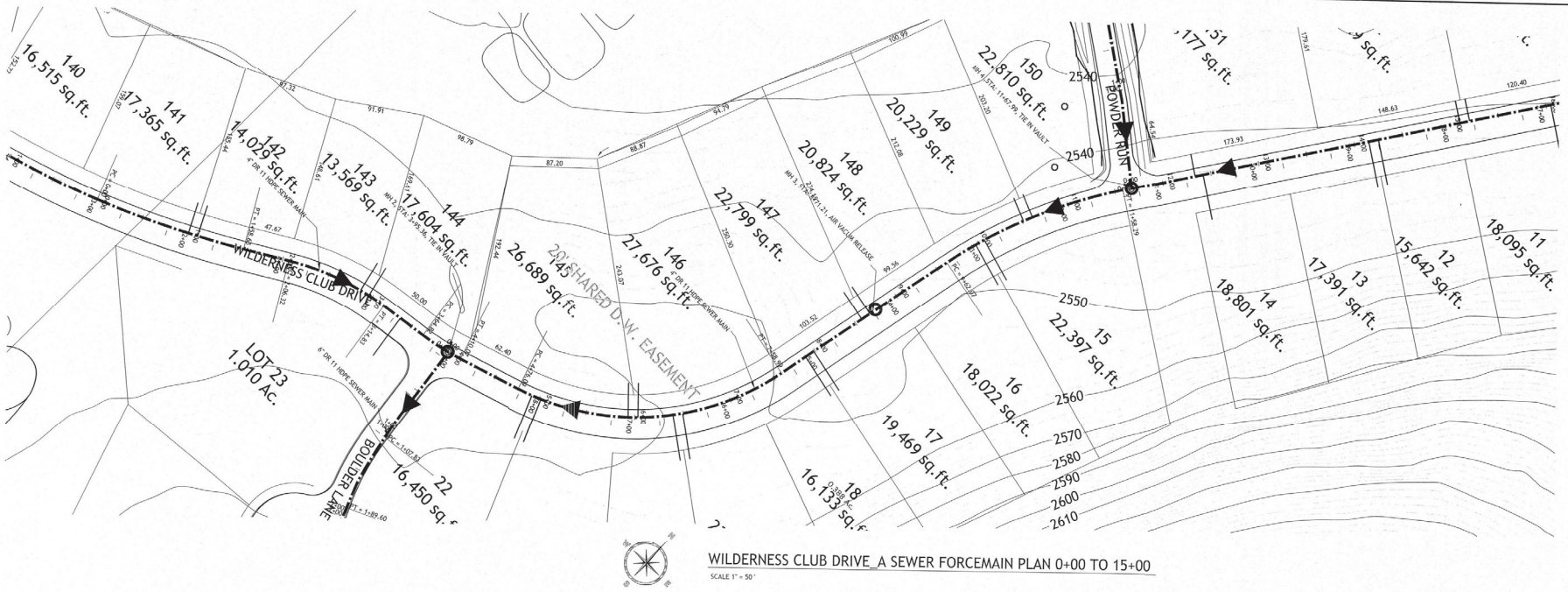
RECORD DRAWINGS - APRIL 20




BOULDER LANE / MAINTENANCE BUILDING ROAD
TO TREATMENT FACILITY
SCALE 1" = 50'

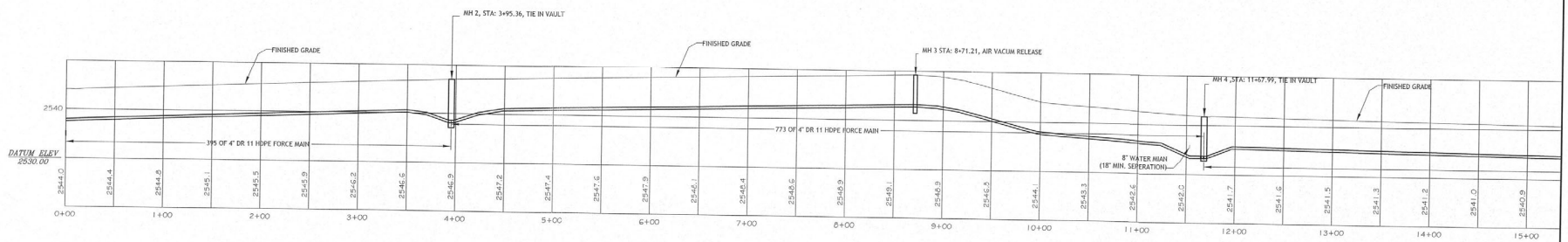



BOULDER LANE / MAINTENANCE BUILDING ROAD
TO TREATMENT FACILITY PROFILE
HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'




WILDERNESS CLUB DRIVE_A SEWER FORCEMAIN PLAN 0+00 TO 15+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE_A SEWER FORCEMAIN PROFILE 0+00 TO 15+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

REVISIONS
1 AJM 1.15.2007

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WILDERNESS DEVELOPMENT L.L.C.
SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

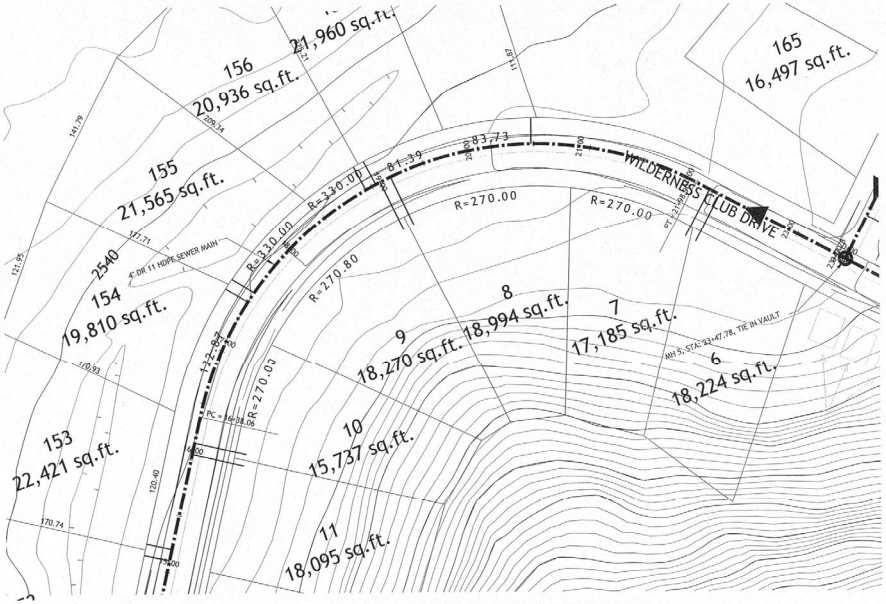
WILDERNESS CLUB DRIVE_A SEWER 0+00 - 15+00 PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

C

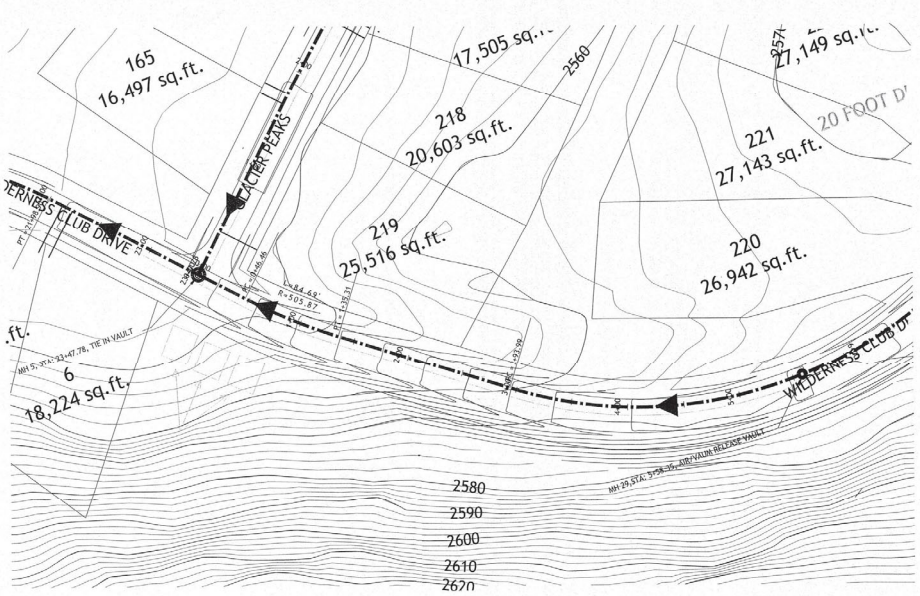
202

RECORD DRAWINGS - APRIL 2010



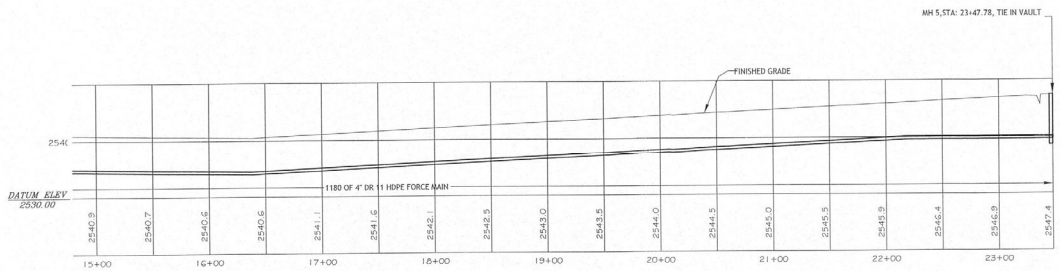

WILDERNESS CLUB DRIVE_A SEWER FORCEMAIN PLAN 15+00 TO 23+47.78

SCALE 1" = 50'



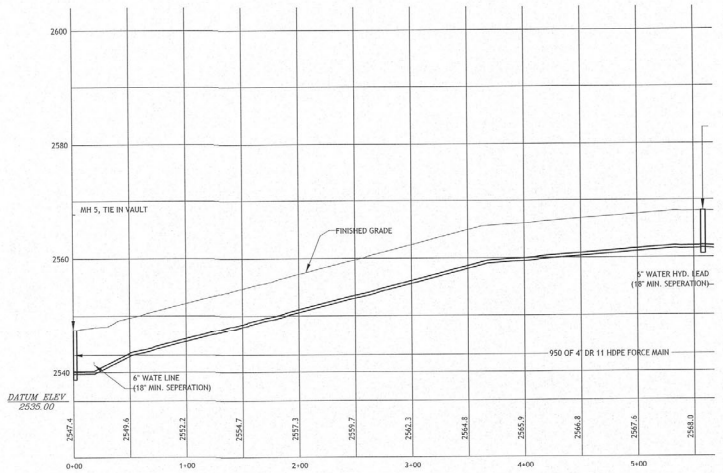

WILDERNESS CLUB DRIVE_B SEWER FORCEMAIN PLAN 0+00 TO 5+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE_A SEWER FORCEMAIN PROFILE 15+00 TO 23+47.78

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'




WILDERNESS CLUB DRIVE_B SEWER FORCEMAIN PROFILE 0+00 TO 5+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

REVISIONS:
AJM 1.15.2007

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FOR
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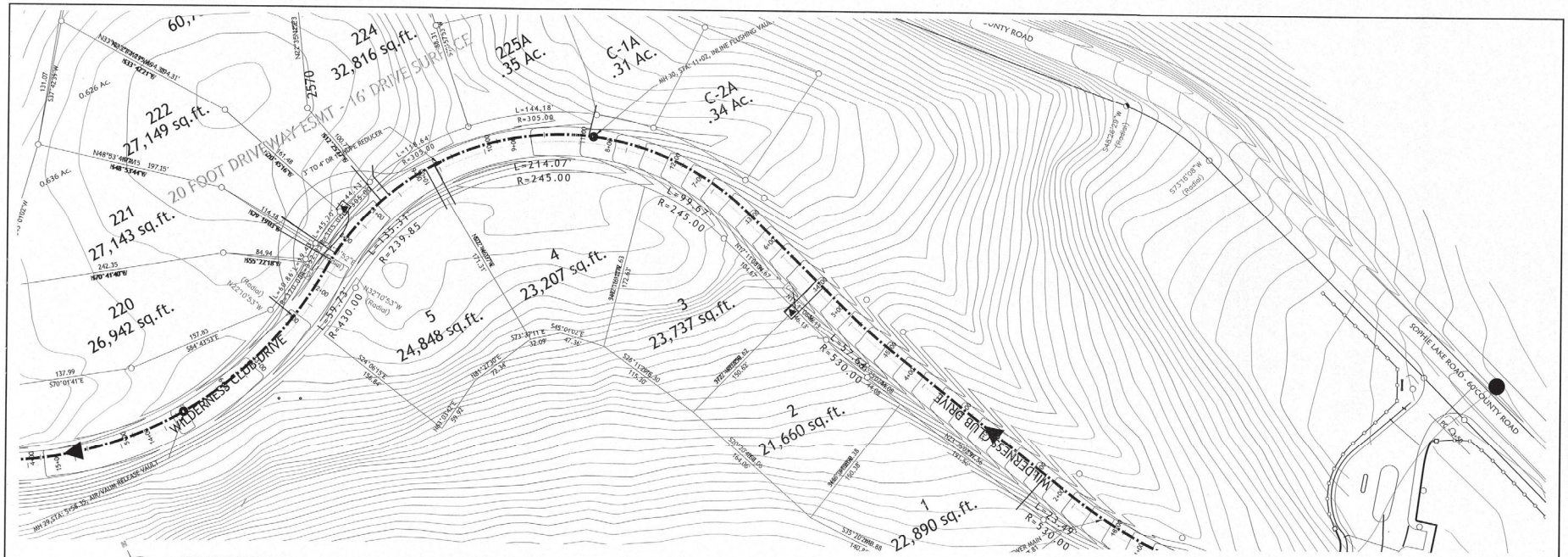
WILDERNESS CLUB
DR_A 15+00 - 23+47.78
DR_B 0+00 - 5+00
SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

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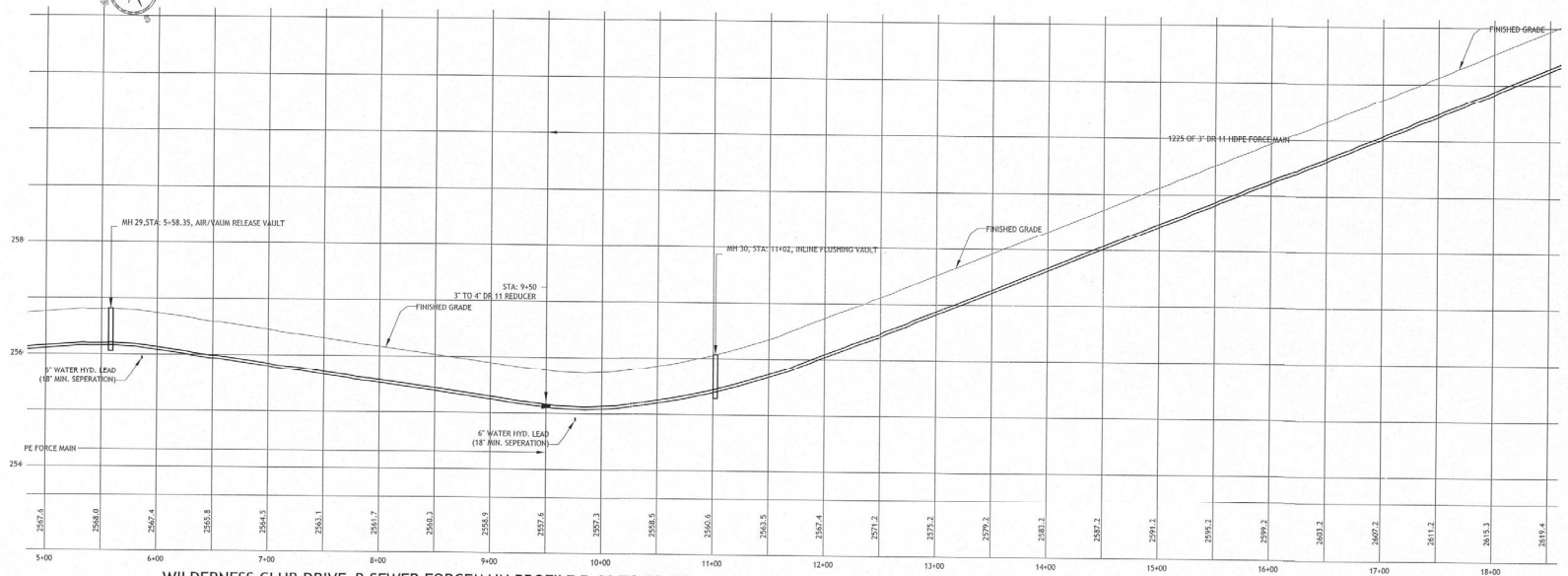
203

RECORD DRAWINGS - APRIL 2010




WILDERNESS CLUB DRIVE_A SEWER FORCEMAIN PLAN 5+00 TO 18+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE_B SEWER FORCEMAIN PROFILE 5+00 TO 18+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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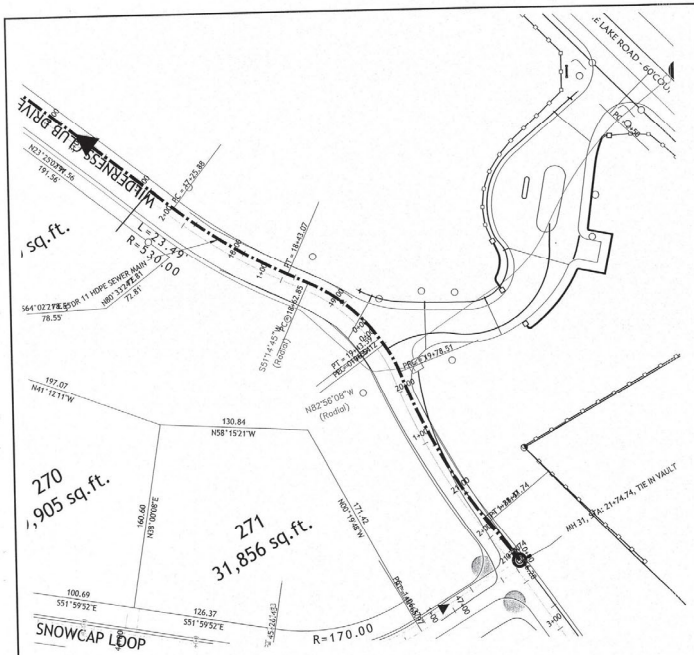
THE WILDERNESS CLUB
FOR
WILDERNESS DEVELOPMENT L.L.C.
SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

WILDERNESS CLUB DRIVE_B 5+00 - 18+00 SEWER PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

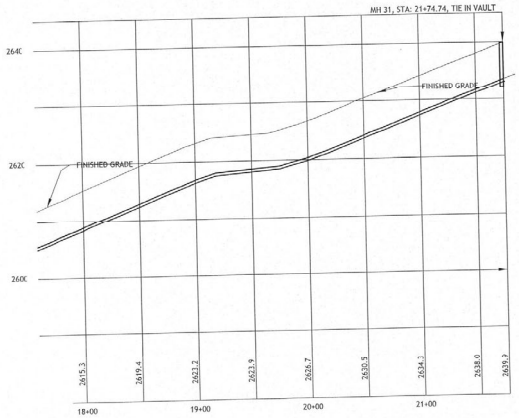
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204




WILDERNESS CLUB DRIVE_B SEWER FORCEMAIN PLAN 18+00 TO 21+74.74

SCALE 1" = 50'




WILDERNESS CLUB DRIVE_B SEWER FORCEMAIN PROFILE 18+00 TO 21+74.74

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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WILDERNESS CLUB
DR_B 18+00 - 21+74.74
SNOWCAP LOOP_A
0+00 - 8+00 SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

C
205

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REVISIONS


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FOR
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SEC. 28, 29, 32, & 33, T35N, R27W, LINCOLN COUNTY, STATE OF MONTANA

GLACIER PEAKS
0+00 - 15+00
SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

C

211

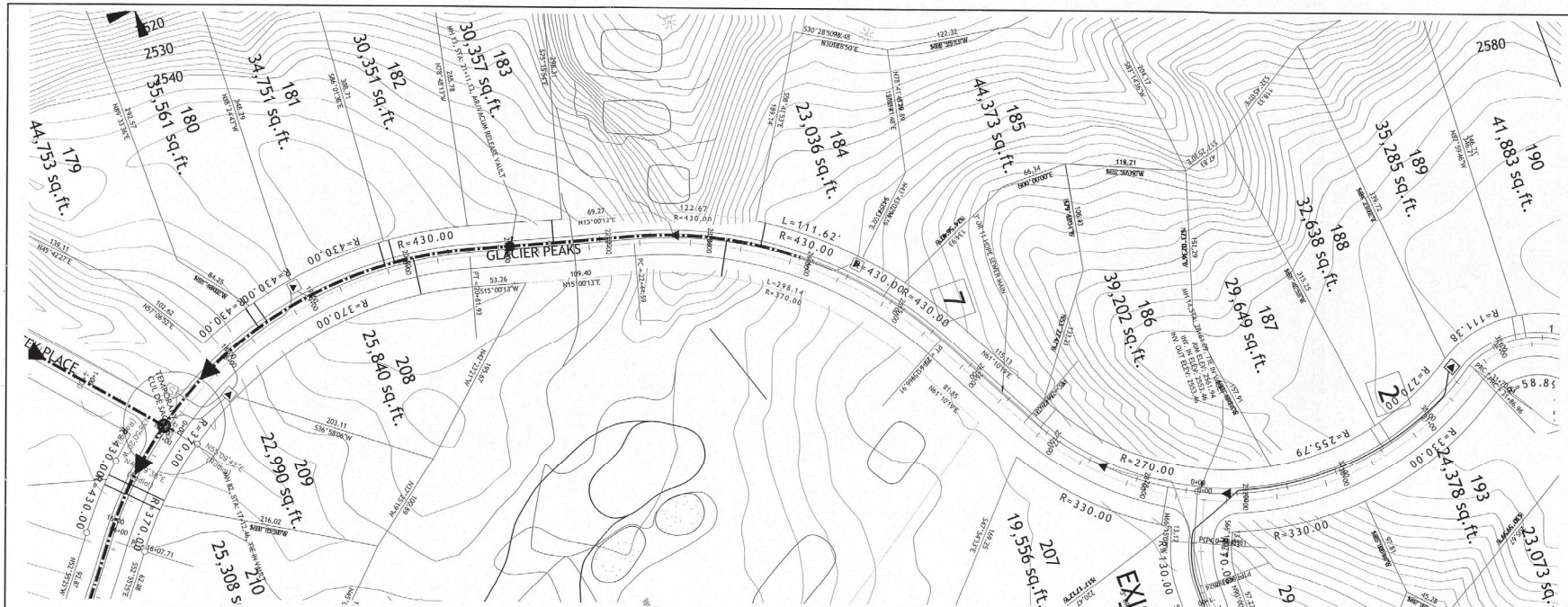
RECORD DRAWINGS - APRIL, 2010




GLACIER PEAKS SEWER FORCEMAIN PLAN 0+00 TO 15+00
SCALE 1" = 50'

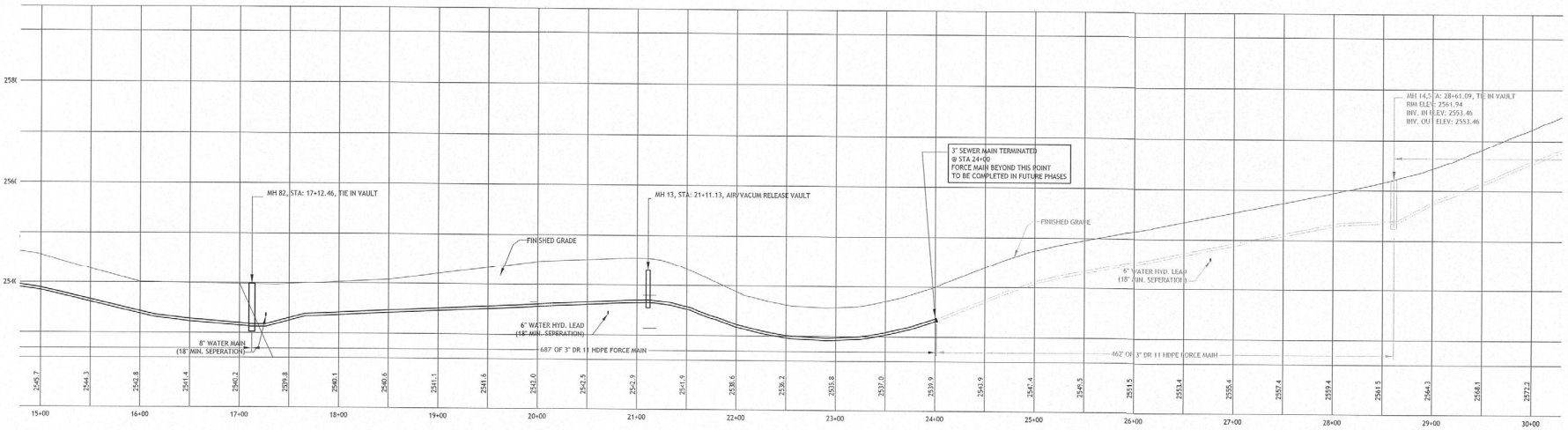



GLACIER PEAKS SEWER FORCEMAIN PROFILE 0+00 TO 15+00
HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'




GLACIER PEAKS SEWER FORCEMAIN PLAN 15+00 TO 30+00

SCALE 1" = 50'




GLACIER PEAKS SEWER FORCEMAIN PROFILE 15+00 TO 30+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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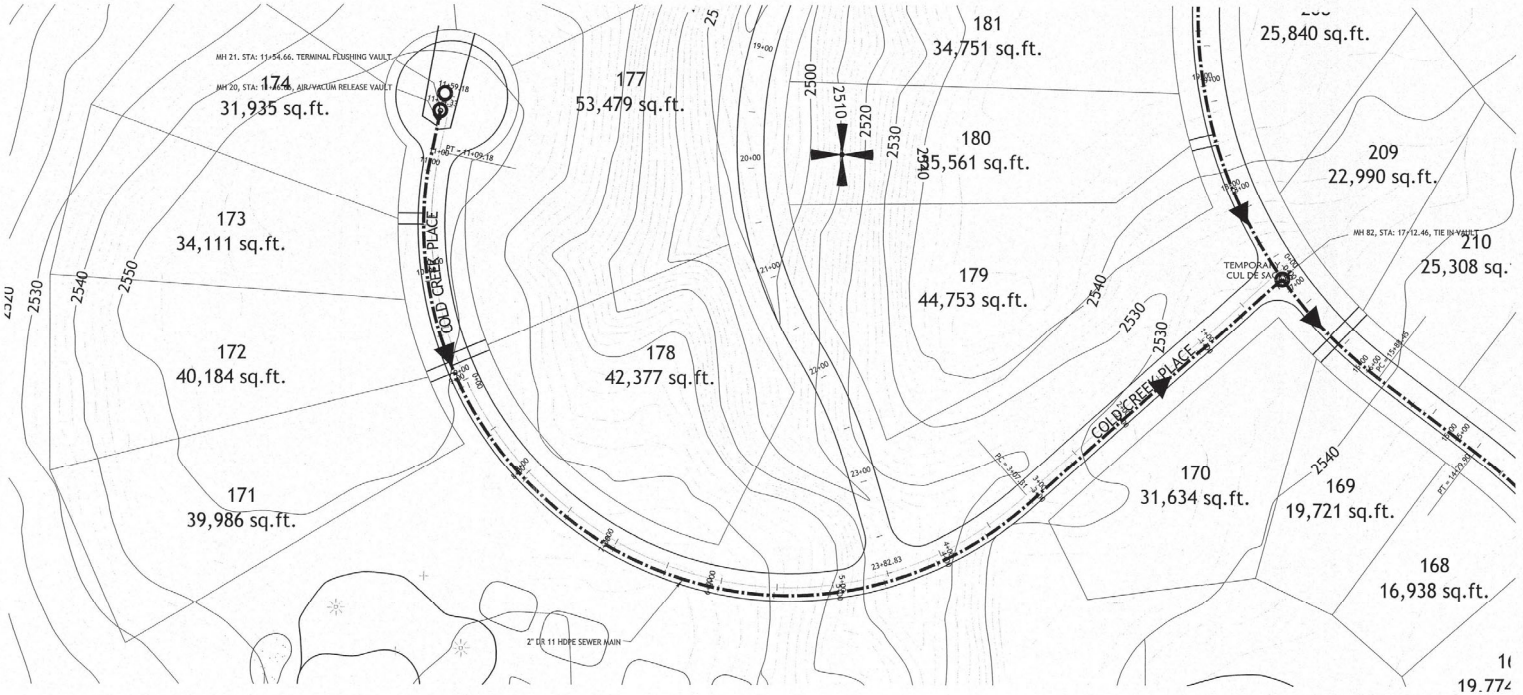
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FOR
WILDERNESS DEVELOPMENT L.L.C.
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GLACIER PEAKS
15+00 - 30+00
SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

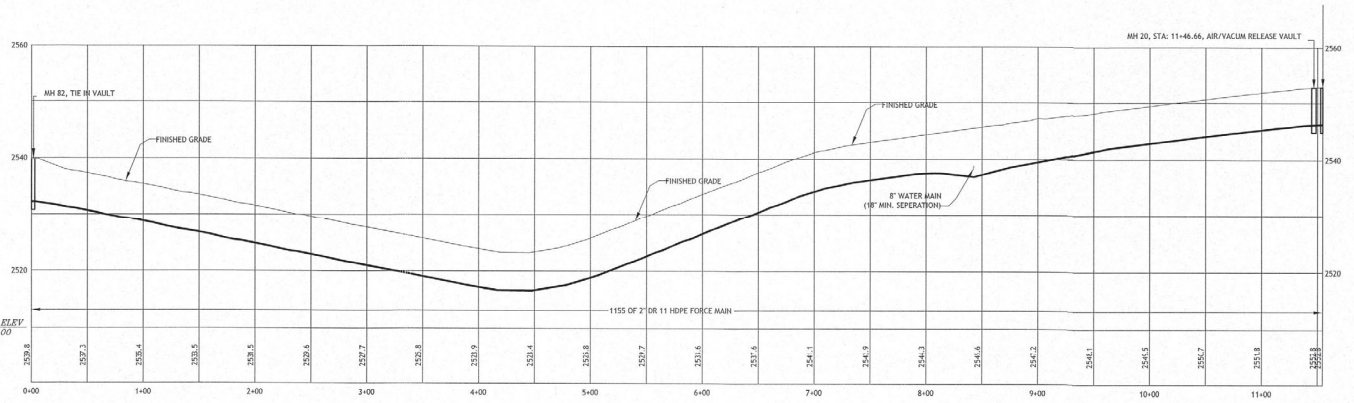
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## COLD CREEK SEWER FORCEMAIN PLAN

SCALE 1" = 50'




## COLD CREEK SEWER FORCEMAIN PROFILE

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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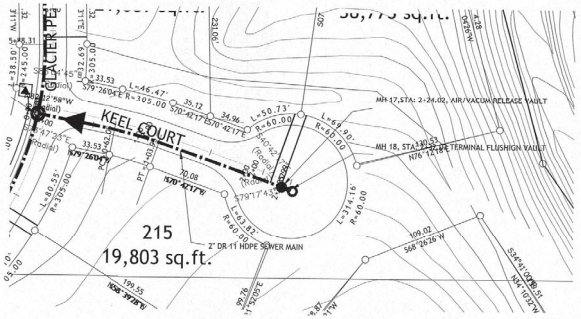
COLD CREEK PLACE SEWER PLAN & PROFILE

JOB NUMBER: 1213.03
DRAWN BY: AIM
DATE: 3-12-2007

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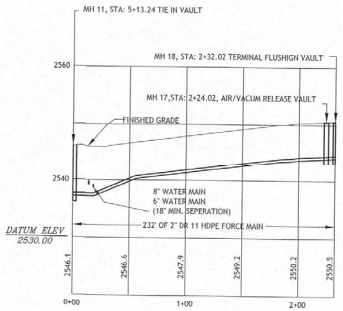
214

RECORD DRAWINGS - APRIL 2010




KEEL COURT SEWER FORCEMAIN PLAN

SCALE 1" = 50'




KEEL COURT SEWER FORCEMAIN PROFILE

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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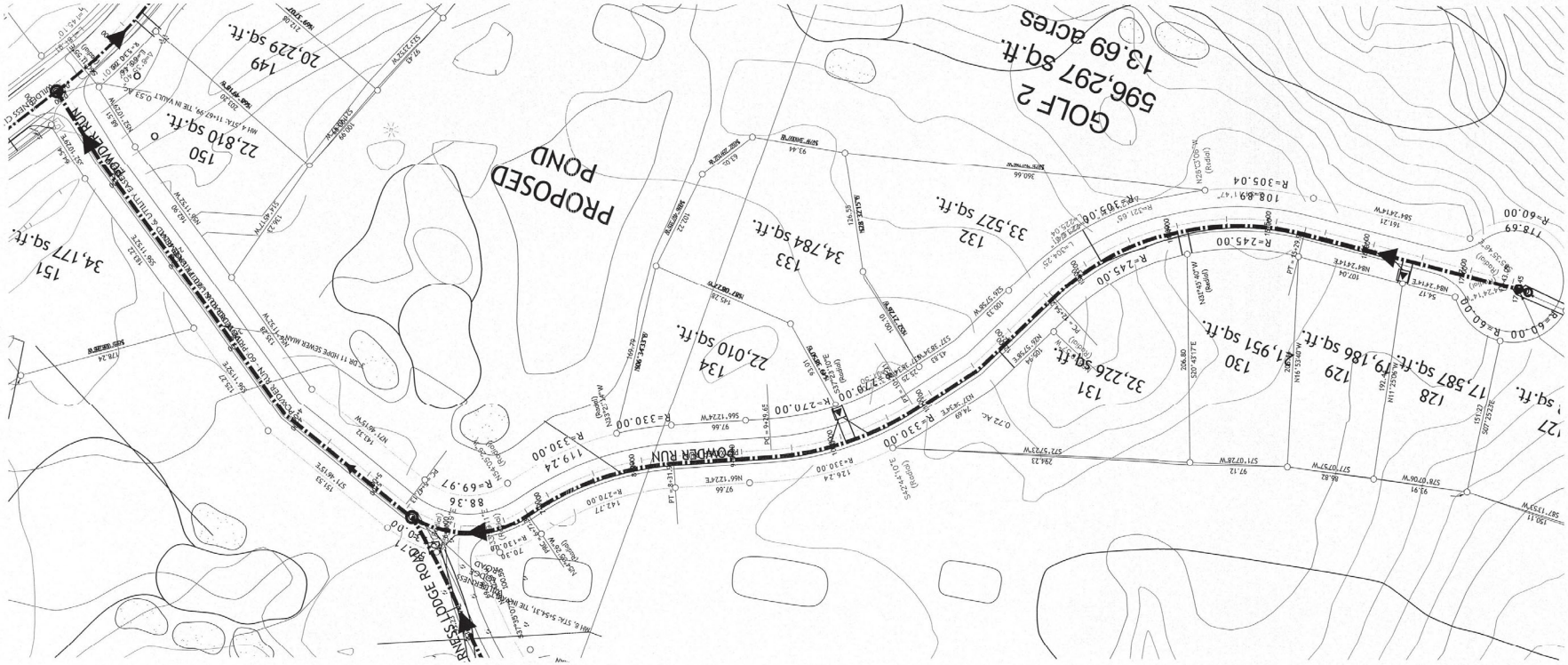
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KEEL COURT
SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

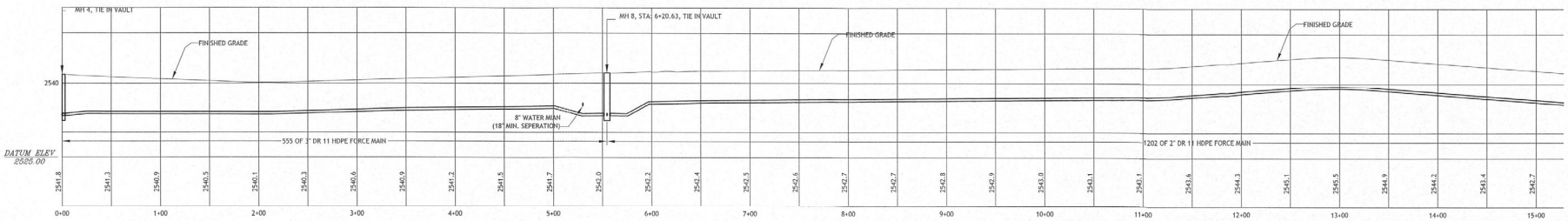
C

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POWDER RUN SEWER FORCEMAIN PLAN 0+00 TO 15+00

SCALE 1" = 50'




POWDER RUN SEWER FORCEMAIN PROFILE 0+00 TO 15+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

REVISIONS:

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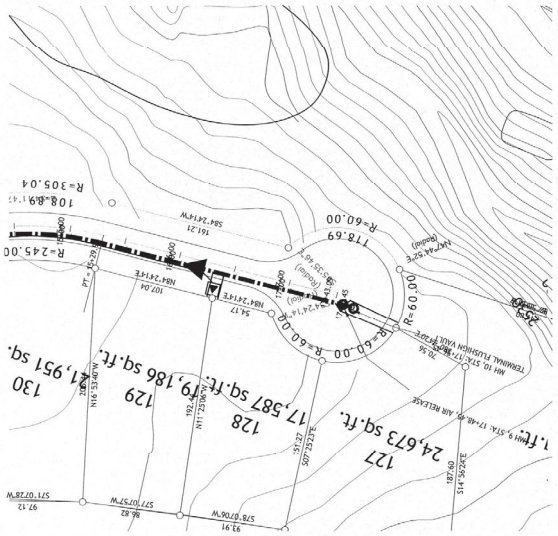
POWDER RUN
0+00 - 15+00
SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

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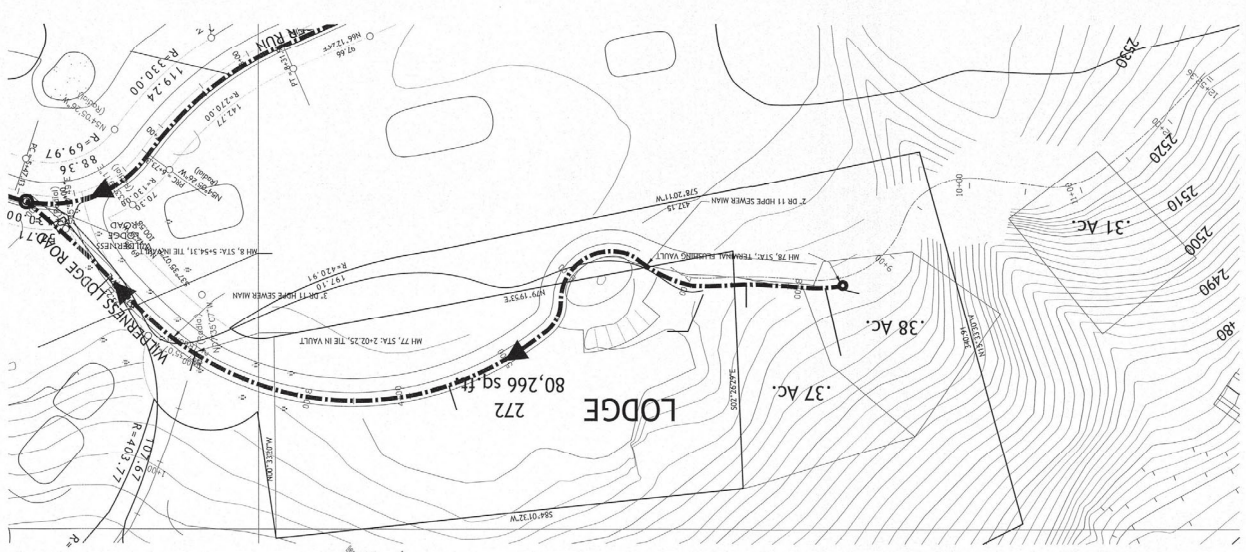
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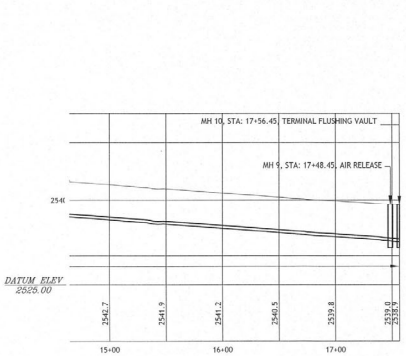
POWDER RUN SEWER FORCEMAIN PLAN 15+00 TO 17+56.45

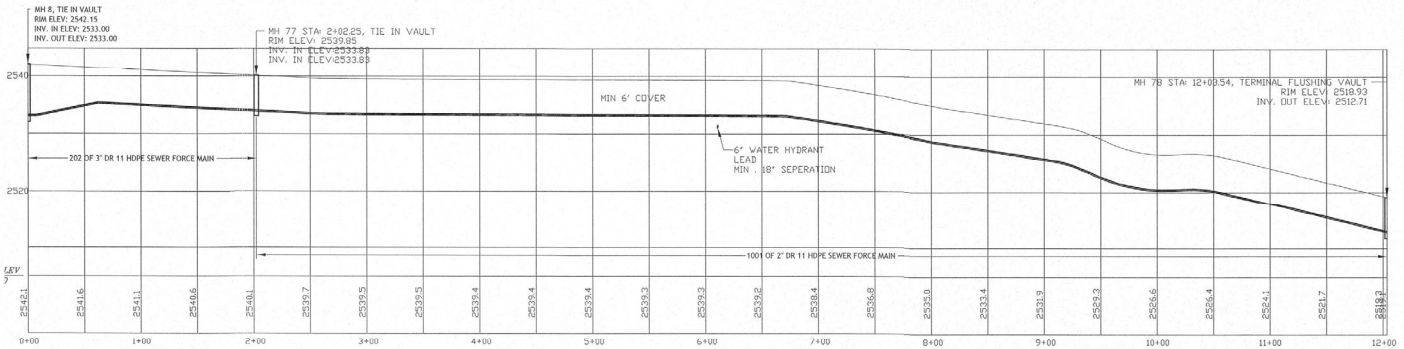
SCALE 1" = 50'



WILDERNESS LODGE LOOP SEWER FORCEMAIN PLAN

SCALE 1" = 50'




POWDER RUN SEWER FORCEMAIN PROFILE 15+00 TO 17+56.45

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

WILDERNESS LODGE LOOP SEWER FORCEMAIN PROFILE

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

REVISIONS
1 AJM 1.15.2007

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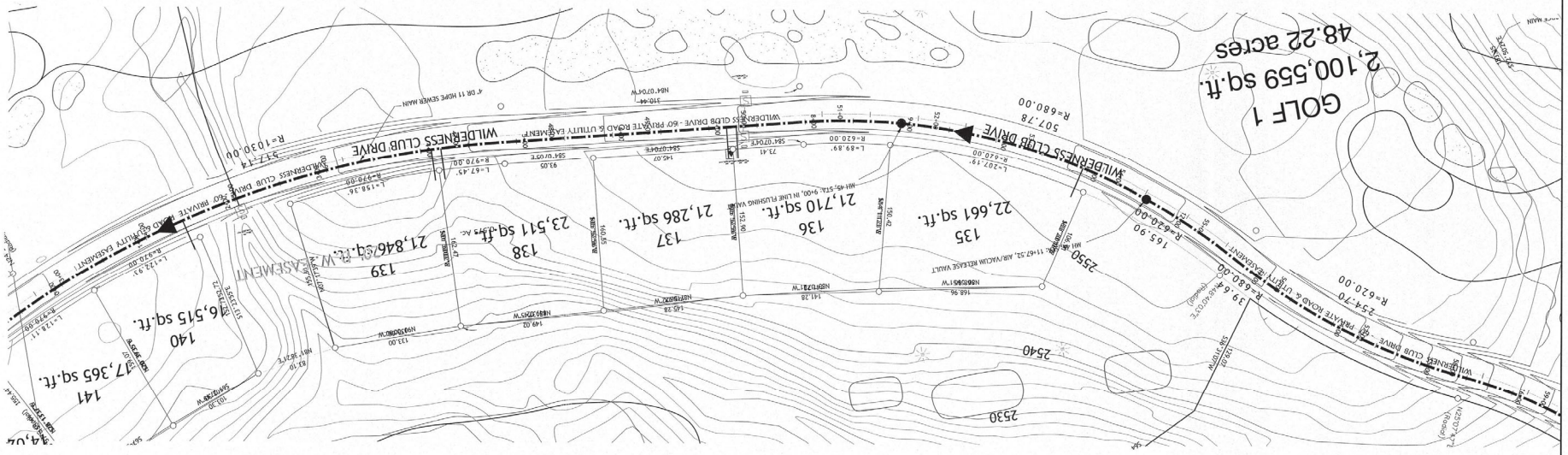
THE WILDERNESS CLUB
FOR
WILDERNESS DEVELOPMENT L.L.C.
SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

POWDER RUN
15+00 - 17+56.45,
WILDERNESS LODGE
LOOP SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

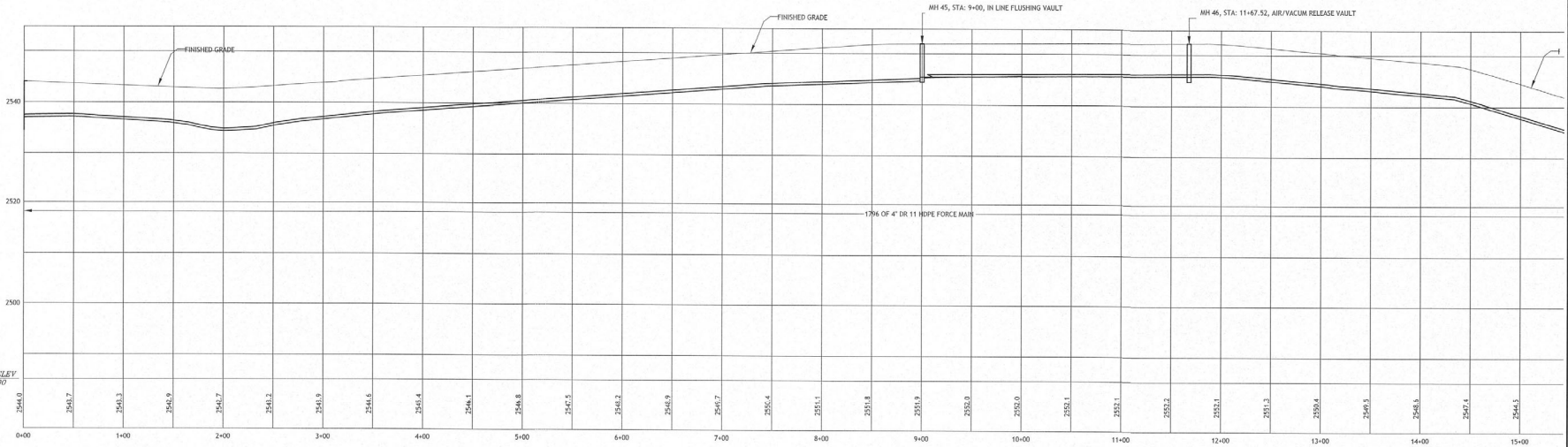
C

217




WILDERNESS CLUB DRIVE_C SEWER FORCEMAIN PLAN 0+00 TO 15+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE _C SEWER FORCEMAIN PROFILE 0+00 TO 15+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

REVISIONS

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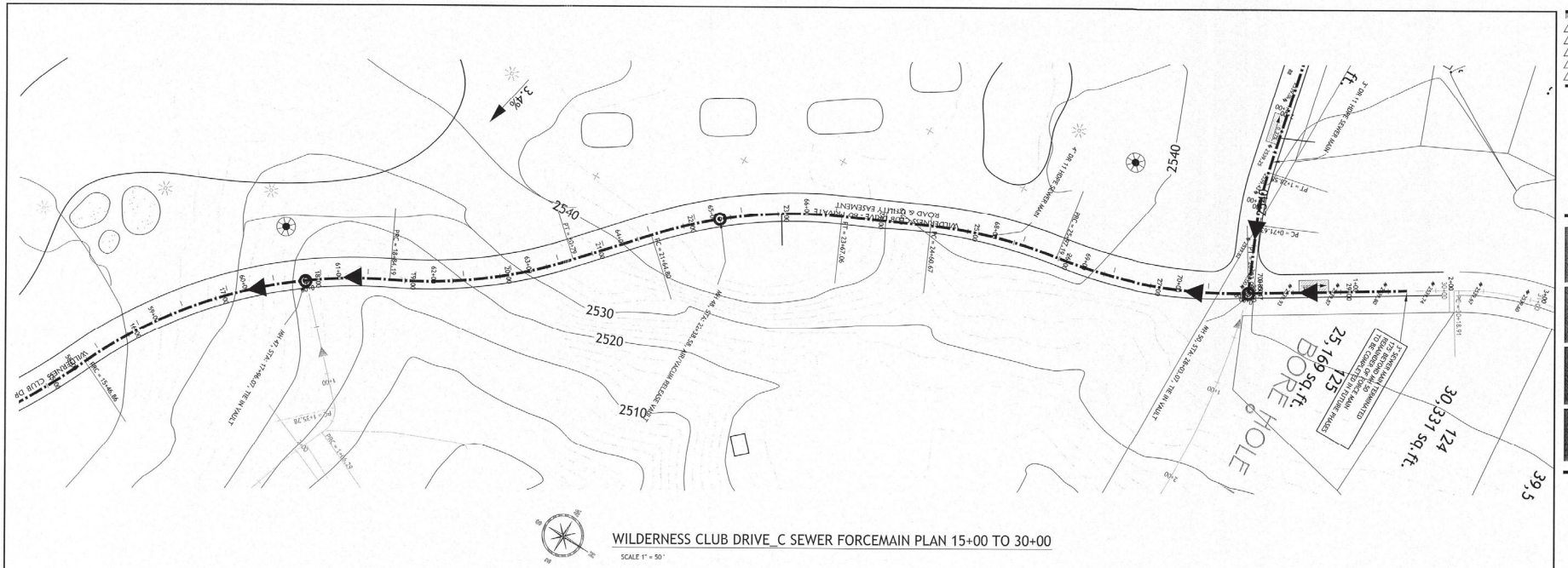
WILDERNESS CLUB DRIVE_C
0+00 - 15+00
SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

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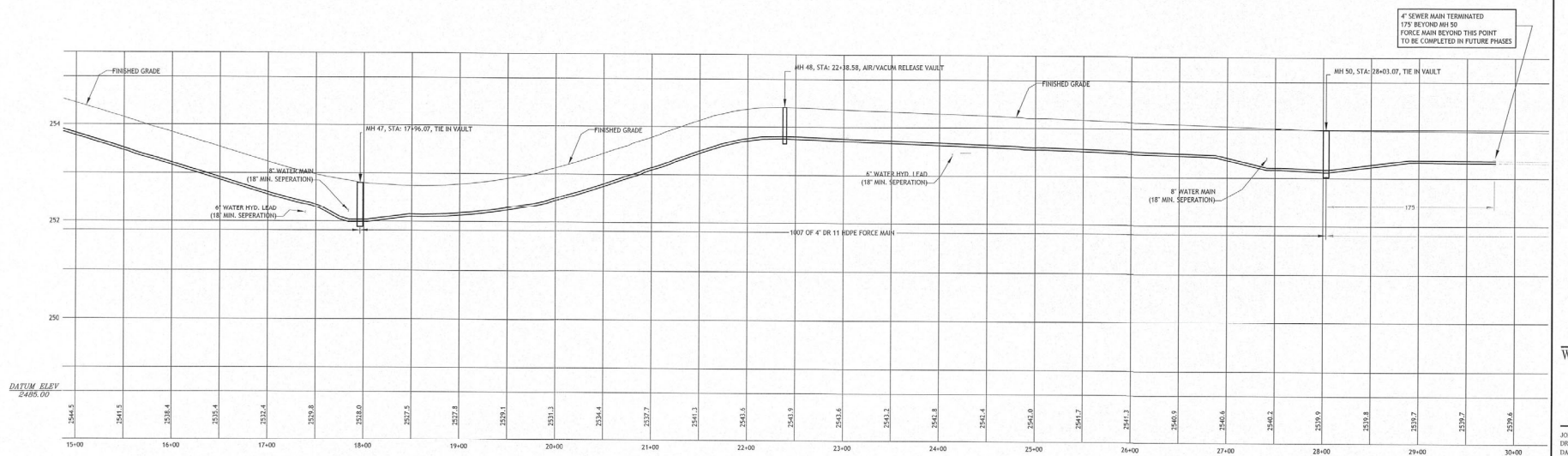
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WILDERNESS CLUB DRIVE_C SEWER FORCEMAIN PLAN 15+00 TO 30+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE _C SEWER FORCEMAIN PROFILE 15+00 TO 30+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

REVISIONS
1 AJM 1.15.2007

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THE WILDERNESS CLUB
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WILDERNESS CLUB
DRIVE_C
15+00 - 30+00
SEWER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

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1. AJM | 1.5.2007

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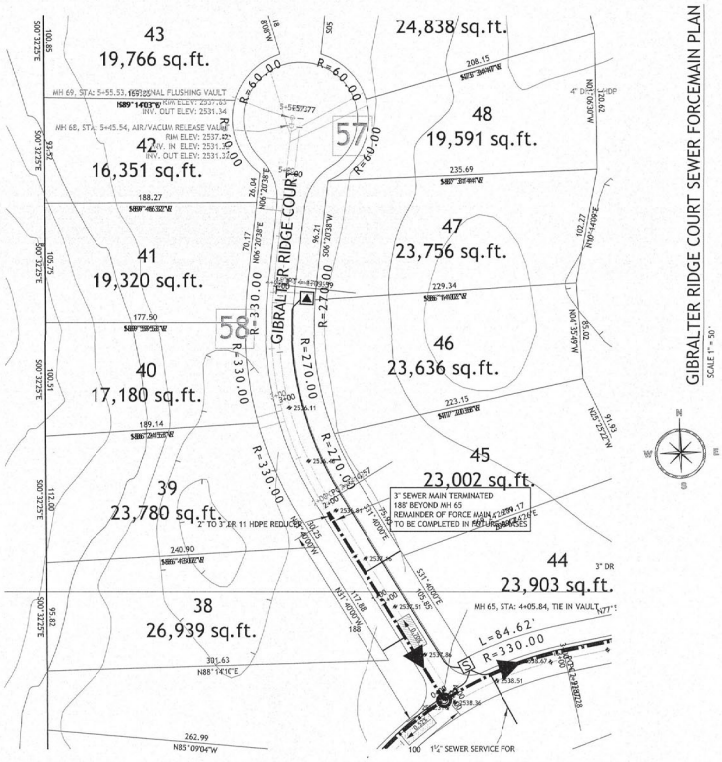
GIBRALTER RIDGE COURT SEWER PLAN & PROFILE

JOB NUMBER: 1.23.005
DRAWN BY: AJM
DATE: 3-12-2007

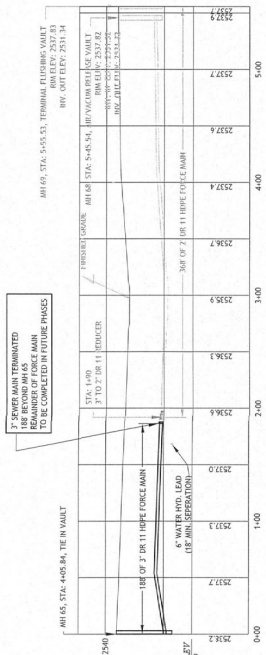
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226

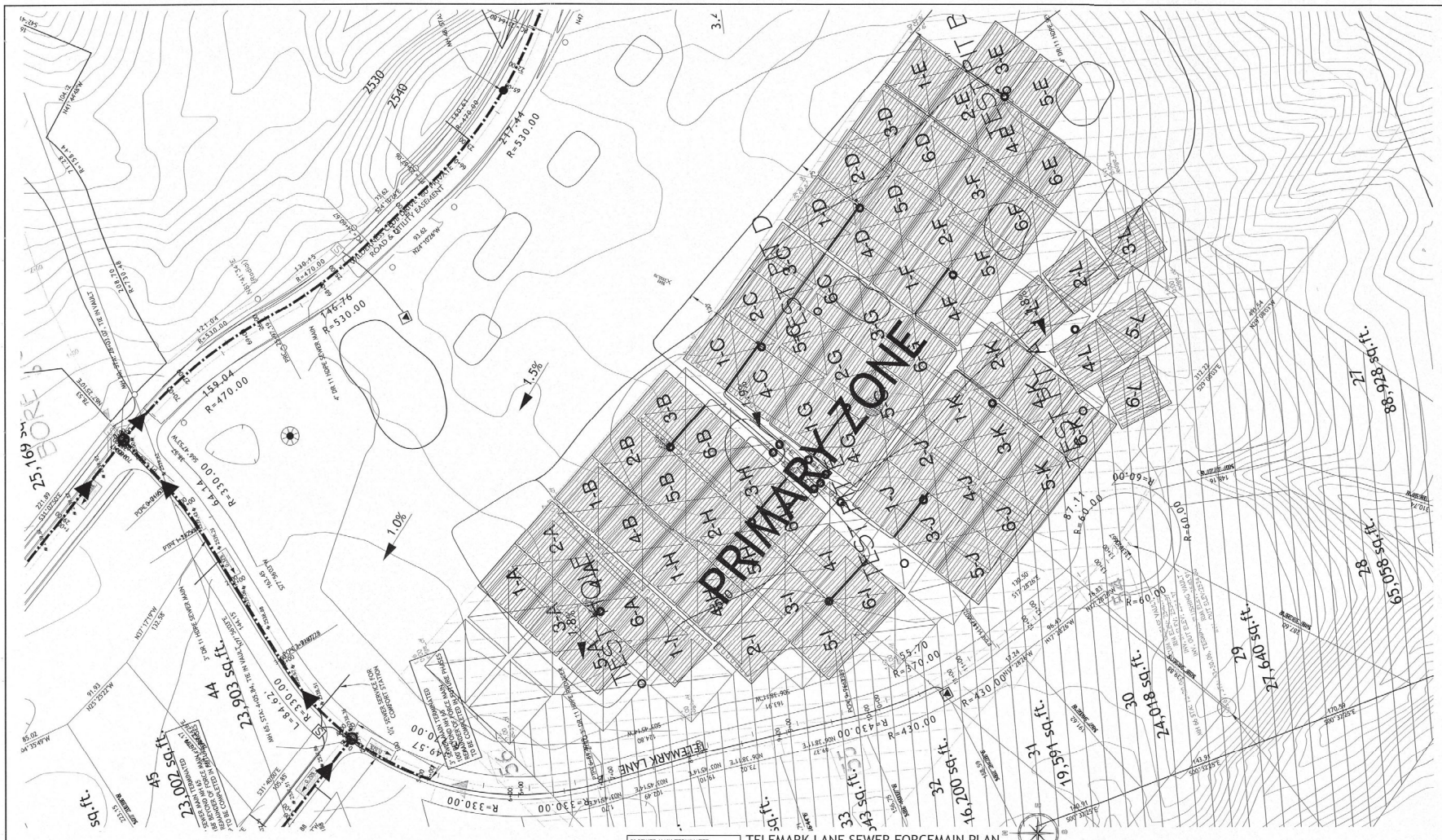
RECORD DRAWINGS - APRIL 2010




GIBRALTER RIDGE COURT SEWER FORCEMAIN PLAN
SCALE 1" = 50'




GIBRALTER RIDGE COURT SEWER FORCEMAIN PROFILE
HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'




TELEMARK LANE SEWER FORCEMAIN PLAN

SCALE 1" = 50'

TELEMARK LANE SEWER FORCEMAIN PROFILE

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

REVISIONS:
1 AJM 1.15.2007

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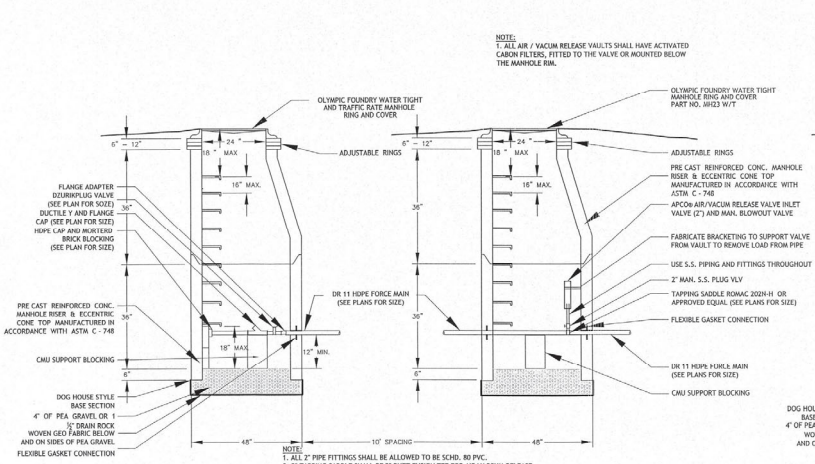
SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

TELEMARK LANE SEWER PLAN & PROFILE

JOB NUMBER: 1213.03
DRAWN BY: AJM
DATE: 3-12-2007

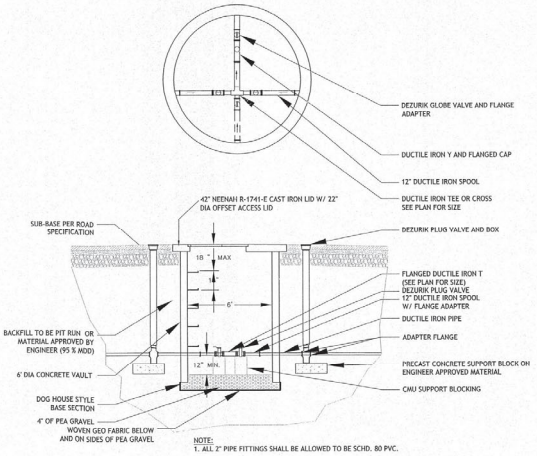
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227

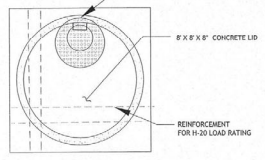



1 C-230 TERMINAL FLUSHING AND AIR RELEASE VAULTS DETAIL
NOT TO SCALE

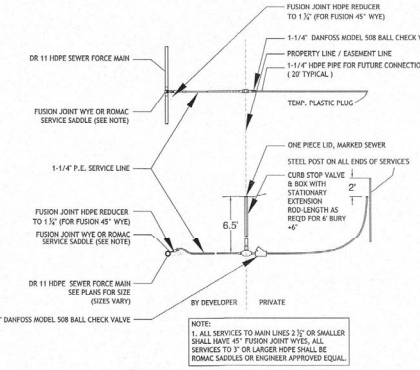
2 C-230 IN LINE FLUSHING VAULT DETAIL
NOT TO SCALE



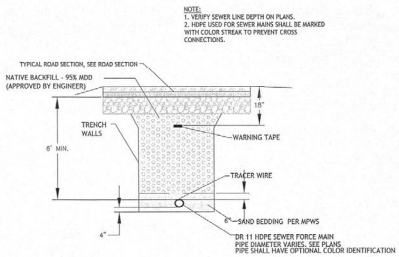

3 C-230 TIE IN VAULT DETAIL
NOT TO SCALE



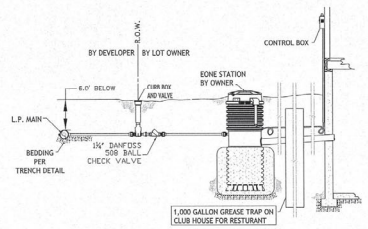

4 C-230 TIE IN VAULT LID DETAIL
NOT TO SCALE



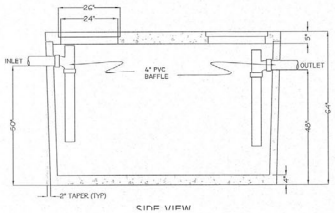

5 C-230 SEWER SERVICE DETAIL
NOT TO SCALE



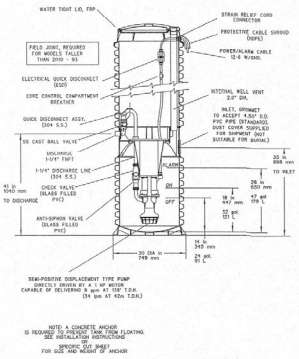

6 C-230 TYPICAL TRENCH DETAIL
NOT TO SCALE



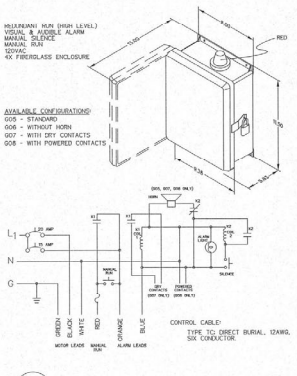

7 C-230 TYPICAL GRINDER IINSALLATION
NOT TO SCALE




8 C-230 1000 GAL. GREASE TRAP FOR CLUB HOUSE KITCHEN
NOT TO SCALE




10 C-230 E-ONE GP 2010 GRINDER PUMP UNIT
NOT TO SCALE




11 C-230 NOT TO SCALE

REVISIONS
1 AJM 8.4.2006
2 PER 8-30-2006 DEQ COMMENTS
3 AJM 12.5.2006

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FOR
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SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

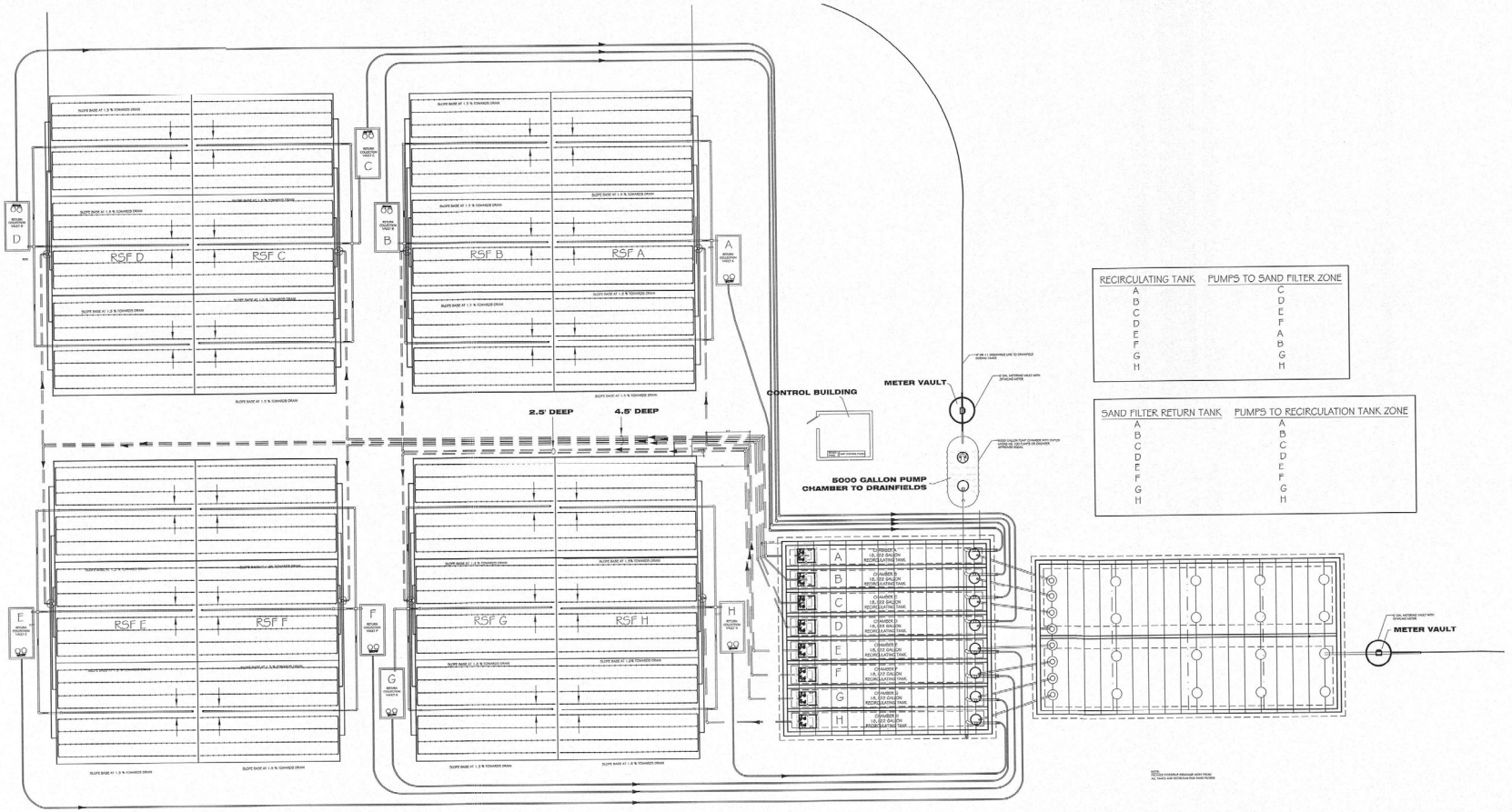
TYPICAL SEWER COLLECTION DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

C

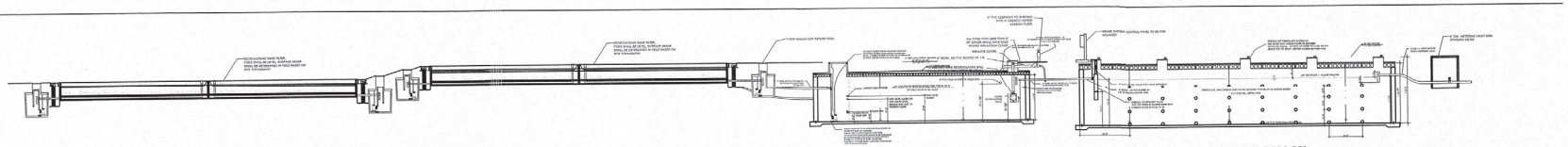
230

RECORD DRAWINGS - APRIL 2010




| RECIRCULATING TANK | PUMPS TO SAND FILTER ZONE |
|---|---|
| A | C |
| B | D |
| C | E |
| D | F |
| E | A |
| F | B |
| G | G |
| H | H |

| SAND FILTER RETURN TANK | PUMPS TO RECIRCULATION TANK ZONE |
|---|---|
| A | A |
| B | B |
| C | C |
| D | D |
| E | E |
| F | F |
| G | G |
| H | H |




SEWER TREATMENT SECTION

5/64"=1'-0"

REVISIONS

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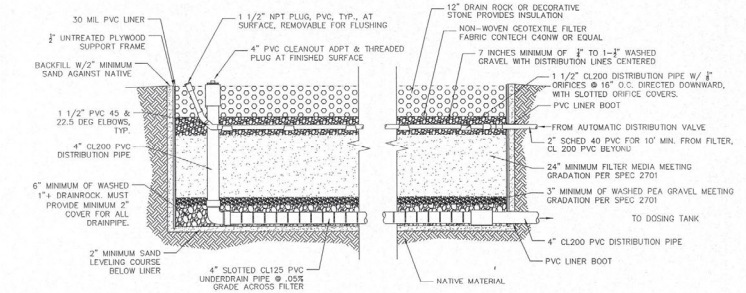
SEWER TREATMENT FACILITY SITE PLAN & SECTION

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

C

231

RECORD DRAWINGS - APRIL 2010



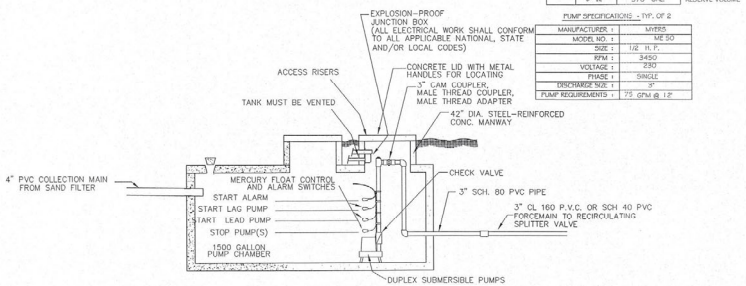

1 RECIRCULATING SAND FILTER SECTION
N.T.S.

PUMP FLOAT SETTINGS

| MARK | DIMENSION | DRAWDOWN |
|---|---|---|
| A | 3 IN. | |
| B | 9 IN. | |
| C | 15 IN. | 260 GAL. |
| D | 17 IN. | |
| | 9 IN. | 570 GAL. RESERVE VOLUME |

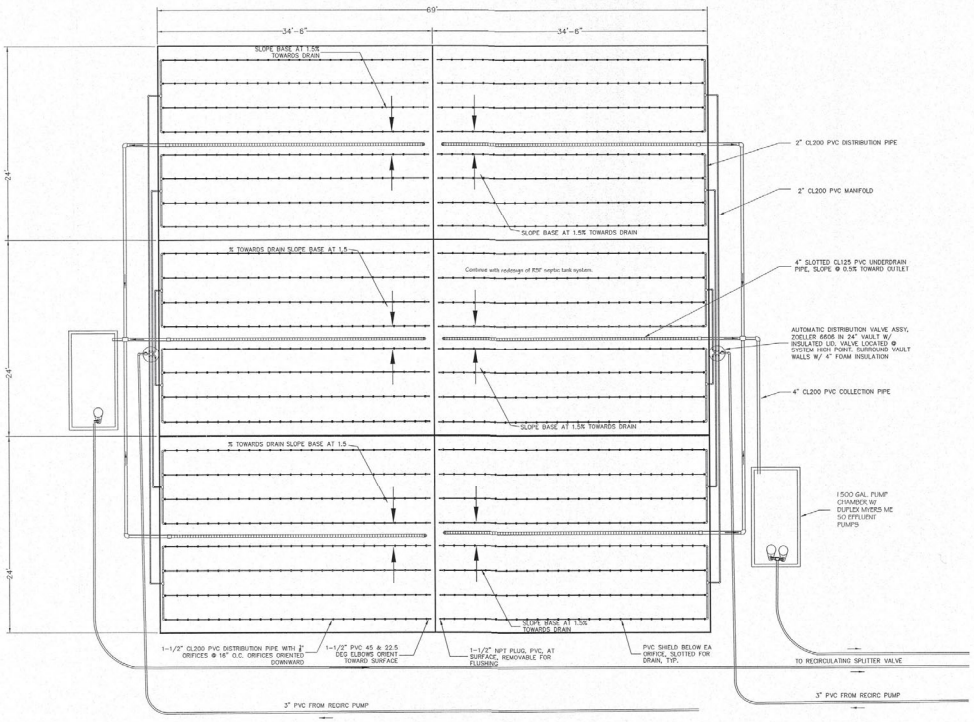
PUMP SPECIFICATIONS - TYP. OF 2

| | |
|---|---|
| MANUFACTURER : | MYERS |
| MODEL NO. : | ME 50 |
| SIZE : | 1/2 H. P. |
| RPM : | 3450 |
| VOLTAGE : | 230 |
| PHASE : | SINGLE |
| DISCHARGE SIZE : | 2" |
| PUMP REQUIREMENTS : | 75 GPM @ 12' |




NOTE
SEE ELECTRICAL SHEETS FOR CONTROL DETIALS

2 RECIRCULATING SAND FILTER RETURN TANK SECTION
N.T.S.




NOTE:
ANY & ALL DISTRIBUTION PIPING EXTERIOR TO FILTER WITH LESS THAN 4' COVER TO BE OVERLAIN BY 4" ROD FOAM INSULATION

3 RECIRCULATING SAND FILTER PLAN
N.T.S.

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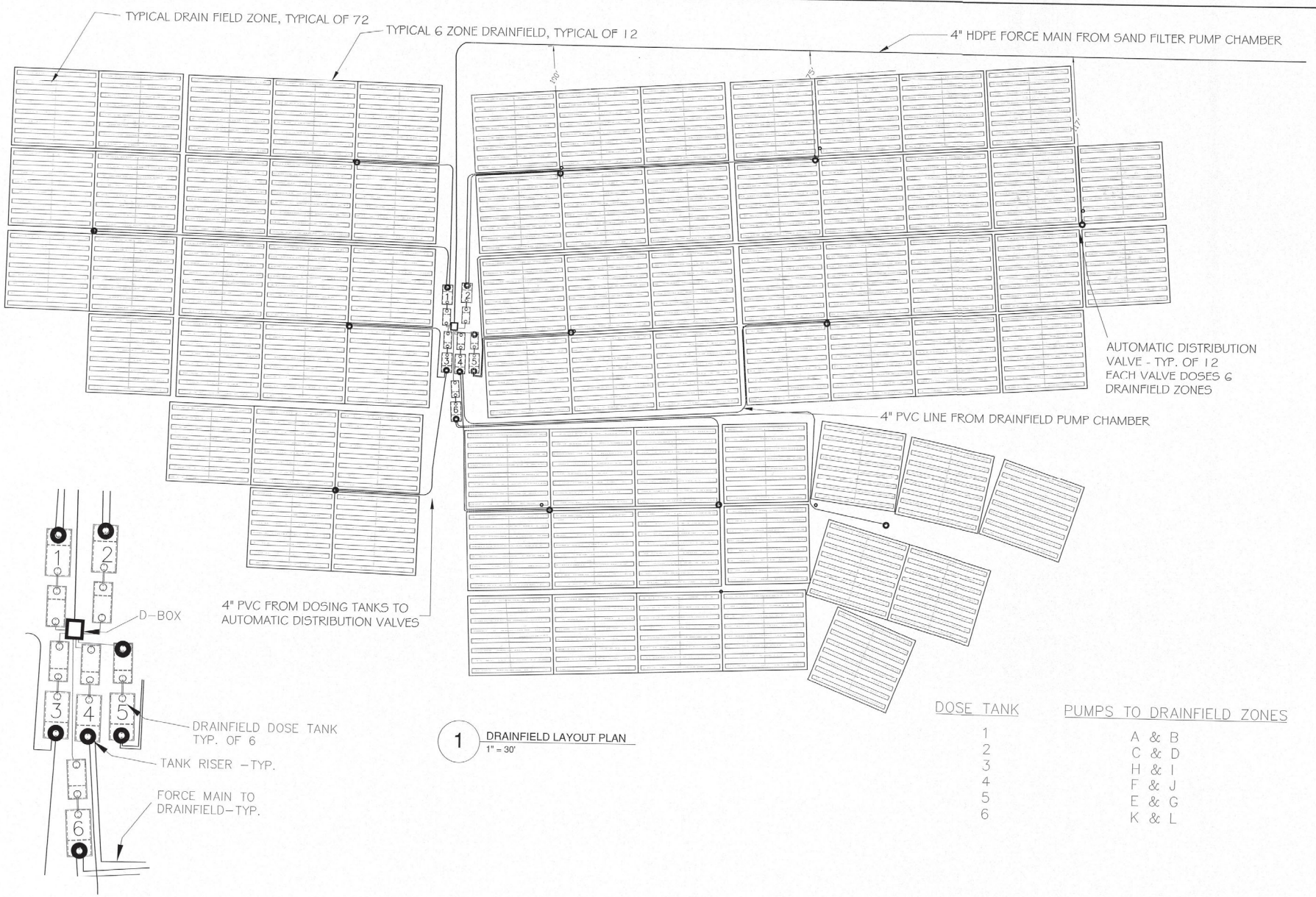
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FOR
WILDERNESS DEVELOPMENT L.L.C.
SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

RECIRCULATING SAND FILTER DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

C
232

RECORD DRAWINGS - APRIL 2010




1 DRAINFIELD LAYOUT PLAN
1" = 30'

| DOSE TANK | PUMPS TO DRAINFIELD ZONES |
|---|---|
| 1 | A & B |
| 2 | C & D |
| 3 | H & I |
| 4 | F & J |
| 5 | E & G |
| 6 | K & L |

REVISIONS:

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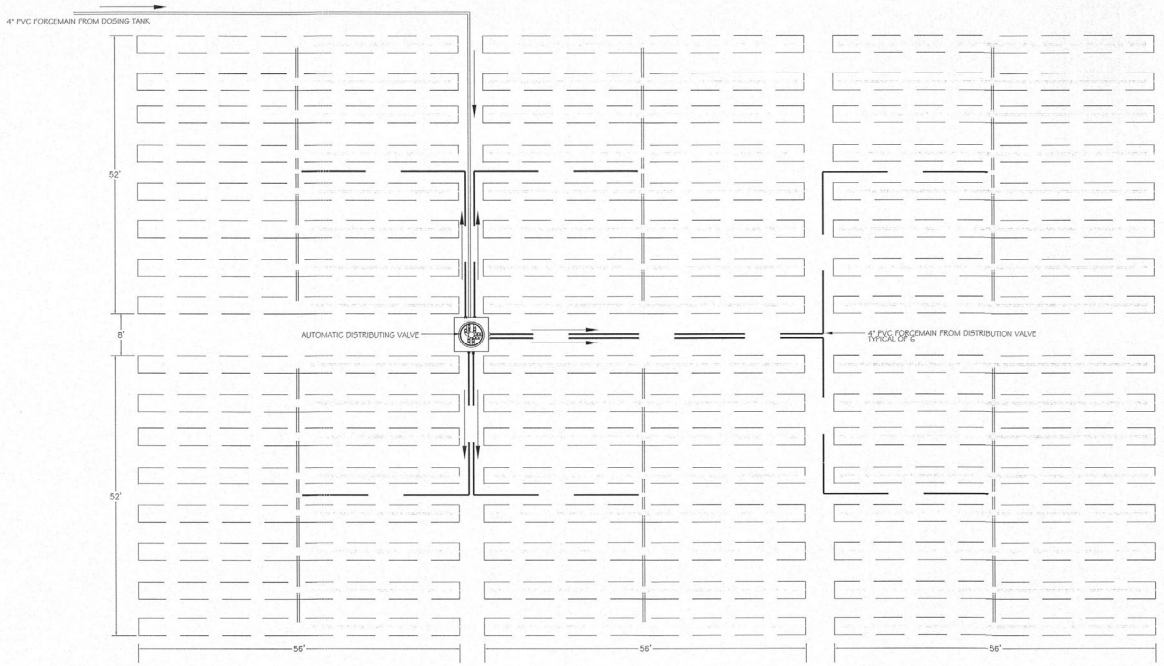
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DRAINFIELD LAYOUT

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

C

233A




**6 - ZONED DRAINFIELD LAYOUT - TYPICAL OF 12**

NOT TO SCALE

REVISIONS:
1.
2.
3.
4.
5.

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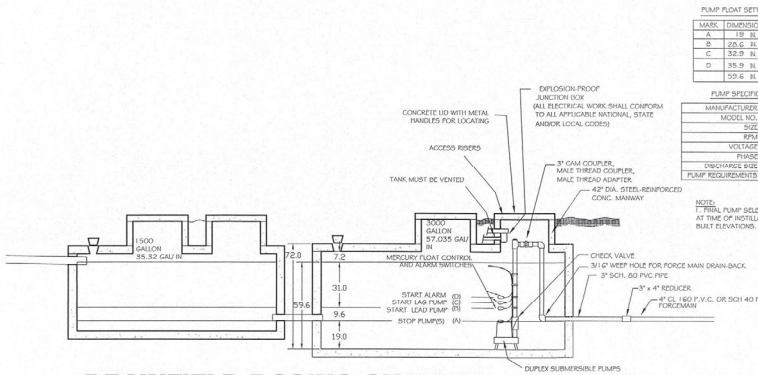
DRAINFIELD LAYOUT

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

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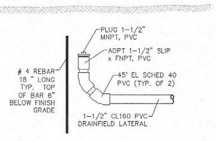
233B

RECORD DRAWINGS - APRIL 2010




## DRAINFIELD DOSING CHAMBER DETAIL - TYP. OF 6

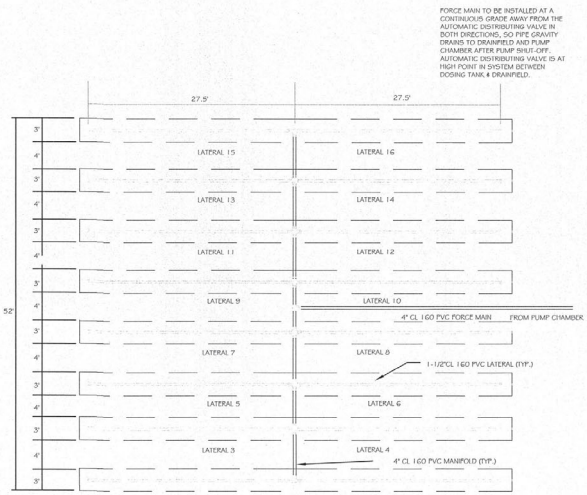
NOT TO SCALE




INSTALL CLEAN-OUT AND LOCATOR BAR AT END OF EACH LATERAL FOR PUBLIC DRAINFIELDS

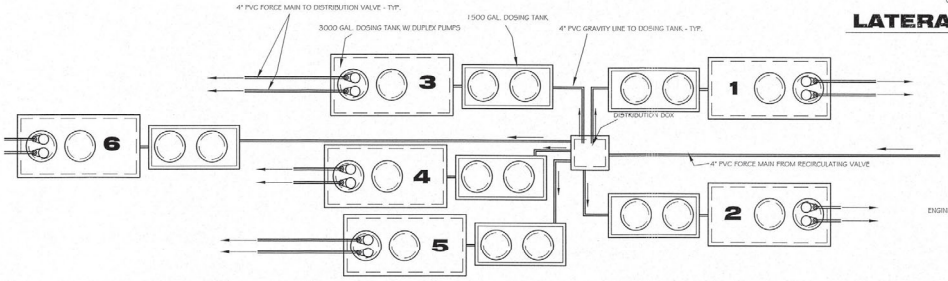
## LATERAL CLEAN-OUT DETAIL

NOT TO SCALE



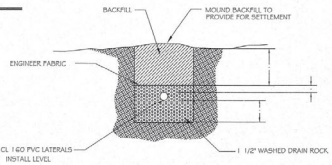

## DRAINFIELD DETAIL

NOT TO SCALE



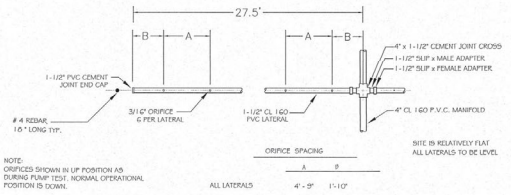

## DOSING CHAMBERS LAYOUT

NOT TO SCALE



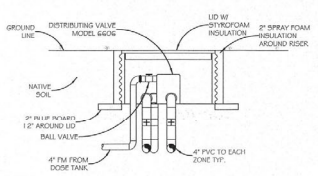

## TRENCH DETAIL

NOT TO SCALE

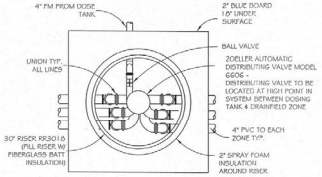



## LATERAL DETAIL

NOT TO SCALE



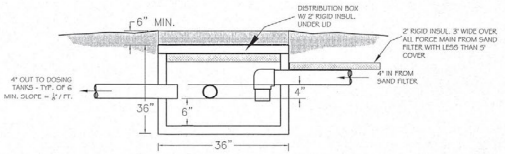

SECTION




PLAN

## DISTRIBUTION VALVE DETAILS

NOT TO SCALE




## DISTRIBUTION BOX DETAIL

NOT TO SCALE

REVISIONS

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SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

DRAINFIELD DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

C
234

RECORD DRAWINGS - APRIL 2010

## SEPTIC TANK GENERAL NOTES:

**SHOP DRAWINGS & SUBMITTALS**

1. SUBMIT SHOP DRAWINGS OF STRUCTURAL ITEMS WHERE REQUIRED FOR REVIEW PRIOR TO FABRICATION OR SHIPMENT TO SITE AS APPLICABLE.
   a. REINFORCING
   b. CONCRETE MIX DESIGN
   c. PRECAST CONCRETE ELEMENTS

**SOIL AND FOUNDATIONS**

REFER TO DIVISION 2 SPECIFICATION SECTION - EARTHWORK - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. FOOTING BEARING PRESSURES ARE LIMITED TO 3000 PSF ASSUMED CAPACITY. CONTRACTOR AND OWNER TO VERIFY PRIOR TO CONSTRUCTION.
2. FOOTINGS AT EXTERIOR OR IN UNHEATED AREAS SHALL BEAR A MINIMUM OF 3'-0" BELOW FINISH GRADE
3. FOOTINGS SHALL BEAR ON COMPACTED STRUCTURAL FILL PER DETAILS ON SHEET C 235B. THERE SHALL BE A MINIMUM 95% COMPACTION (ASTM) D1557 MODIFIED PROCTOR DENSITY) OF ALL BACKFILL SOIL UNDER SLABS, FOOTINGS AND AROUND FOUNDATION WALLS.
4. CONTRACTOR SHALL PROVIDE TEMPORARY BRACING TO PREVENT MOVEMENT OF WALLS IF BACKFILL IS PLACED BEFORE THE ROOF SYSTEM IS IN PLACE.

**REINFORCING STEEL**

REFER TO DIVISION 3 SPECIFICATION SECTION -CONCRETE REINFORCING - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. DEFORMED BAR: ASTM A615, GRADE 60 #4 & LARGER
   GRADE 40 # 3 & SMALLER
2. DETAIL, FABRICATE, LABEL, SUPPORT AND PLACE ALL REINFORCEMENT IN ACCORDANCE WITH ACI 315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES", AND ACI 318, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE", LATEST EDITIONS. BARS SHALL BE SECURELY TIED IN PLACE AND PROVIDED WITH CONCRETE COVER AS SHOWN ON THE DRAWINGS, PER ACI 318 OR AS FOLLOWS: FOOTINGS, 3" FROM THE SOIL; FORMED CONCRETE AGAINST SOIL, 2"; COLUMNS AND BEAMS, 1.5", INTERIOR FACE OF WALLS, ¾"; EXTERIOR FACE OF WALLS, 1.5".
3. SUBMIT SHOP DRAWINGS INDICATING BAR SIZE, SPACING, LAYOUT AND DETAILS, INCLUDING ELEVATIONS OF ALL CONCRETE WALLS FOR REVIEW PRIOR TO FABRICATION.
4. PLACE ALL SLAB-ON-GRADE BETWEEN CONSTRUCTION JOINTS ALLOWING A MINIMUM OF 24 HOURS BETWEEN ADJACENT POURS.

**CAST-IN-PLACE CONCRETE**

REFER TO DIVISION 3 SPECIFICATION SECTION - CONCRETE - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. PROVIDE MIX DESIGN AS FOLLOWS:

   PORTLAND CEMENT ASTM C150 TYPE I/II
   WATER CEMENT RATIO = .45 MAXIMUM (INCLUDES FLY ASH)
   28 DAY f'c = 4000 PSI, SLUMP = 4"
   ENTRAINED AIR 5%-7%
   3/4" MAX. NORMAL WEIGHT AGGREGATE

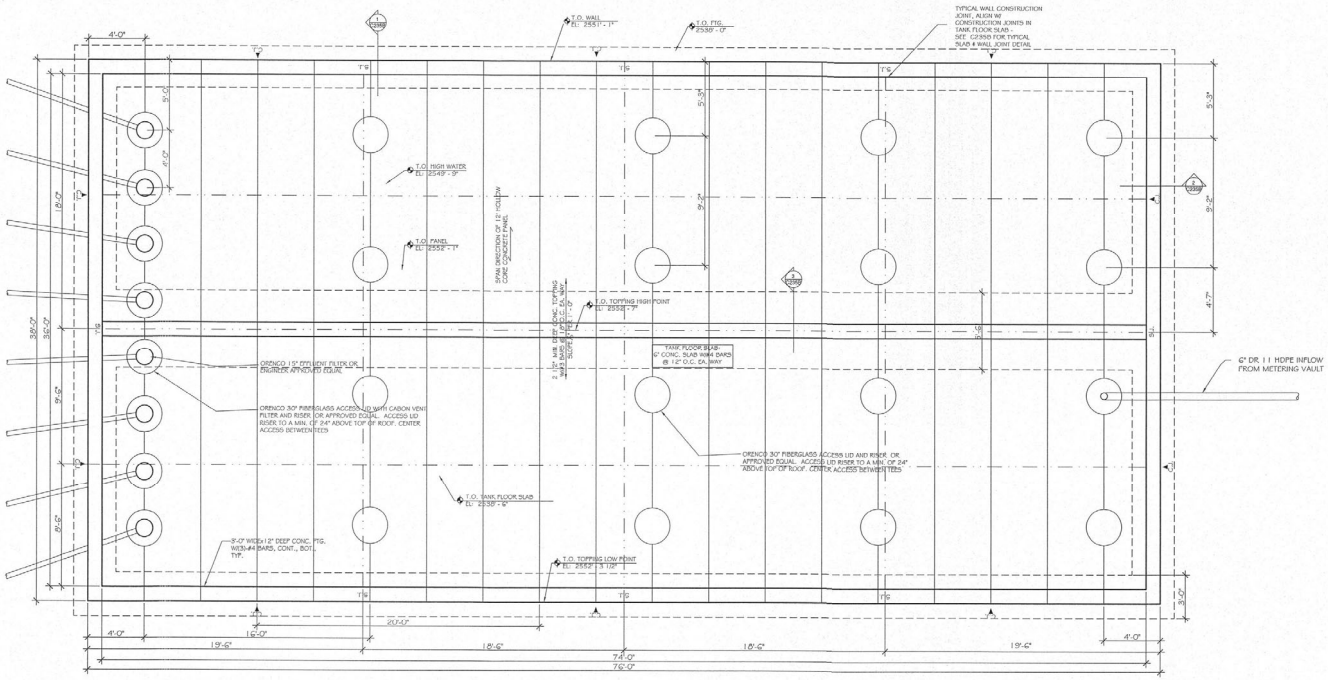
2. CURING COMPOUND: ASTM C309, TYPE 2, CLASS B
3. PROVIDE AIR-ENTRAINMENT IN ALL CONCRETE AS SET FORTH IN THE SPECIFICATIONS.
4. UNAUTHORIZED ADDITIONS TO THE MIX SHALL NOT BE MADE AT THE JOB SITE
5. DO NOT USE CALCIUM CHLORIDE IN ANY CONCRETE.
6. CONCRETE SHALL BE PLACED AND CURED IN ACCORDANCE WITH IBC AND ACI STANDARDS.
7. SUBMIT ENGINEERED CONCRETE MIX DESIGNS, INCLUDING REQUIRED BACKUP DATA, FOR EACH TYPE OF CONCRETE PROPOSED FOR USE TO THE STRUCTURAL ENGINEER FOR REVIEW BEFORE COMMENCING WITH CONCRETE WORK.

**PRE-CAST/PRE-STRESS CONCRETE**

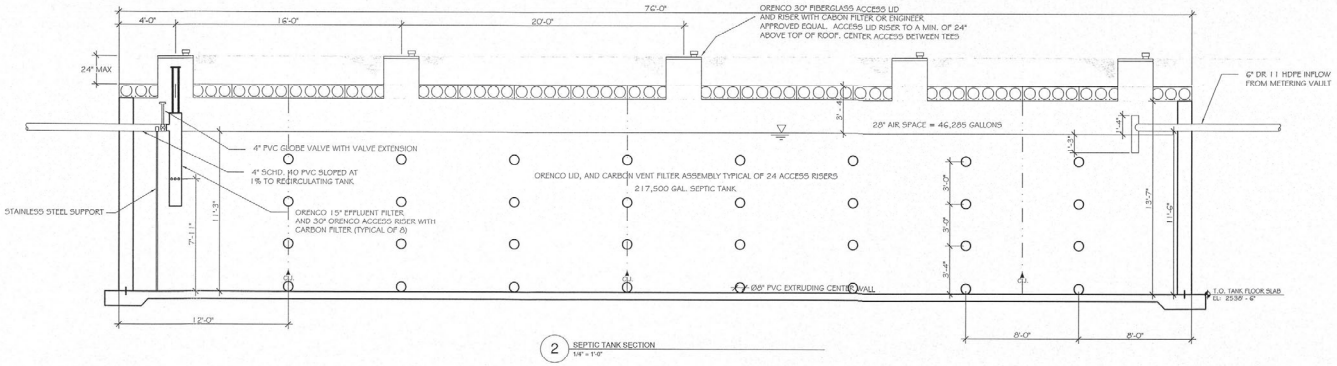
1. 12" INCH HOLLOWCORE (H.C.) COMPOSITE FLOOR SYSTEM MANUFACTURED BY "CENTRAL PRE-MIX PRE-STRESS COMPANY," SPOKANE, WASHINGTON.

| | |
|---|---|
| PANEL WIDTH: | 4'-0" NOMINAL |
| SECTION PROPERTIES: | Ag =363 SQ. IN.; I = 8390 IN4; Yb = 7.5 IN; WEIGHT = 114 PSF (WITH TOPPING) |
| CONCRETE STRENGTH: | H.C. f'c = 8000 PSI (@28 DAYS); TOPPING f'c = 4000 PSI (@28 DAYS) |
| RESTRESS STANDS: | TYPE AND PATTERN PER CENTRAL PRE-MIX |

2. INSTILLATION GUIDE PROVIDED BY "CENTAL PRE-MIX"
3. PENETRATION REQUIREMENTS, HANGERS AND SUSPENDING GUIDLINES PER "CENTRAL PRE-MIX"
4. PROVIDE SHOP DRAWINGS & SUBMITTALS INCLUDING H.C. LAYOUT, DETAIL AND DESIGN CALCULATIONS TO ENGINEER FOR REVIEW PRIOR TO FABRICATION.




1 SEPTIC TANK PLAN
1/4" = 1'-0"




2 SEPTIC TANK SECTION
1/4" = 1'-0"

REVISIONS:


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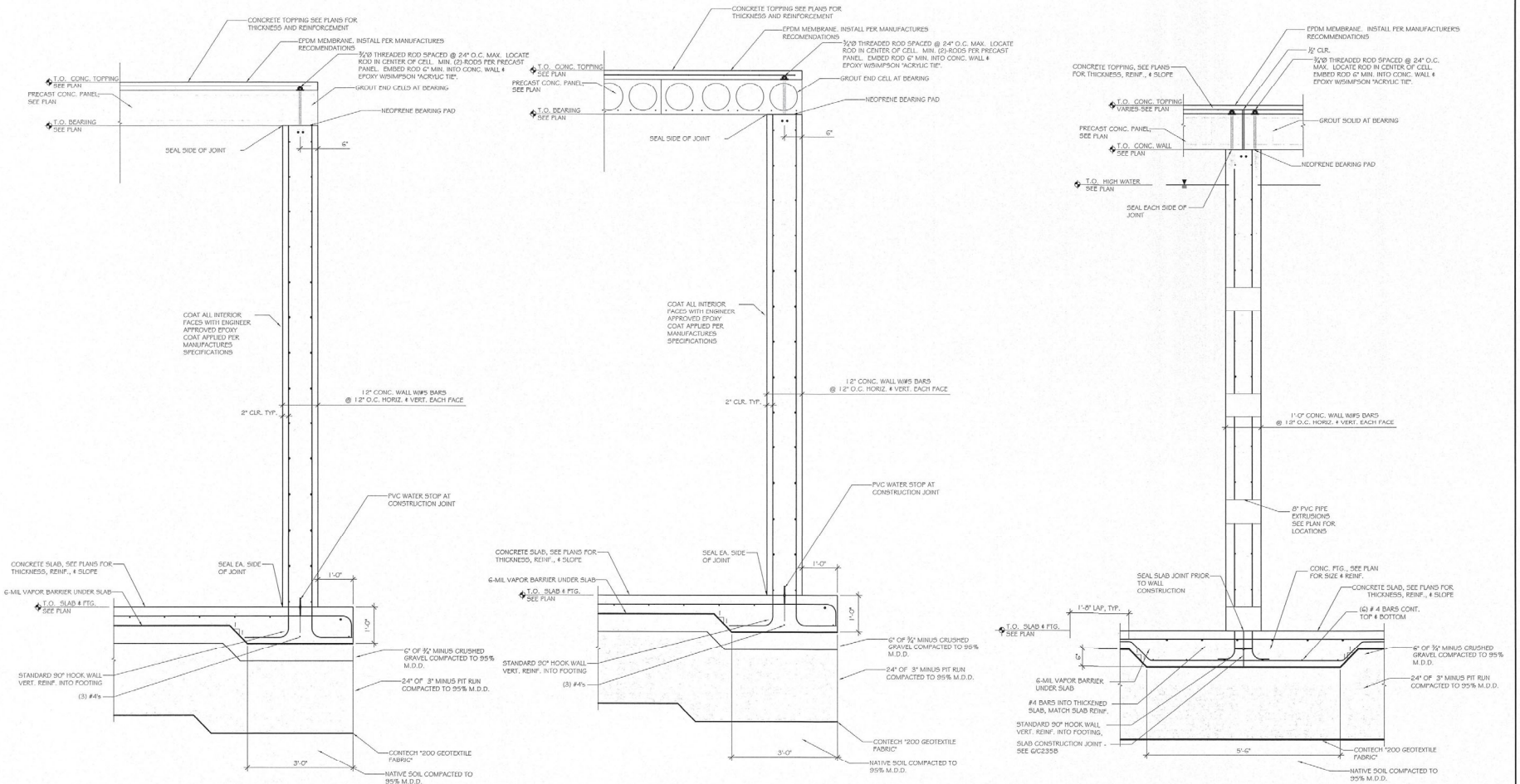
SEPTIC TANK PLAN AND SECTION DETAIL

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

C

235A

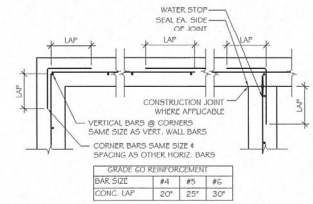
RECORD DRAWINGS - APRIL 2010




1 TYPICAL WALL SECTION
3/4" = 1'-0"

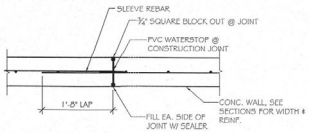
2 TYPICAL WALL SECTION
3/4" = 1'-0"

3 TYPICAL INTERIOR WALL SECTION
3/4" = 1'-0"



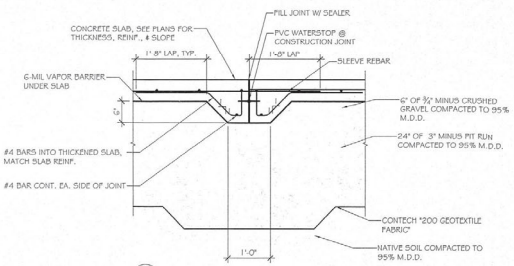

| GRADE 60 REINFORCEMENT | | | |
|---|---|---|---|
| BAR SIZE | #4 | #5 | #6 |
| CONC. LAP | 20" | 25" | 30" |

4 TYPICAL CONC. WALL CONSTRUCTION DETAIL
3/4" = 1'-0"




CONSTRUCTION JOINT NOTES:
1) CUT HORIZONTAL BARS ONE SIDE OF JOINT.
2) PROVIDE 20" LAP ONE SIDE OF JOINT. SLEEVE REINFORCING CONTINUOUS THROUGH JOINT FOR SUPPAGE.
3) SEE PLANS FOR JOINT LOCATIONS.
4) MAX SPACING SHALL BE LESS THAN 30 X WALL THICKNESS. ½ RECOMMENDED SPACING @ CORNERS AND END OF WALLS.

5 TYPICAL WALL CONSTRUCTION JOINT DETAIL
3/4" = 1'-0"




6 TYPICAL SLAB CONSTRUCTION JOINT DETAIL
3/4" = 1'-0"

REVISIONS

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FOR
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SEC. 28, 29, 32 & 33, T33N, R27W, LINCOLN COUNTY, STATE OF MONTANA

## SEPTIC TANK DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

C

235B

RECORD DRAWINGS - APRIL 2010

## RECIRCULATING TANK GENERAL NOTES:

### SHOP DRAWINGS & SUBMITTALS

1. SUBMIT SHOP DRAWINGS OF STRUCTURAL ITEMS WHERE REQUIRED FOR REVIEW PRIOR TO FABRICATION OR SHIPMENT TO SITE AS APPLICABLE.
   a. REINFORCING
   b. CONCRETE MIX DESIGN
   c. PRECAST CONCRETE ELEMENTS

### SOIL AND FOUNDATIONS

REFER TO DIVISION 2 SPECIFICATION SECTION - EARTHWORK - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. FOOTING BEARING PRESSURES ARE LIMITED TO 1500 PSF ASSUMED CAPACITY. CONTRACTOR AND OWNER TO VERIFY PRIOR TO CONSTRUCTION.
2. FOOTINGS AT EXTERIOR OR IN UNHEATED AREAS SHALL BEAR A MINIMUM OF 5'-0" BELOW FINISH GRADE
3. FOOTINGS SHALL BEAR ON COMPACTED STRUCTURAL FILL PER DETAILS ON SHEET C.236B. THERE SHALL BE A MINIMUM 95% COMPACTION (ASTM) D1557 MODIFIED PROCTOR DENSITY) OF ALL BACKFILL SOIL UNDER SLABS, FOOTINGS AND AROUND FOUNDATION WALLS.
4. CONTRACTOR SHALL PROVIDE TEMPORARY BRACING TO PREVENT MOVEMENT OF WALLS IF BACKFILL IS PLACED BEFORE THE FLOOR SYSTEM OR SLAB IS IN PLACE.

### REINFORCING STEEL

REFER TO DIVISION 3 SPECIFICATION SECTION -CONCRETE REINFORCING - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. DEFORMED BAR: ASTM A615, GRADE 60 #4 & LARGER, GRADE 40 # 3 & SMALLER
2. DETAIL, FABRICATE, LABEL, SUPPORT AND PLACE ALL REINFORCEMENT IN ACCORDANCE WITH ACI 315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES", AND ACI 318, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE", LATEST EDITIONS. BARS SHALL BE SECURELY TIED IN PLACE AND PROVIDED WITH CONCRETE COVER AS SHOWN ON THE DRAWINGS, PER ACI 318 OR AS FOLLOWS: FOOTINGS, 3" FROM THE SOIL; FORMED CONCRETE AGAINST SOIL, 2"; COLUMNS AND BEAMS, 1.5"; INTERIOR FACE OF WALLS, ¾"; EXTERIOR FACE OF WALLS, 1.5".
3. SUBMIT SHOP DRAWINGS INDICATING BAR SIZE, SPACING, LAYOUT AND DETAILS, INCLUDING ELEVATIONS OF ALL CONCRETE WALLS FOR REVIEW PRIOR TO FABRICATION.
4. PLACE ALL SLAB-ON-GRADE BETWEEN CONSTRUCTION JOINTS ALLOWING A MINIMUM OF 24 HOURS BETWEEN ADJACENT POURS.

### CAST-IN-PLACE CONCRETE

REFER TO DIVISION 3 SPECIFICATION SECTION - CONCRETE - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. PROVIDE MIX DESGIN AS FOLLOWS:

   PORTLAND CEMENT ASTM C150 TYPE I/II
   WATER CEMENT RATIO = .45 MAXIMUM (INCLUDES FLY ASH)
   28 DAY f'c = 4000 PSI, SLUMP = 4"
   ENTRAINED AIR 5%-7%
   3/4" MAX. NORMAL WEIGHT AGGREGATE

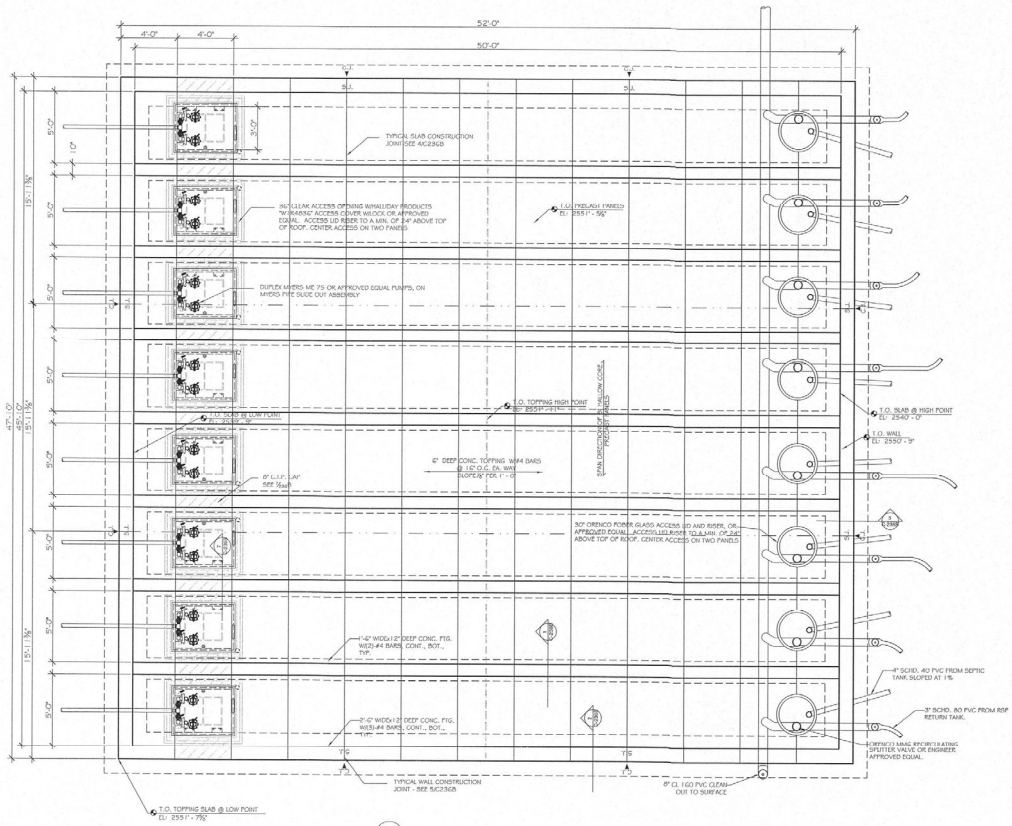
2. CURING COMPOUND: ASTM C309, TYPE 2, CLASS B
3. PROVIDE AIR-ENTRAINMENT IN ALL CONCRETE AS SET FORTH IN THE SPECIFICATIONS.
4. UNAUTHORIZED ADDITIONS TO THE MIX SHALL NOT BE MADE AT THE JOB SITE
5. DO NOT USE CALCIUM CHLORIDE IN ANY CONCRETE.
6. CONCRETE SHALL BE PLACED AND CURED IN ACCORDANCE WITH IBC AND ACI STANDARDS.
7. SUBMIT ENGINEERED CONCRETE MIX DESIGNS, INCLUDING REQUIRED BACKUP DATA, FOR EACH TYPE OF CONCRETE PROPOSED FOR USE TO THE STRUCTURAL ENGINEER FOR REVIEW BEFORE COMMENCING WITH CONCRETE WORK.

### PRE-CAST/PRE-STRESS CONCRETE

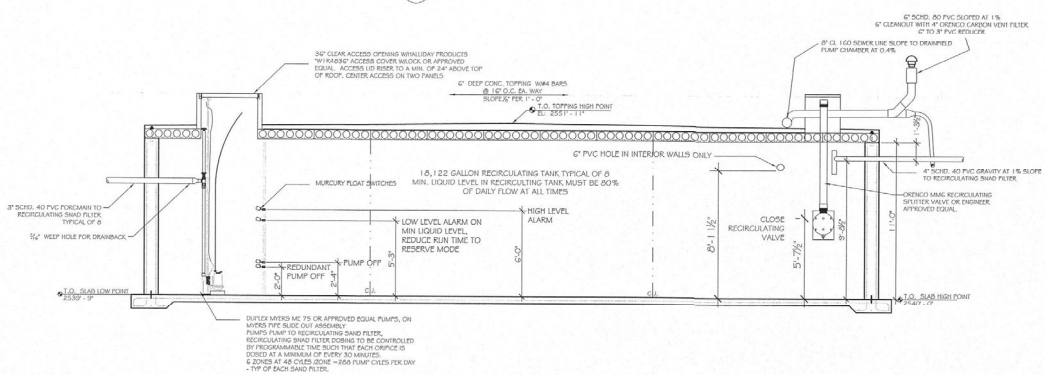
1. 12- INCH HOLLOWCORE (H.C.) COMPOSITE FLOOR SYSTEM MANUFACTURED BY "CENTRAL PRE-MIX PRE-STRESS COMPANY," SPOKANE, WASHINGTON.

| | |
|---|---|
| PANEL WIDTH: | 4'-0" NOMINAL |
| SECTION PROPERTIES: | Ag =363 SQ. IN.; I = 8390 IN4; Yb = 7.5 IN; WEIGHT = 114 PSF (WITH TOPPING) |
| CONCRETE STRENGTH: | H.C. f'c = 8000 PSI (@28 DAYS); TOPPING f'c = 4000 PSI (@28 DAYS) |
| RESTRESS STANDS: | TYPE AND PATTERN PER CENTRAL PRE-MIX |

2. INSTILLATION GUIDE PROVIDED BY "CENTAL PRE-MIX"
3. PENETRATION REQUIREMENTS, HANGERS AND SUSPENDING GUIDLINES PER "CENTRAL PRE-MIX"
4. PROVIDE SHOP DRAWINGS & SUBMITTALS INCLUDING H.C. LAYOUT, DETAIL AND DESIGN CALCULATIONS TO ENGINEER FOR REVIEW PRIOR TO FABRICATION.




1 RECIRCULATING TANK PLAN
1/4" = 1'-0"




2 RECIRCULATING TANK SECTION
1/4" = 1'-0"

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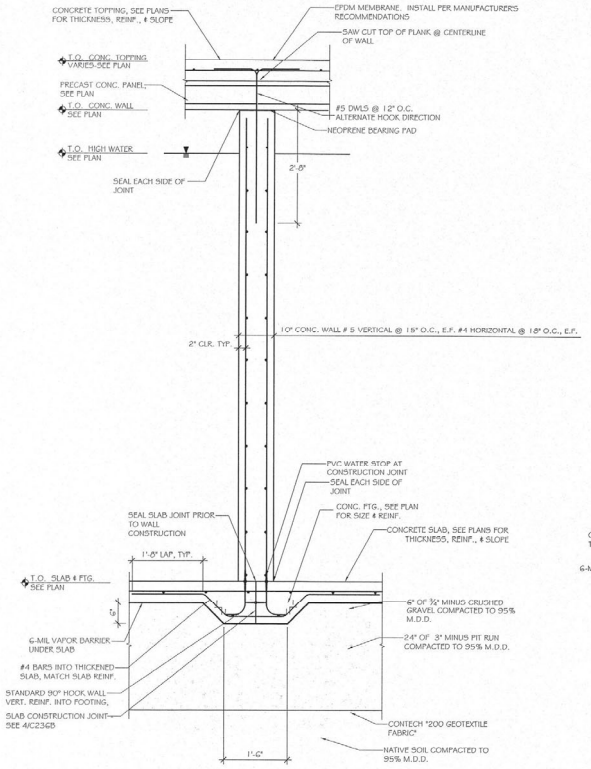
RECIRCULATION TANK DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

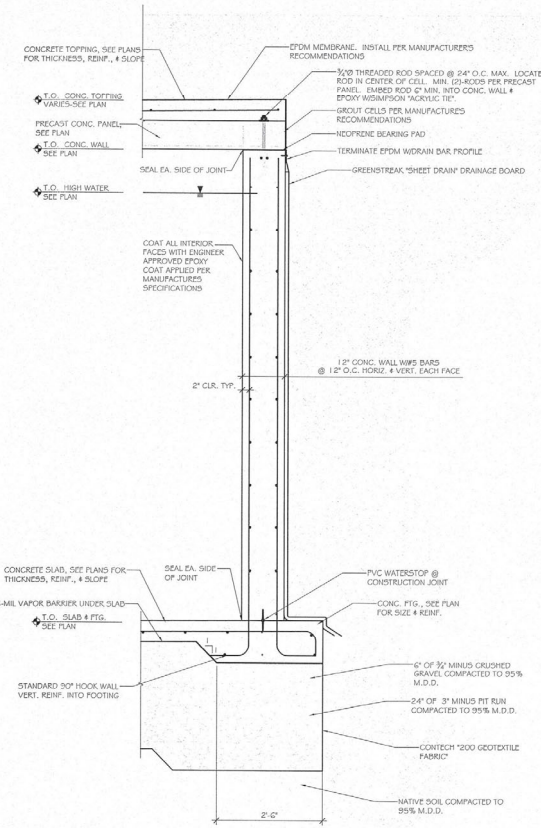
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236A

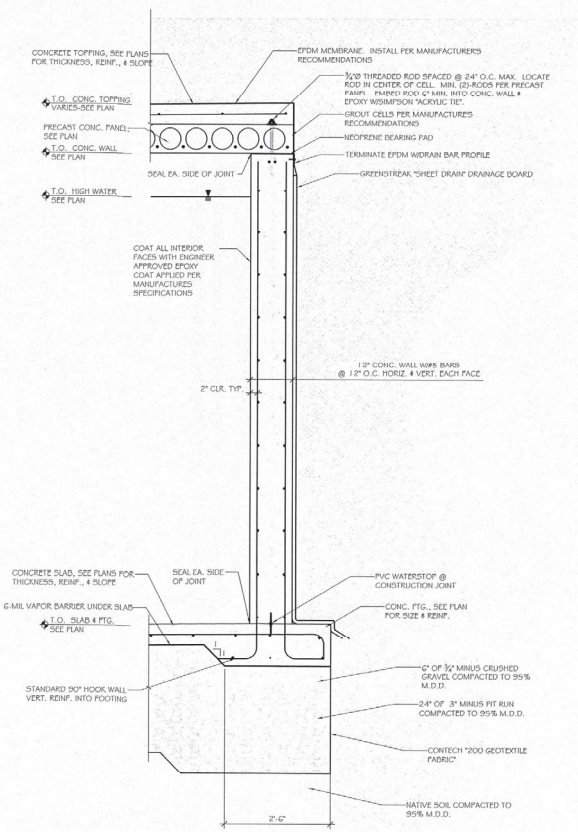
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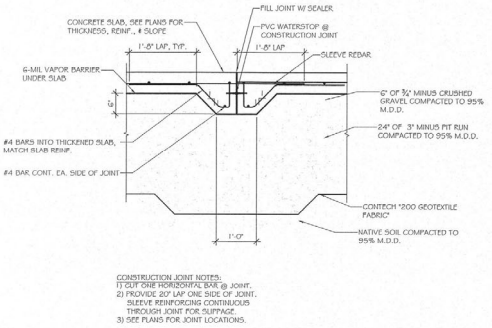

1 TYPICAL BAFFLE WALL SECTION
3/4" = 1'-0"




2 TYPICAL EXTERIOR WALL SECTION

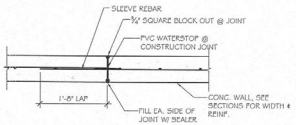



3 TYPICAL EXTERIOR WALL SECTION
3/4" = 1'-0"



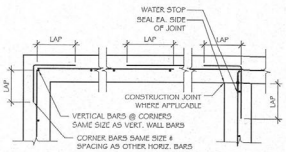

CONSTRUCTION JOINT NOTES:
1) CUT ONE HORIZONTAL BAR @ JOINT.
2) PROVIDE 20" LAP ONE SIDE OF JOINT. SLEEVE REINFORCING CONTINUOUS THROUGH JOINT FOR SLIPPAGE.
3) SEE PLANS FOR JOINT LOCATIONS.

4 TYPICAL SLAB CONSTRUCTION JOINT DETAIL
3/4" = 1'-0"



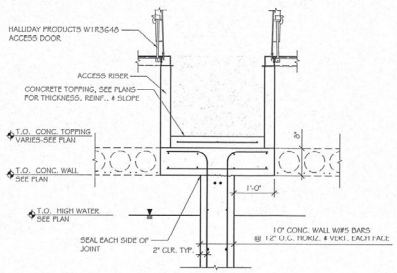

CONSTRUCTION JOINT NOTES:
1) CUT HORIZONTAL BARS ONE SIDE OF JOINT.
2) PROVIDE 20" LAP ONE SIDE OF JOINT. SLEEVE REINFORCING CONTINUOUS THROUGH JOINT FOR SLIPPAGE.
3) SEE PLANS FOR JOINT LOCATIONS.
4) MAX SPACING SHALL BE LESS THAN 3.0 X WALL THICKNESS. ⅓ RECOMMENDED SPACING @ CORNERS AND END OF WALLS

5 TYPICAL WALL CONSTRUCTION JOINT DETAIL
3/4" = 1'-0"




| GRADE 60 REINFORCEMENT | | | |
|---|---|---|---|
| BAR SIZE | #4 | #5 | #6 |
| CONC. LAP | 20" | 25" | 30" |

6 TYPICAL CONC. WALL CONSTRUCTION DETAIL
3/4" = 1'-0"




7 TYPICAL CONC. WALL CONSTRUCTION DETAIL
3/4" = 1'-0"

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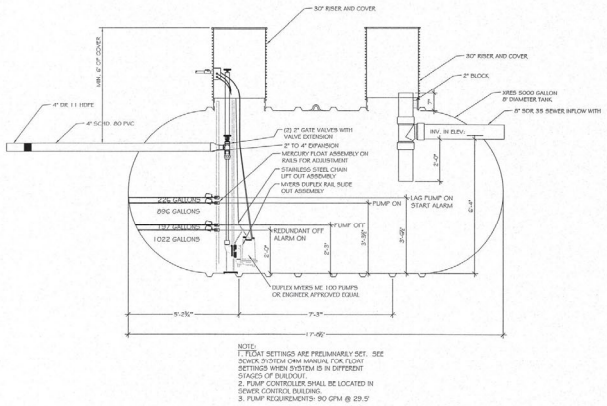
RECIRCULATING TANK DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

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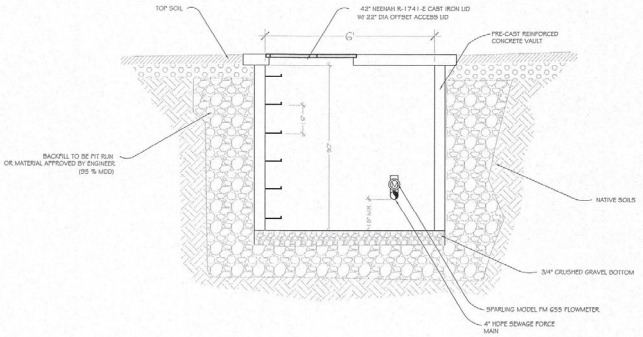
236B

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5000 GALLON DRAINFIELD PUMP CHAMBER

3/8"=1'-0"




6' SEWER METERING VAULT

N.T.S.

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SEWER TREATMENT FACILITY SITE DETAILS

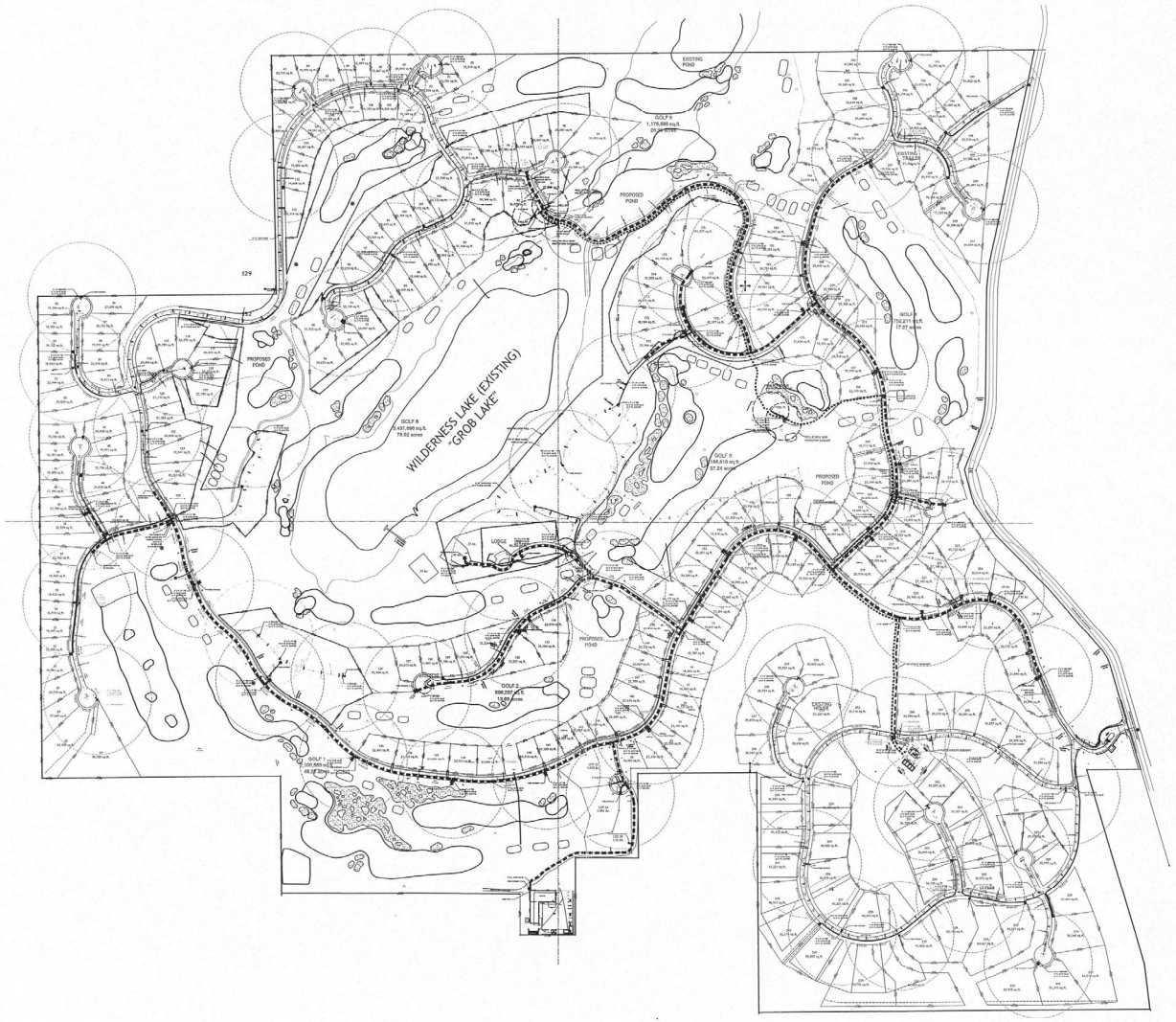
JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

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RECORD DRAWINGS - APRIL 2010

NOTE:
1. ALL WATER LINES SHALL BE DR 11 HDPE, UNLESS OTHERWISE NOTED IN THESE PLANS.
2. ALL VALVES, TEE, AND ELBOWS SHALL BE FUSION JOINTS OR FLANGE JOINTS, UNLESS OTHERWISE NOTED IN THESE PLANS.
3. ALL WATER LINES SHALL BE A MINIMUM OF 6' OF DEPTH. AND ALL WATER SEWER CROSSINGS SHALL HAVE A MINIMUM OF 18" OF VERTICAL SEPARATION.
4. ALL COVERED FLANGED FITTINGS SHALL BE WRAPPED IN POLYETHYLENE TO AID IN THE PREVENTION OF CORROSION OF THE FLANGE.




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SITE PLAN
SCALE 1" = 300'

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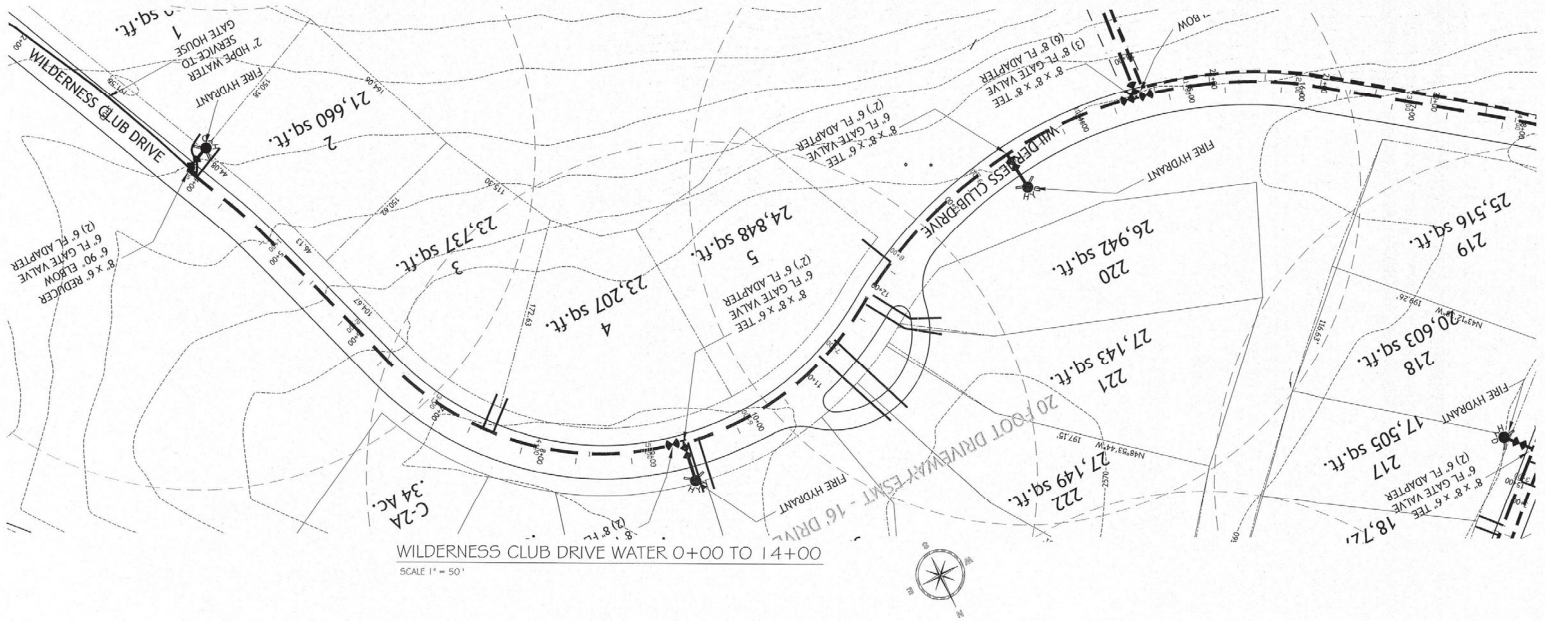
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WATER SITE PLAN

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

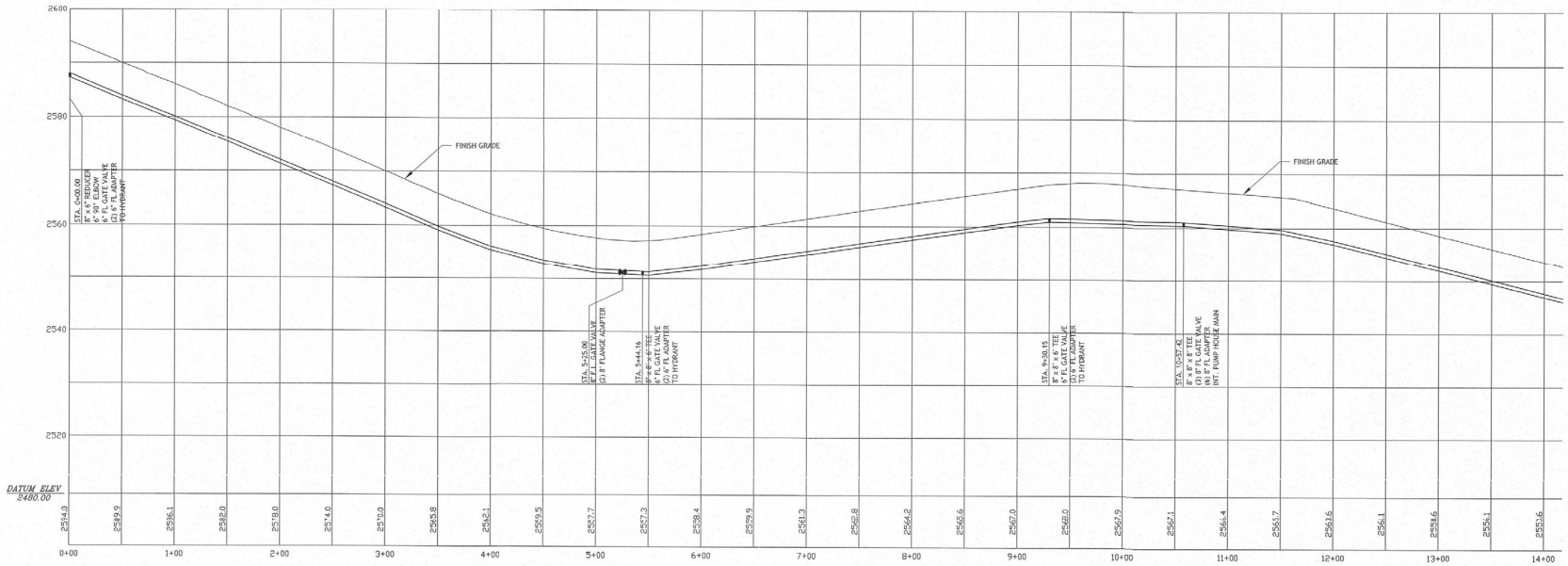
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300

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WILDERNESS CLUB DRIVE WATER 0+00 TO 14+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE WATER PROFILE 0+00 TO 14+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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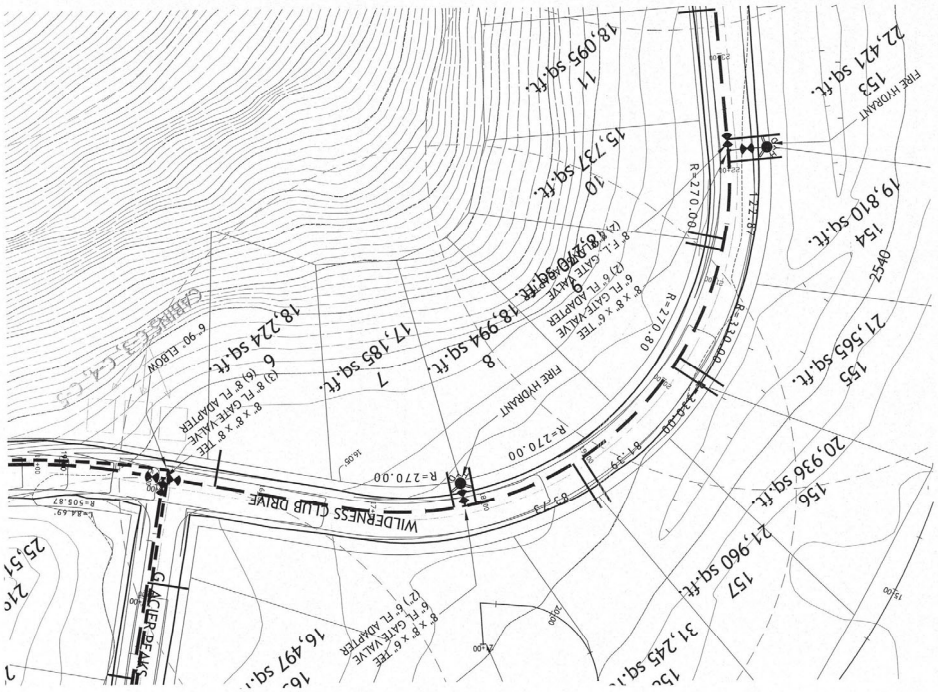
WILDERNESS CLUB DRIVE WATER 0+00 - 14+00 PLAN & PROFILE

JOB NUMBER: 1311.05
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DATE: 8-13-2007

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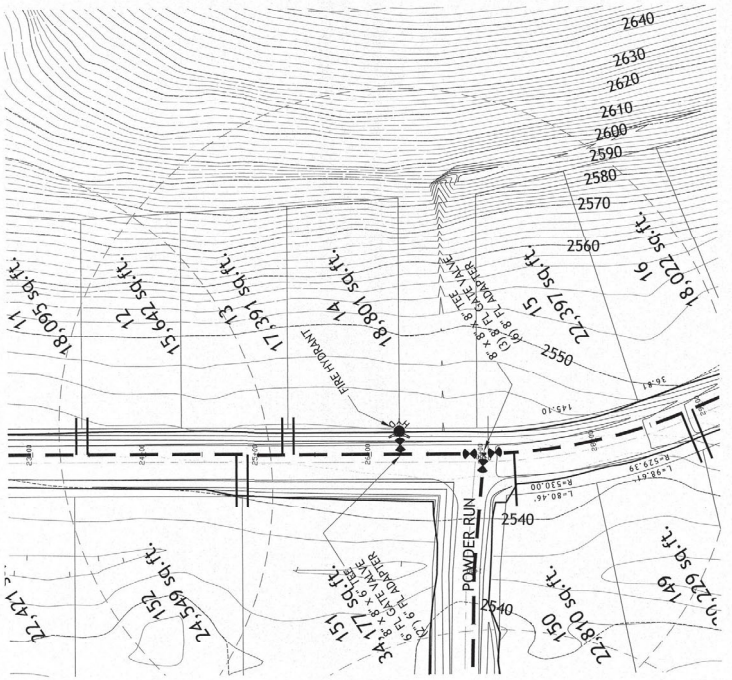
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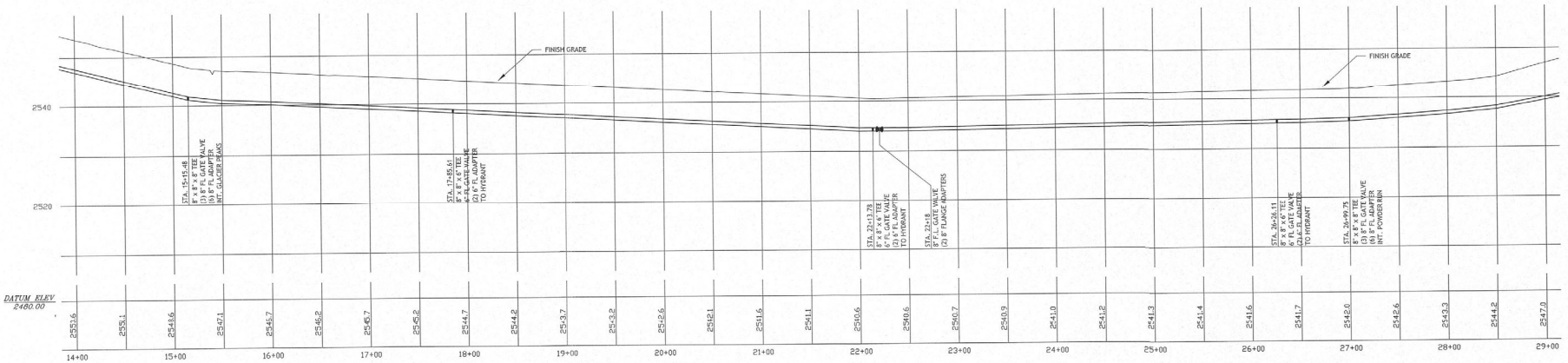

WILDERNESS CLUB DRIVE WATER 14+00 TO 23+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE WATER 23+00 TO 29+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE WATER PROFILE 14+00 TO 29+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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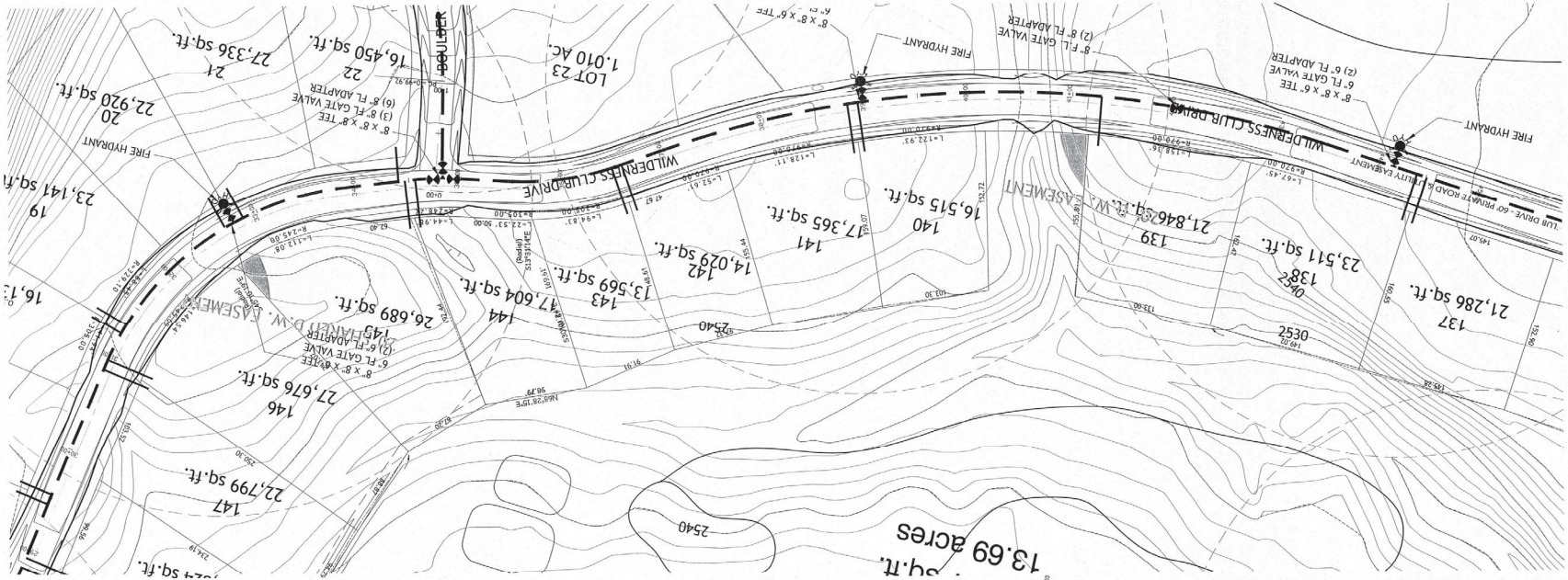
WILDERNESS CLUB
DRIVE WATER
14+00 - 29+00
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

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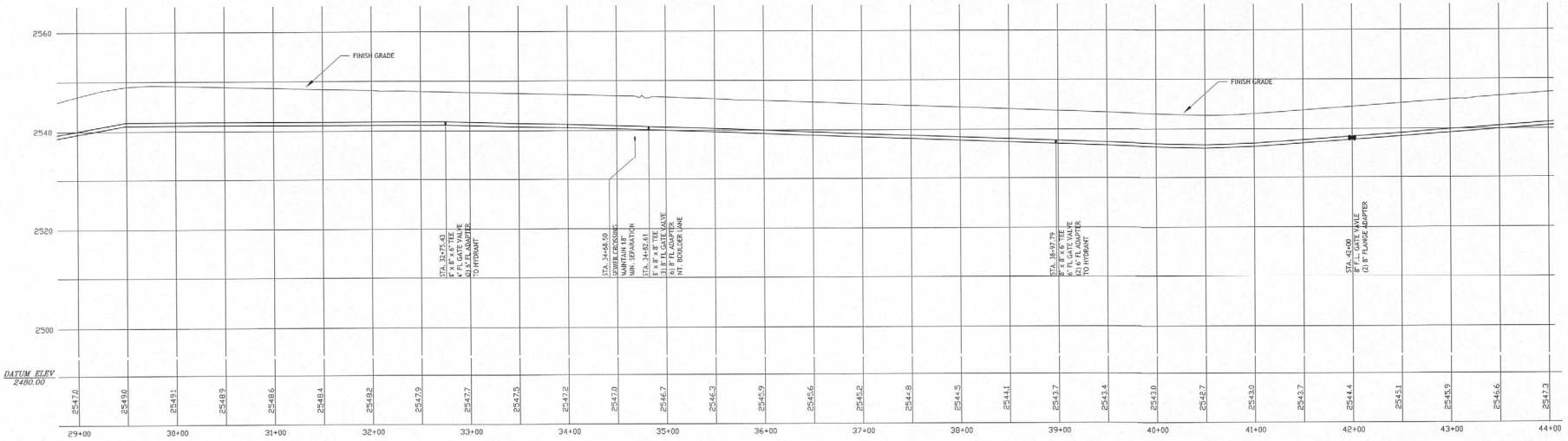
302

RECORD DRAWINGS - APRIL 2010




WILDERNESS CLUB DRIVE WATER 29+00 TO 44+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE WATER PROFILE 29+00 TO 44+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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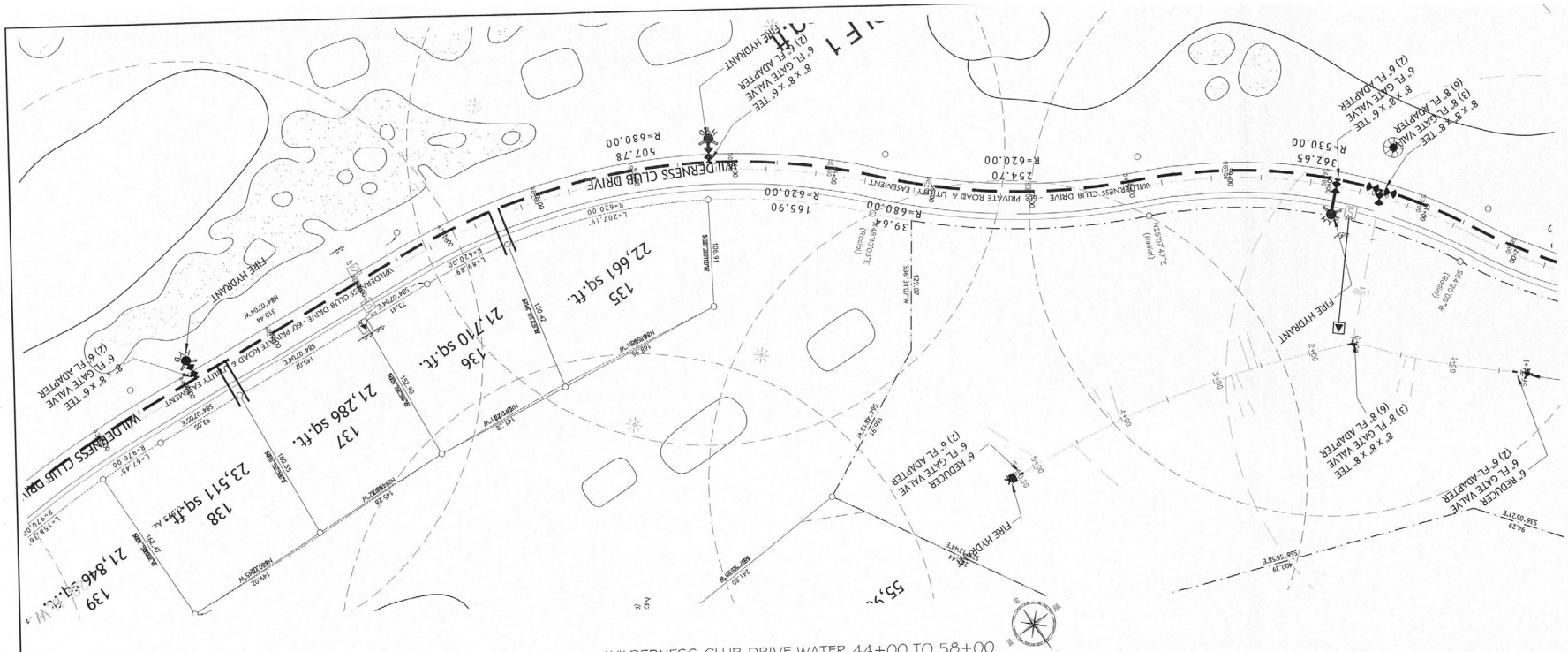
WILDERNESS CLUB
DRIVE WATER
29+00 - 44+00
PLAN & PROFILE

JOB NUMBER: 1213.05
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DATE: 3-12-2007

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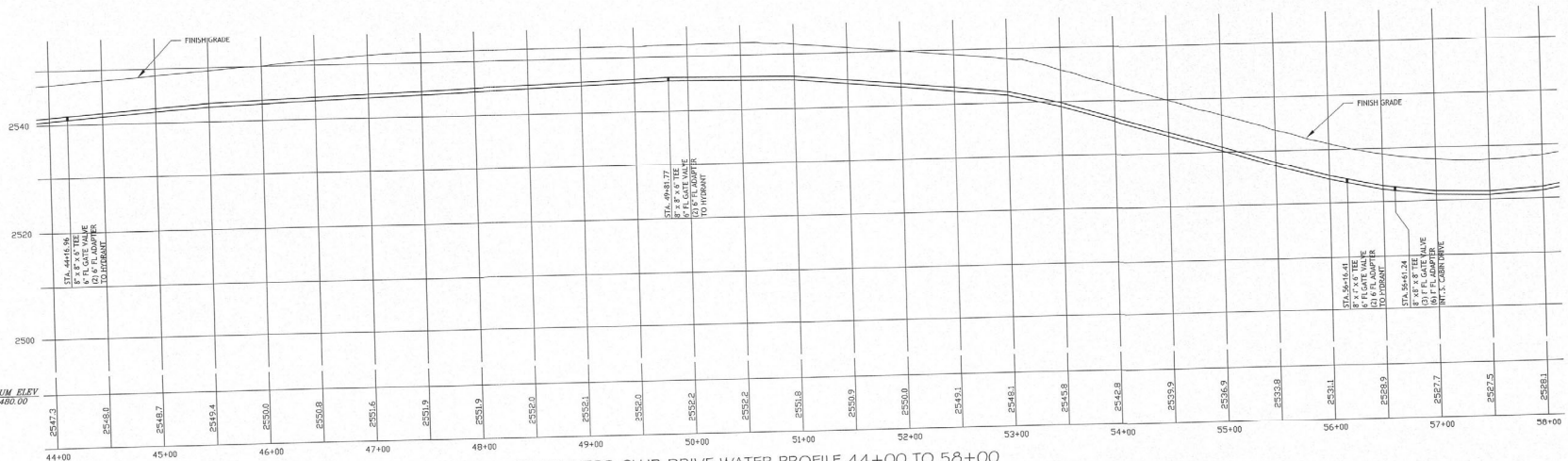
303

RECORD DRAWINGS - APRIL 20




WILDERNESS CLUB DRIVE WATER 44+00 TO 58+00

SCALE 1" = 50'




WILDERNESS CLUB DRIVE WATER PROFILE 44+00 TO 58+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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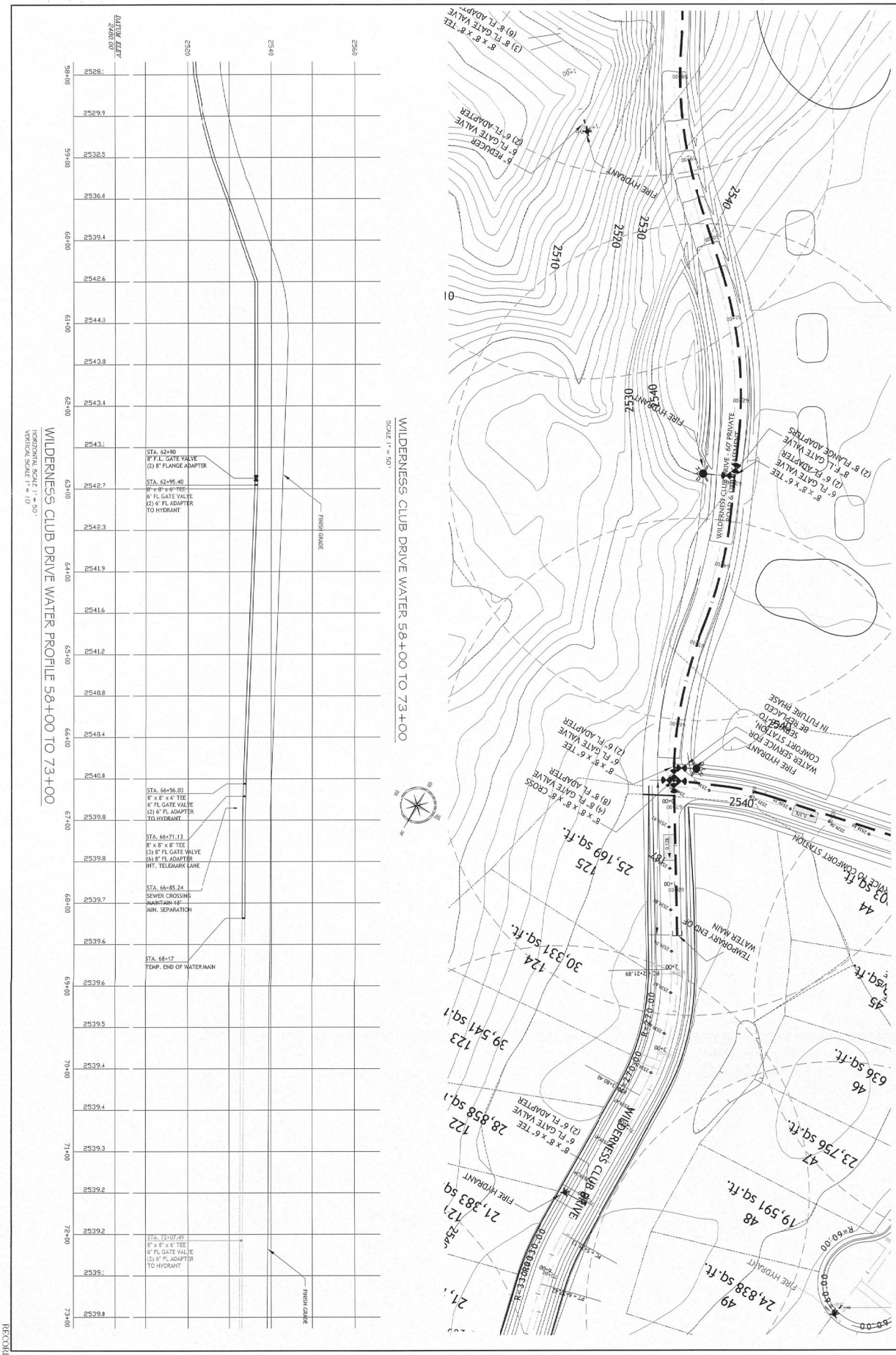
WILDERNESS CLUB
DRIVE WATER
44+00 - 58+00
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

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RECORD DRAWINGS - APRIL 20




# THE WILDERNESS CLUB

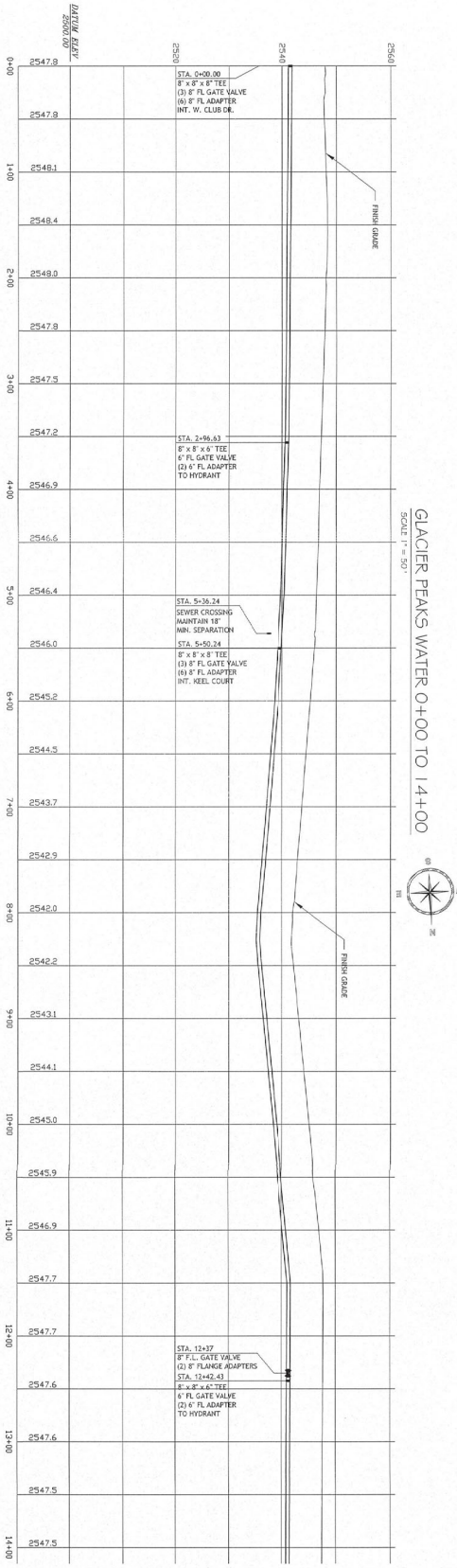
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GLACIER PEAKS WATER
0+00 - 14+00
PLAN & PROFILE

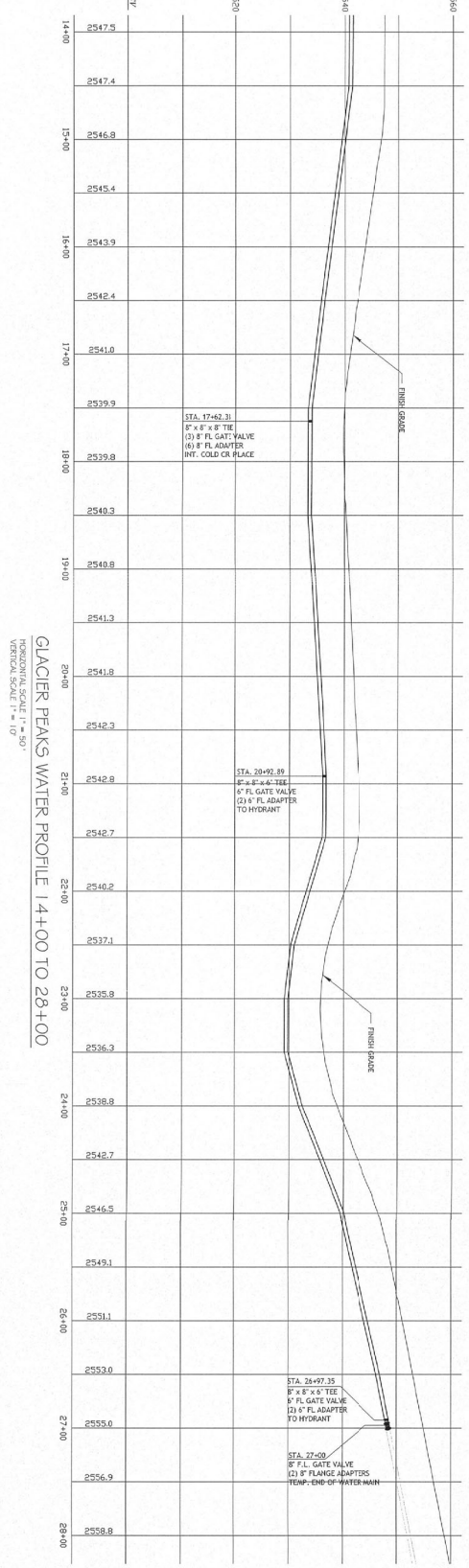
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DRAWN BY: AJM
DATE: 5.12.2007

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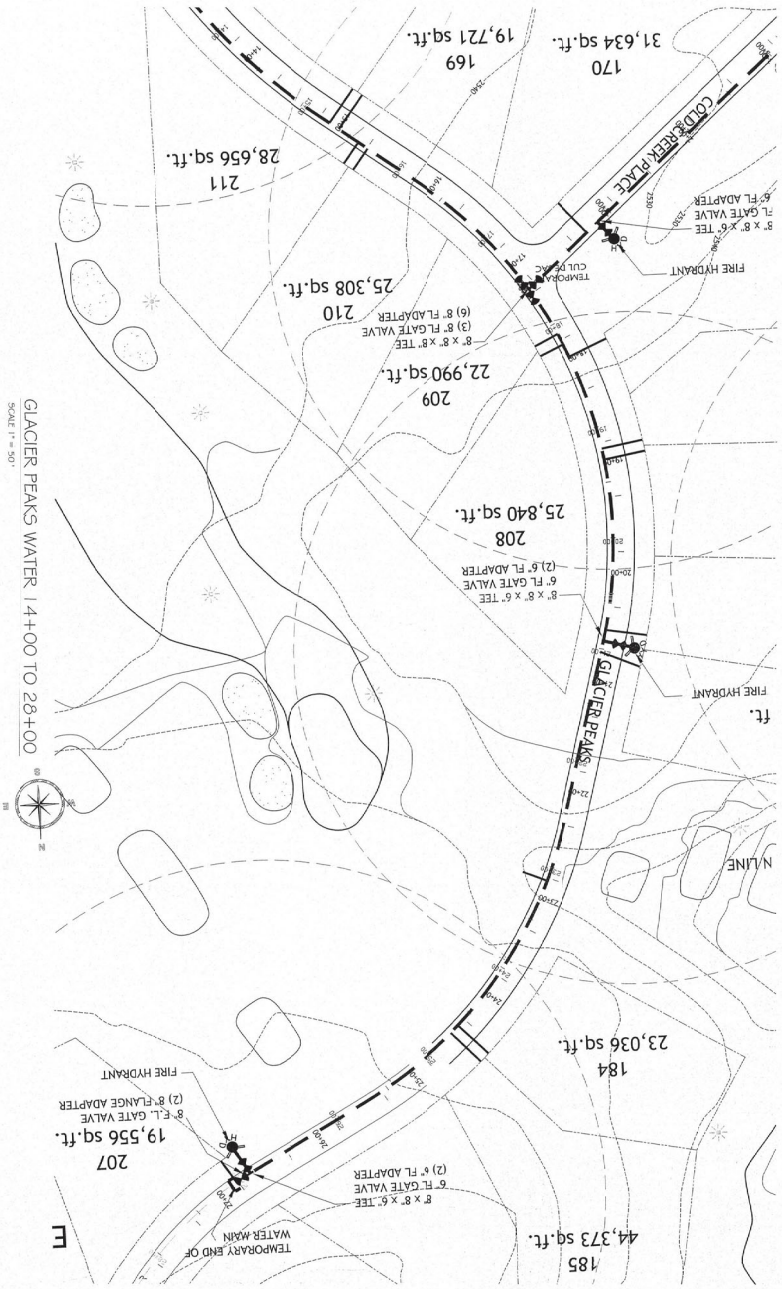



GLACIER PEAKS WATER PROFILE 14+00 TO 28+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

GLACIER PEAKS WATER 14+00 TO 28+00

SCALE 1" = 50'




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GLACIER PEAKS WATER
14+00 - 28+00
PLAN & PROFILE

JOB NUMBER 123.05
DRAWN BY AJM
DATE 5-12-2010

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COLD CREEK PLACE
WATER
0+00 - 11+00
PLAN & PROFILE

JOB NUMBER 12105
DRAWN BY: AIM
DATE: 3-12-2007

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RECORD DRAWINGS - APRIL 2010




COLD CREEK PLACE WATER 0+00 TO 11+00
SCALE 1" = 50'

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POWDER RUN
WATER
0+00 - 15+00
PLAN & PROFILE

JOB NUMBER: 121305
DRAWN BY: AJM
DATE: 3-12-2007

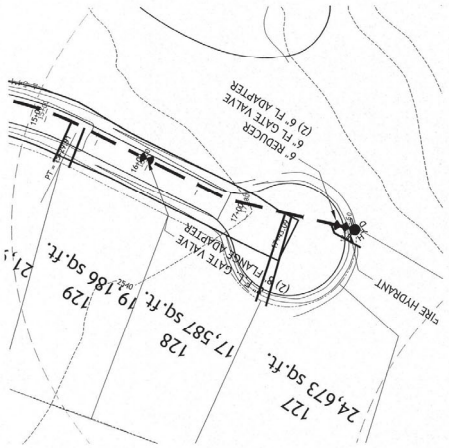
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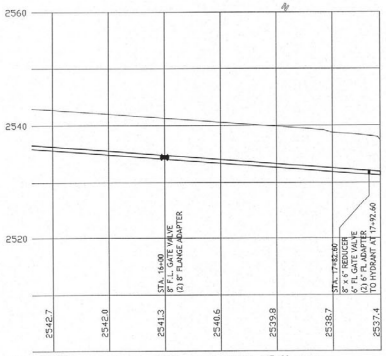
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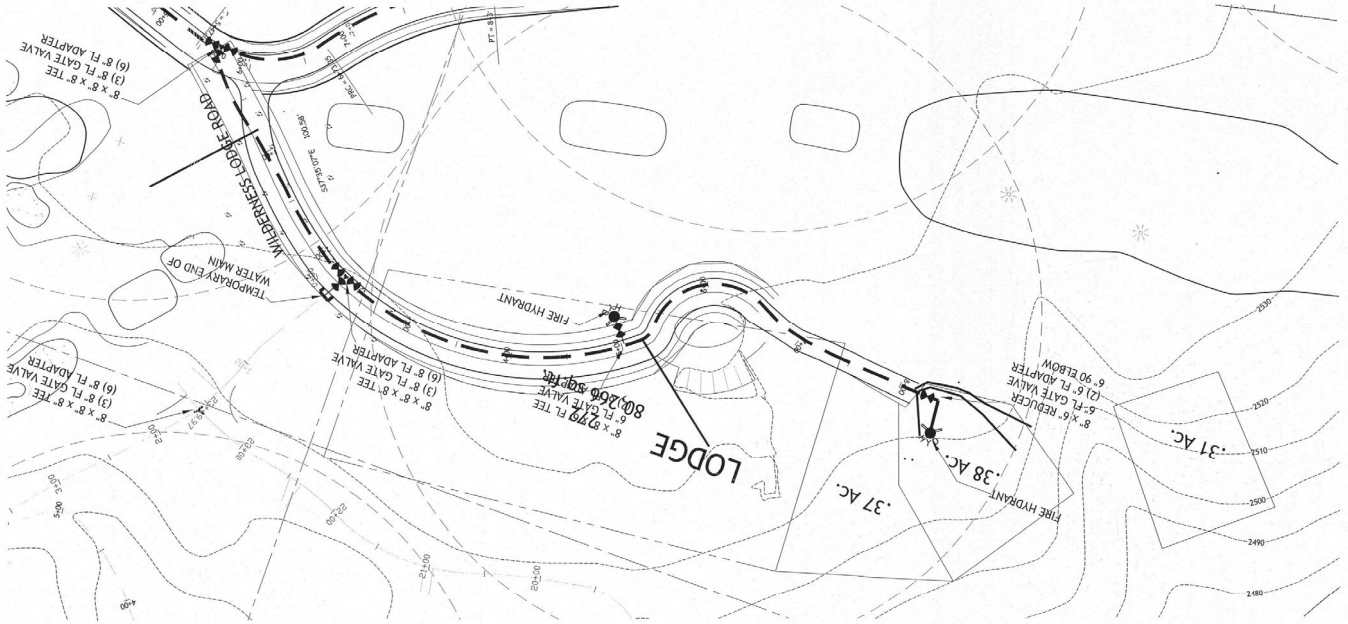

POWDER RUN WATER
15+00 TO END

SCALE 1" = 50'



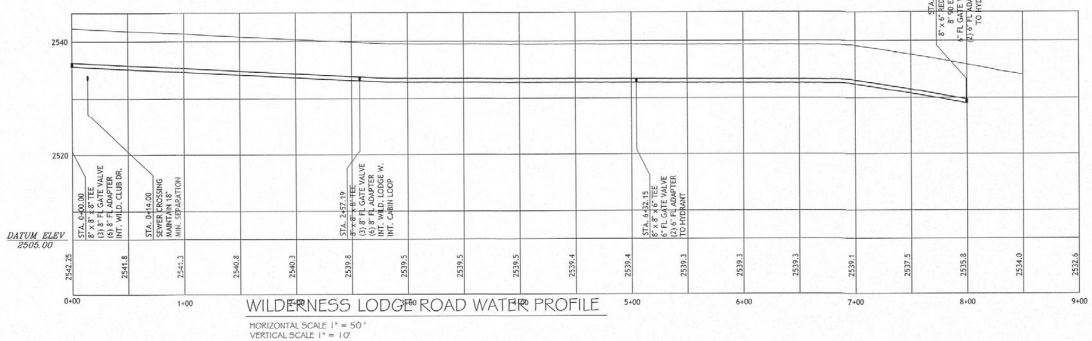

POWDER RUN WATER PROFILE 15+00 TO END

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'




WILDERNESS LODGE WEST WATER

SCALE 1" = 50'




WILDERNESS LODGE ROAD WATER PROFILE

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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POWDER RUN
WATER 15+00 - END,
WILDERNESS LODGE
WATER
PLAN & PROFILE

JOB NUMBER: 121305
DRAWN BY: AIM
DATE: 3-12-2007

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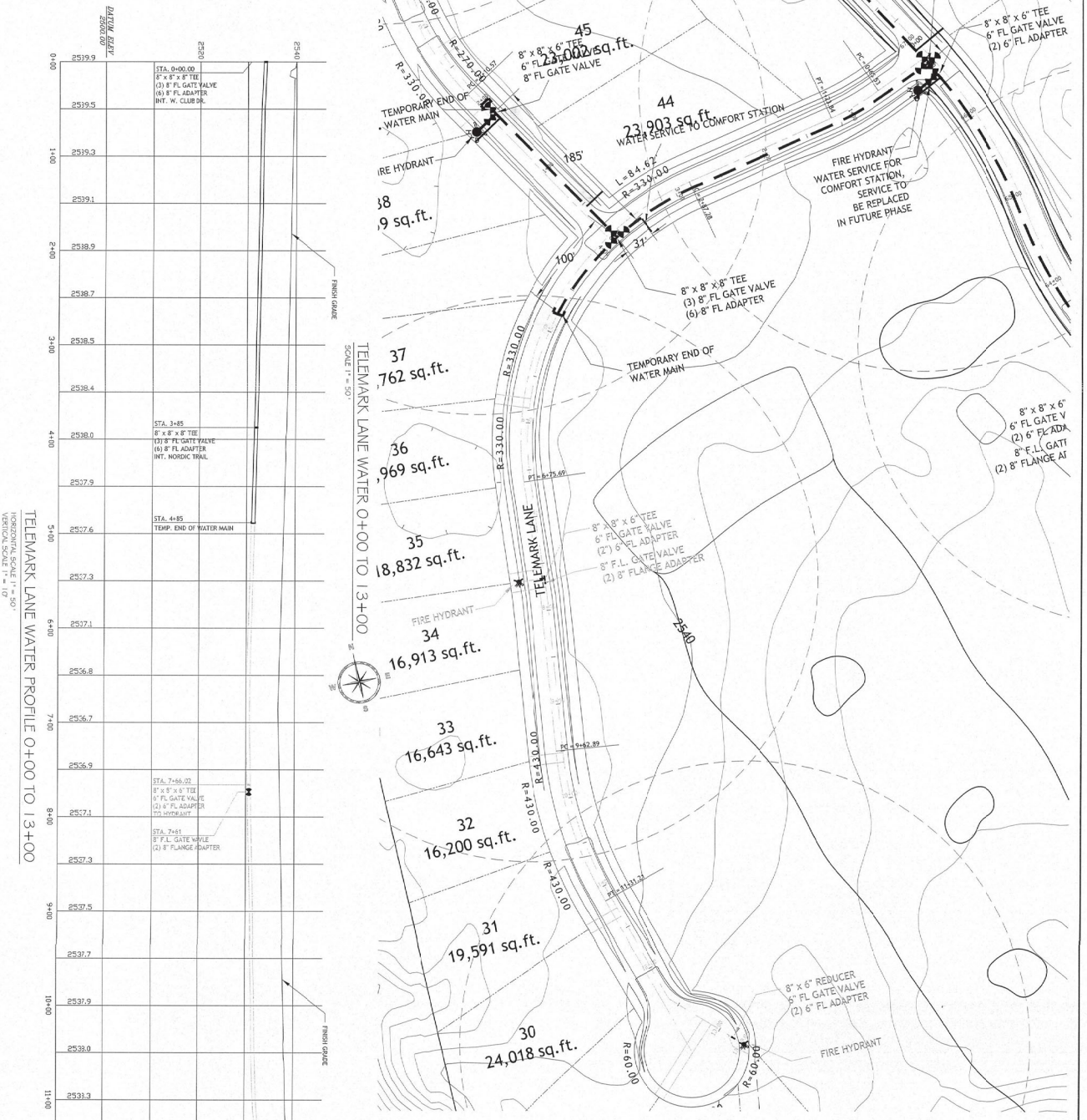
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BOULDER LANE
WATER
0+00 - 12+20
PLAN & PROFILE

JOB NUMBER: 123105
DRAWN BY: AJM
DATE: 3-12-2007

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TELEMARK LANE
WATER
0+00 - 13+00
PLAN & PROFILE

C

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DRAWN BY: AJM
DATE: 3-19-2007

# THE WILDERNESS CLUB

FOR

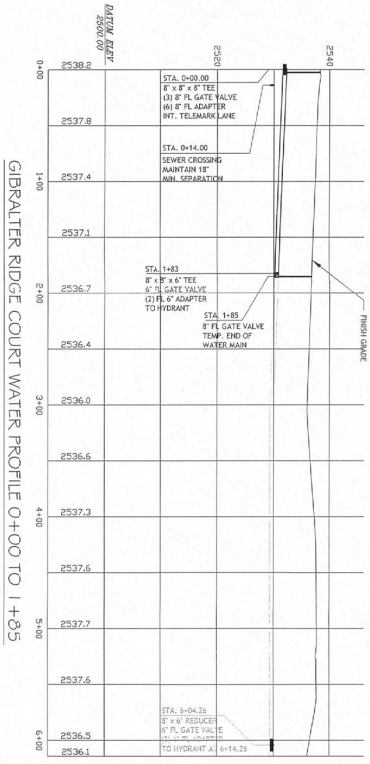
# WILDERNESS DEVELOPMENT L.L.C.

SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

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Civil Structural
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REVISIONS

RECORD DRAWINGS - APRIL 2007

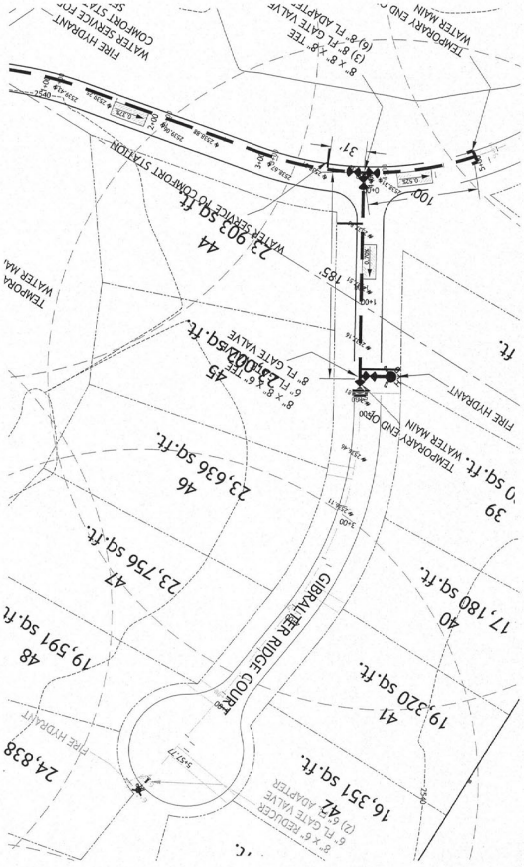



GIBRALTER RIDGE COURT WATER PROFILE 0+00 TO 1+85

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

GIBRALTER RIDGE COURT WATER 0+00 TO 1+85

SCALE 1" = 50'




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GIBRALTER RIDGE COURT
0+00 - 6+00
PLAN & PROFILE

JOB NUMBER: 1315.05
DRAWN BY: AHM
DATE: 5.12.2010

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RECORD DRAWINGS - APRIL 2010

BIG CANYON DRIVE WATER 0+00 TO 7+00
SCALE 1" = 50'




BIG CANYON DRIVE WATER PROFILE 0+00 TO 7+00
HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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BIG CANYON DRIVE
WATER
0+00 - 7+00
PLAN & PROFILE

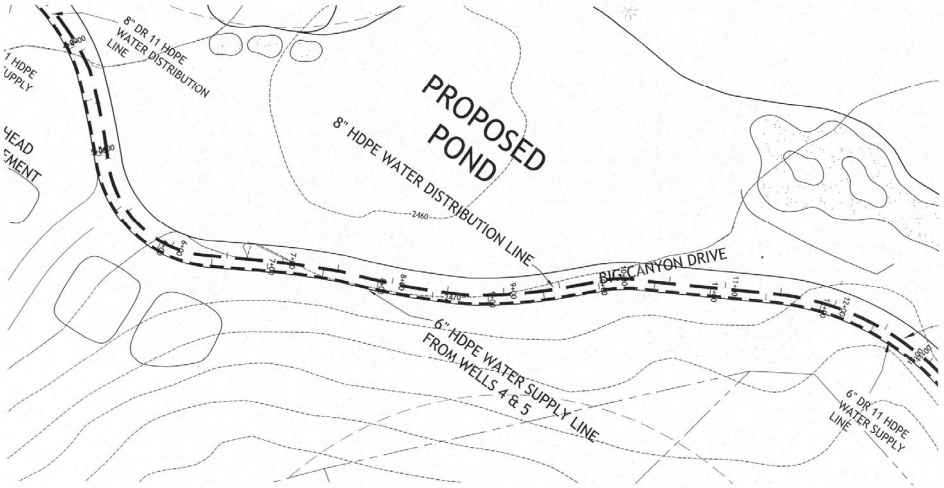
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DATE: 3-12-2007

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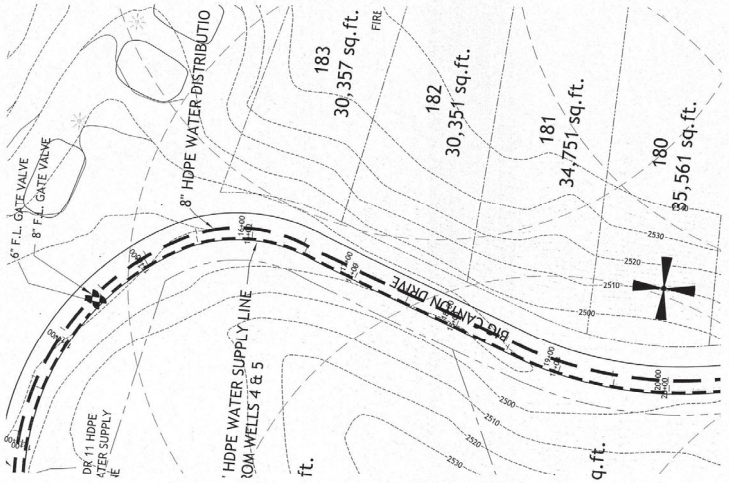
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RECORD DRAWINGS - APRIL 2010

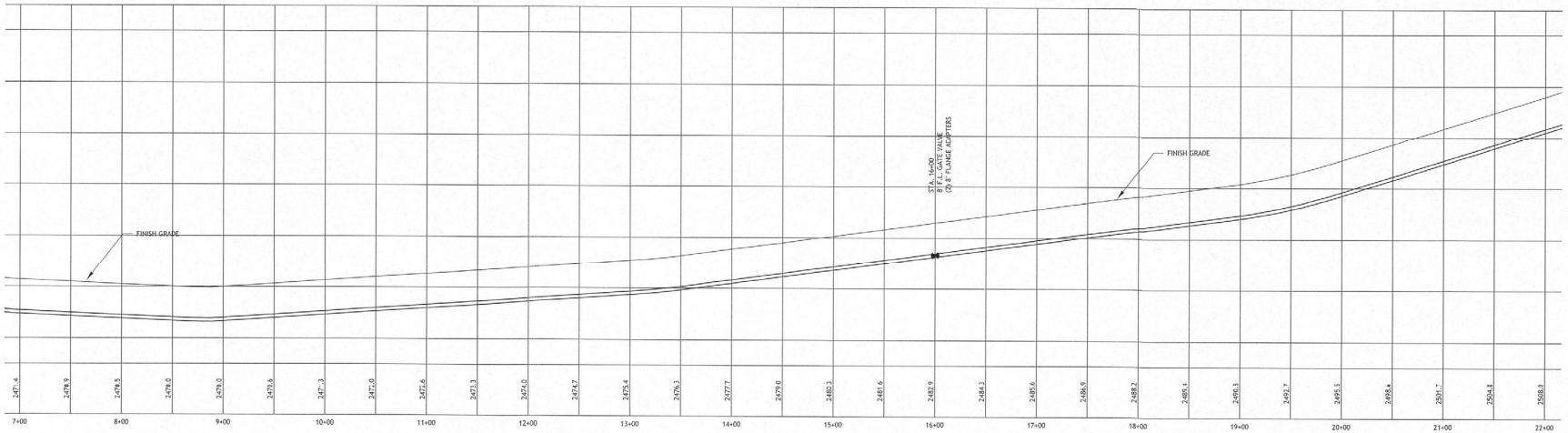
REVISIONS:




BIG CANYON DRIVE WATER 7+00 TO 15+00
SCALE 1" = 50'




BIG CANYON DRIVE WATER 15+00 TO 22+00
SCALE 1" = 50'




BIG CANYON DRIVE WATER PROFILE 7+00 TO 22+00
HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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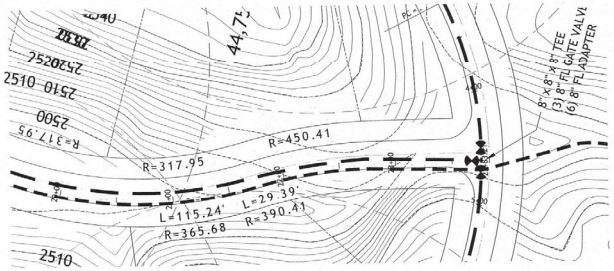
BIG CANYON DRIVE
WATER
7+00 - 22+00
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

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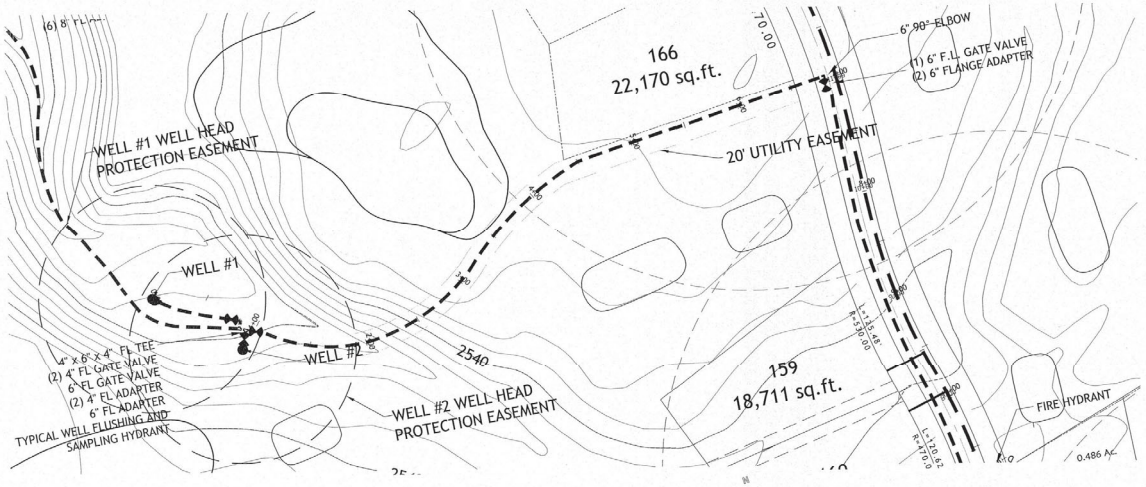
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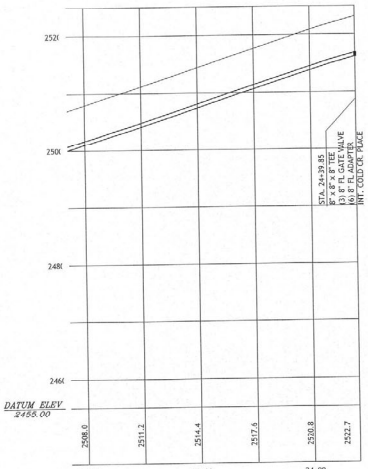

BIG CANYON DRIVE WATER 22+00 TO 25+00

SCALE 1" = 50'



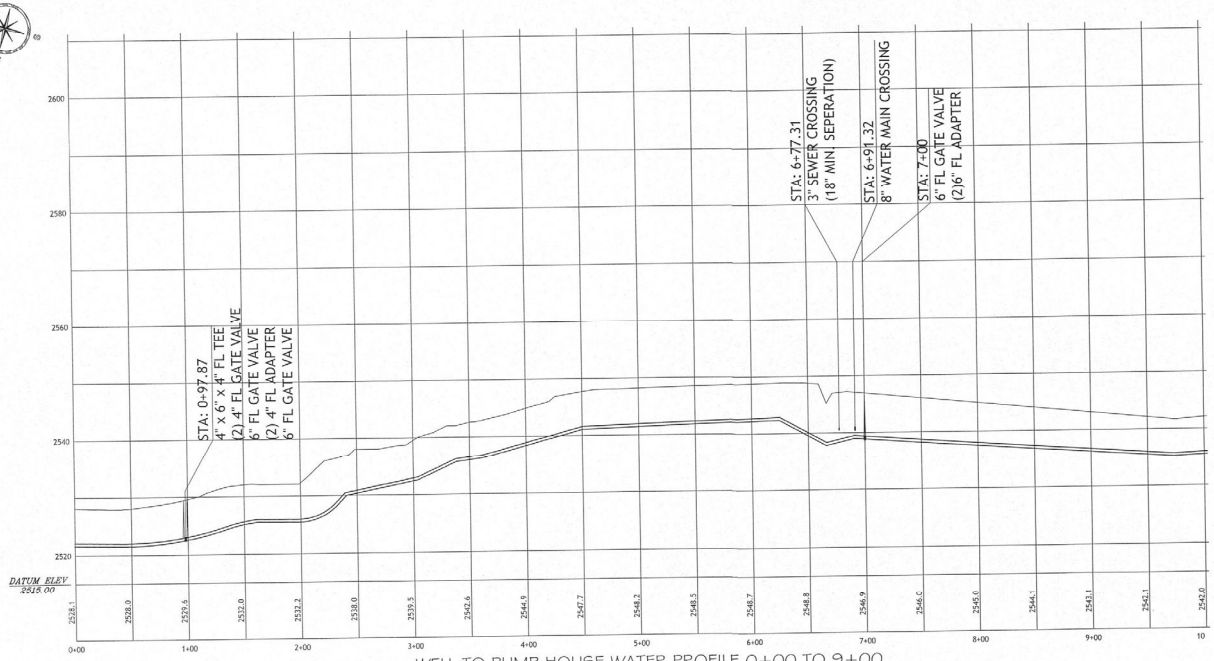

WELL TO PUMP HOUSE WATER 0+00 TO 9+00

SCALE 1" = 50'




BIG CANYON DRIVE WATER PROFILE 22+00 TO 25+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'




WELL TO PUMP HOUSE WATER PROFILE 0+00 TO 9+00

HORIZONTAL SCALE 1" = 50'
VERTICAL SCALE 1" = 10'

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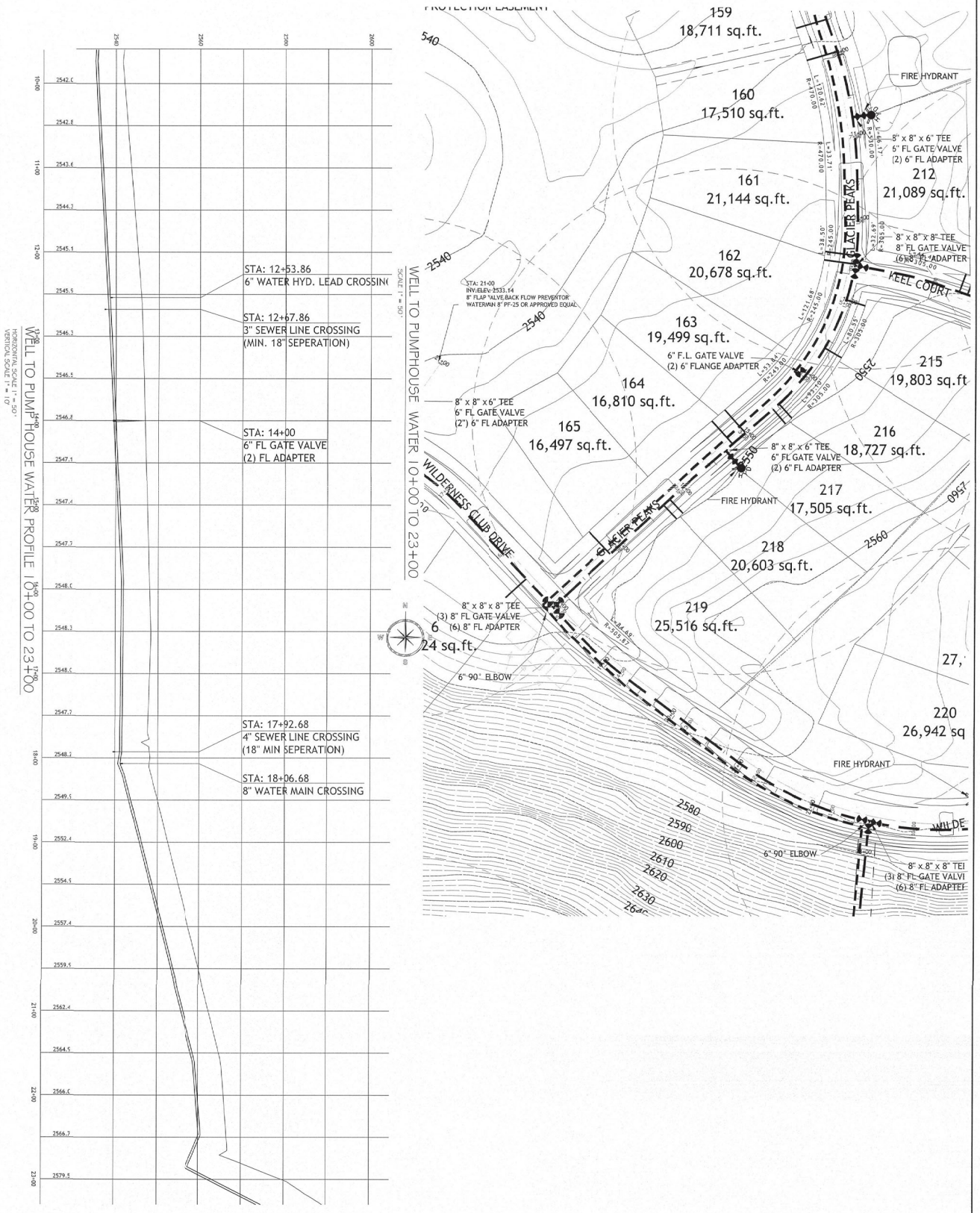
BIG CANYON DR.
22+00 - 25+00,
WELL TO PUMP HOUSE
0+00 - 9+00 WATER
PLAN & PROFILE

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 8-12-2007

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RECORD DRAWINGS - APRIL 2010




RECORD DRAWINGS - APRIL 2016

# THE WILDERNESS CLUB

FOR

## WILDERNESS DEVELOPMENT L.L.C.

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WELL TO PUMP HOUSE WATER 10+00 - 23+00 PLAN & PROFILE

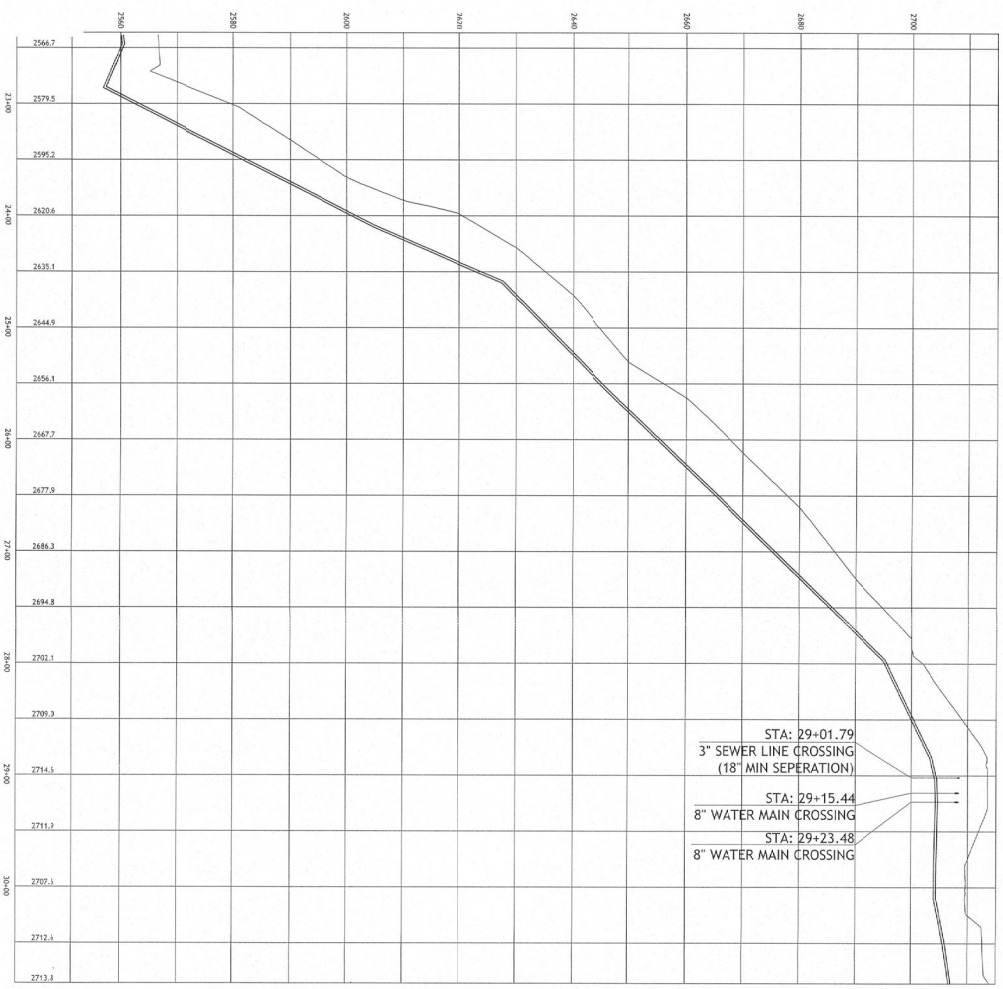
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DATE: 3-12-2007

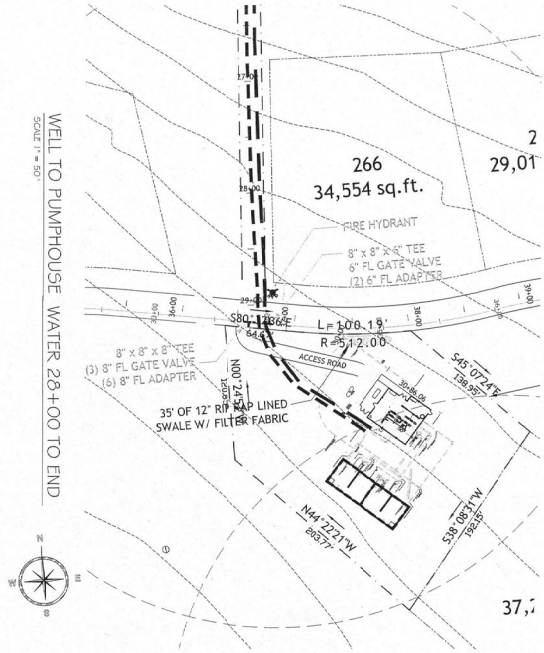
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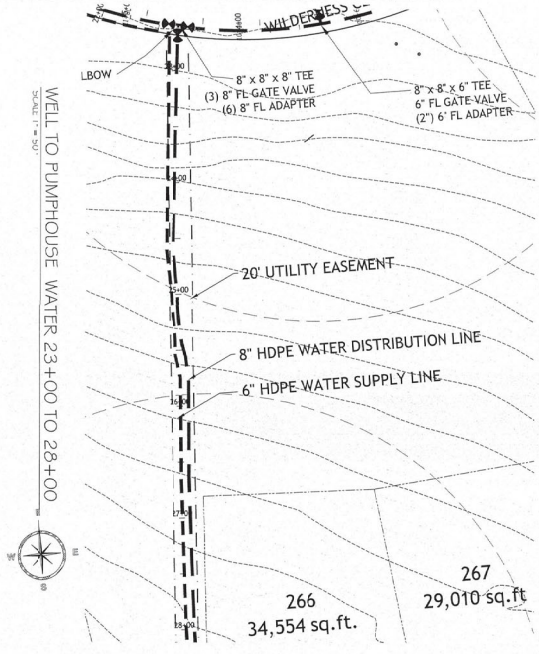
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RECORD DRAWINGS - APRIL 2010

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WELL TO PUMP HOUSE WATER 23+00 - END PLAN & PROFILE

APP. NUMBER: 070190
DRAWN BY: AIM
DATE: 3-12-2007

# THE WILDERNESS CLUB

FOR

## WILDERNESS DEVELOPMENT L.L.C.

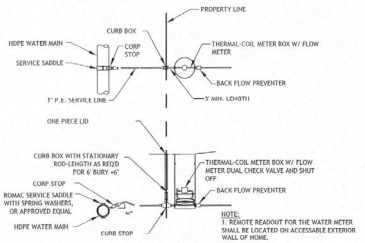
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APEC Engineering

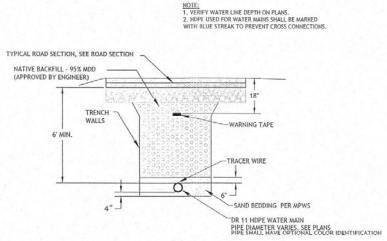
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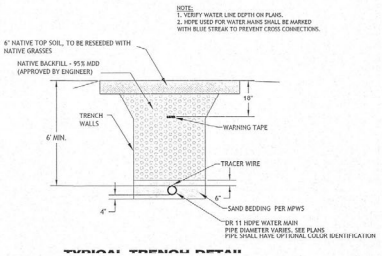
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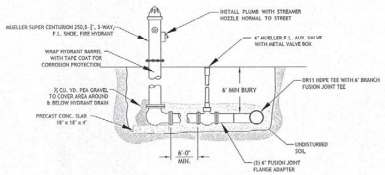

1 C-334 NTS **TYPICAL WATER SERVICE DETAIL**



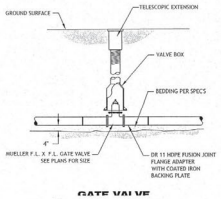

2 C-334 NTS **TYPICAL WATER LINE TRENCH DETAIL_1**



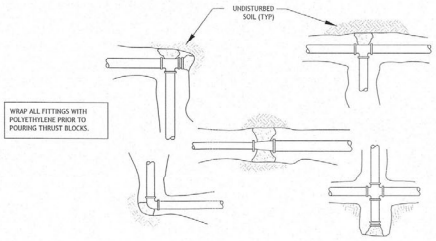

3 C-334 NTS **TYPICAL WATER LINE TRENCH DETAIL_2**




4 C-334 NTS **TYPICAL FIRE HYDRANT DETAIL**




5 C-334 NTS **TYPICAL GATE VALVE DETAIL**



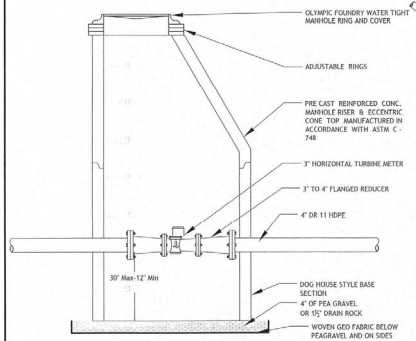

NOTE:
1. THE SHOWN THRUST BLOCKS MUST BE BUILT EXACTLY TO THE DIMENSION SHOWN BELOW NO OVERSIZE THRUST BLOCKS WILL BE ACCEPTED.
2. THRUST BLOCKS SHALL BE REQUIRED AT ANGLED FITTINGS AND VALVES OTHER THAN FLANGED FITTINGS OR FUSION JOINT FITTINGS.

CONCRETE THRUST BLOCK BEARING AREA REQUIRED

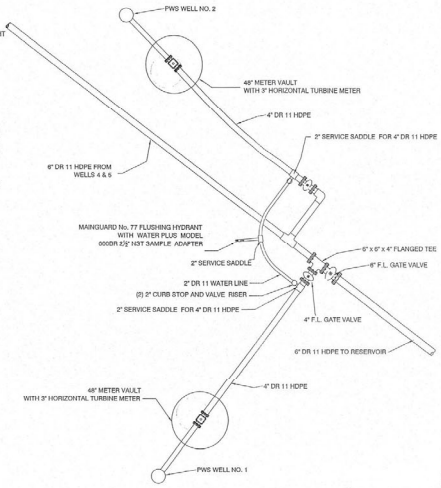
| PIPE SIZE (inches) | 90 DEG (S) (SQ. FT) | 45 DEG (S) (SQ. FT) | 22.5 DEG (S) (SQ. FT) | 11.25 DEG (S) (SQ. FT) |
|---|---|---|---|---|
| 4 | 1.5 | 0.7 | 0.3 | 0.2 |
| 6 | 3.3 | 1.5 | 0.7 | 0.3 |
| 8 | 6.0 | 2.6 | 1.2 | 0.6 |
| 10 | 10.9 | 4.6 | 2.1 | 1.0 |

* NOTE : FOR PIPELINE PRESS BELOW 150 P.S.I.

6 C-336 NTS **TYPICAL THRUST BLOCK DETAIL & SCHEDULE**

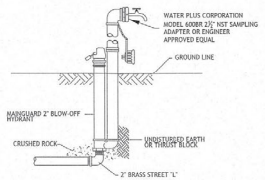



7 C-334 NTS **3" METER VAULT DETAIL**



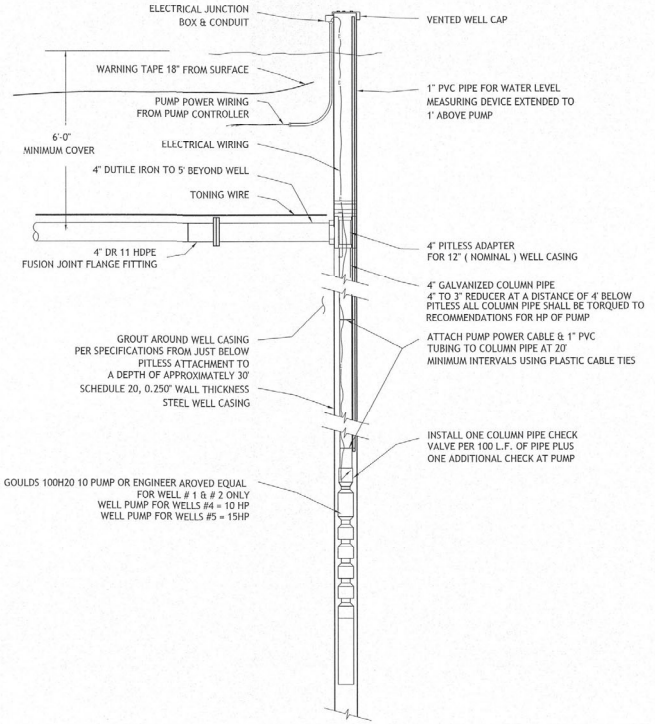

8 C-334 NTS **TYPICAL WELL MANIFOLD DETAIL**

**MAINGUARD NO. 77 BLOW-OFF HYDRANT**




Post Hydrants shall be non-freezing, self draining type with a 6' bury. These hydrants will be furnished with a 2" FIP inlet, a non turning operating rod, and shall open to the left. All of the working parts shall be of bronze-to-bronze design, and be servicable from above grade with no digging. The outlet shall also be bronze and be 2-1/2" NST. Hydrants shall be lockable to prevent unauthorized use as manufactured by Ropferle Foundry Co., St. Louis, MO, or approved equal.

9 C-334 NTS **TYPICAL FLUSHING HYDRANT**




10 C-334 NTS **WELL DETAIL**

REVISIONS:
1 AJM 1.15.2007
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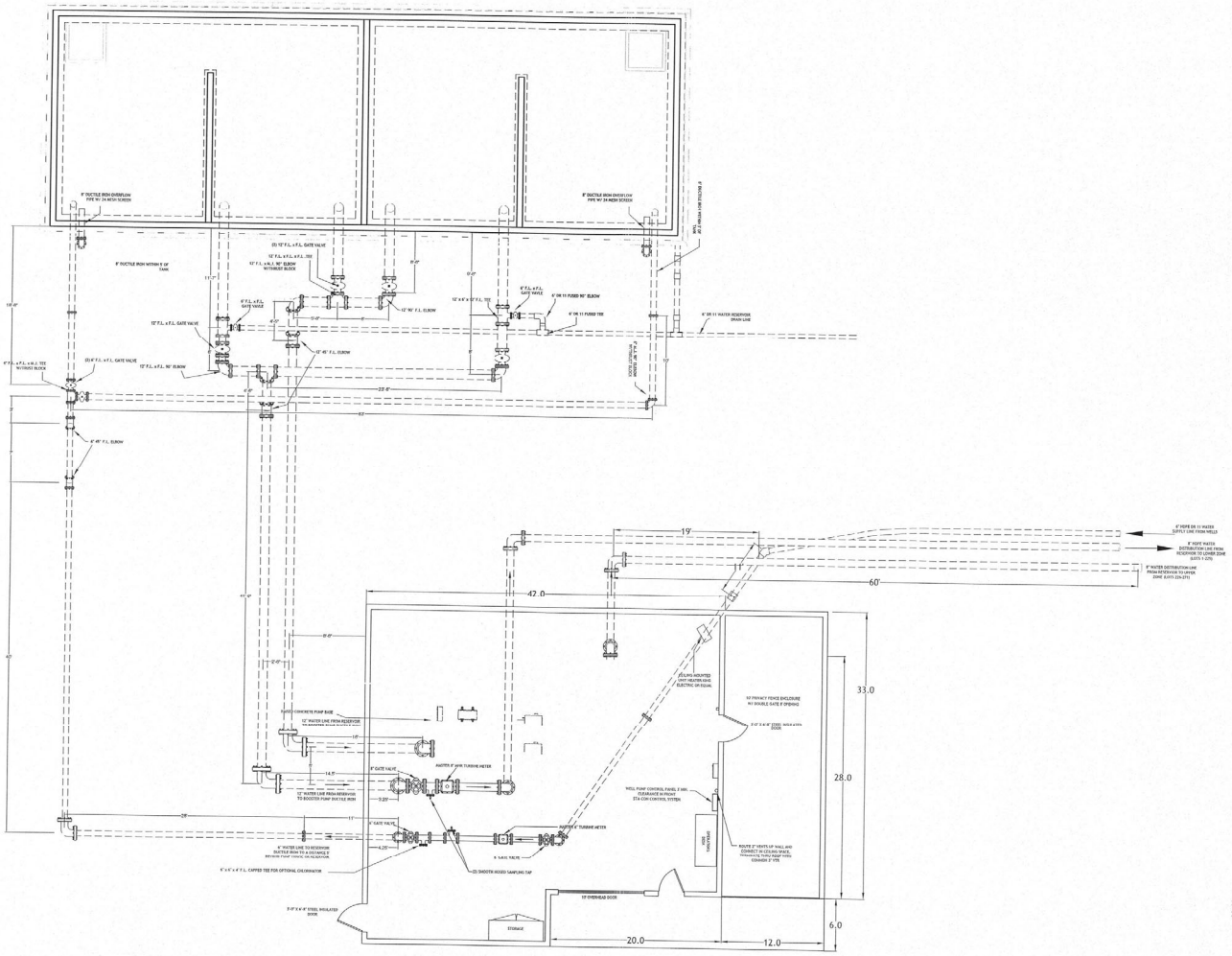
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WATER DETAILS A

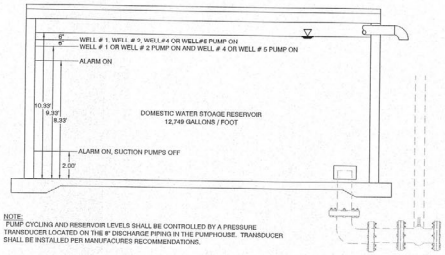
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DRAWN BY: AJM
DATE: 3-12-2007

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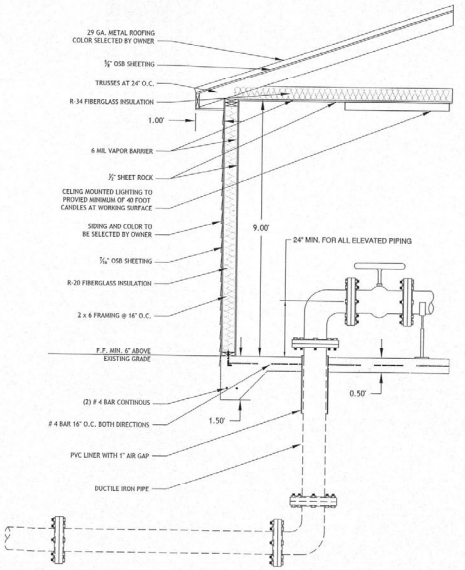



1 C-335 PUMP HOUSE PLAN DETAIL
NTS




NOTE:
PUMP CYCLING AND RESERVOIR LEVELS SHALL BE CONTROLLED BY A PRESSURE TRANSDUCER LOCATED ON THE 8" DISCHARGE PIPING IN THE PUMPHOUSE. TRANSDUCER SHALL BE INSTALLED PER MANUFACURES RECOMMENDATIONS.

3 C-335 RESERVOIR SECTION DETAIL
NTS




2 C-335 PUMP HOUSE WALL SECTION DETAIL
NTS

NOTE
1. ALL STRUCTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS OF THE PUMP HOUSE SHALL BE THE RESPONSIBILITY OF OTHERS UNLESS OTHERWISE NOTED HEREON.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATED ALL DOMESTIC WATER PIPING TO THE FIRST ELBOW ABOVE THE FINISH FLOOR ELEVATION OF THE PUMP HOUSE. THE CONTRACTOR SHALL RESPONSIBLE FOR PLACEING APPROPRIATE LINER PIPE ON ALL FLOOR EXTRUSIONS. THE CONTRACTOR SHALL PLACE A FLANGED CAP ON ALL WATER PIPE THAT IS TO BE TERMINATED IN THE PUMP HOUSE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE TO FURNISH AND INSTALL COMPLETE WELL CONROLLER AFTER PUMP HOUSE IS CONSTRUCTED BY OTHERS.
4. ALL DOMESTIC WATER PIPING SHALL BE INSTALLED DURING PHASE 1 THAT CONNECTS PUMP HOUSE TO WATER STORAGE RESERVOIR. 8 INCH WATER LINE FROM PRESSURE BOOSTING PORTION OF WATER SYSTEM SHALL BE INSTALLED TO EXTENT OF SITE GRADING FOR PUMP HOUSE AND WATER RESERVIOR, LINE SHALL BE CAPPED WITH A FLANGED CAP AND DURABLY MARKED WITH A STEEL POST.

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SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

PUMP HOUSE DETAILS

JOB NUMBER: 121305
DRAWN BY: AIM
DATE: 3-12-2007

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## WATER RESERVOIR GENERAL NOTES:

### SHOP DRAWINGS & SUBMITTALS

1. SUBMIT SHOP DRAWINGS OF STRUCTURAL ITEMS WHERE REQUIRED FOR REVIEW PRIOR TO FABRICATION OR SHIPMENT TO SITE AS APPLICABLE.
   a. REINFORCING
   b. CONCRETE MIX DESIGN
   c. PRECAST CONCRETE ELEMENTS

### SOIL AND FOUNDATIONS

REFER TO DIVISION 2 SPECIFICATION SECTION - EARTHWORK - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. FOOTING BEARING PRESSURES ARE LIMITED TO 1500 PSF ASSUMED CAPACITY. CONTRACTOR AND OWNER TO VERIFY PRIOR TO CONSTRUCTION.
2. FOOTINGS AT EXTERIOR OR IN UNHEATED AREAS SHALL BEAR A MINIMUM OF 3'-0" BELOW FINISH GRADE.
3. FOOTINGS SHALL BEAR ON COMPACTED STRUCTURAL FILL PER DETAILS ON SHEET C 236. THERE SHALL BE A MINIMUM 95% COMPACTION (ASTM) D1557 MODIFIED PROCTOR DENSITY OF ALL BACKFILL SOIL UNDER SLABS, FOOTINGS AND AROUND FOUNDATION WALLS.
4. CONTRACTOR SHALL PROVIDE TEMPORARY BRACING TO PREVENT MOVEMENT OF WALLS IF BACKFILL IS PLACED BEFORE THE FLOOR SYSTEM OR SLAB IS IN PLACE.

### REINFORCING STEEL

REFER TO DIVISION 3 SPECIFICATION SECTION -CONCRETE REINFORCING - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. DEFORMED BAR: ASTM A615, GRADE 60 #4 & LARGER
   GRADE 40 # 3 & SMALLER
2. DETAIL, FABRICATE, LABEL, SUPPORT AND PLACE ALL REINFORCEMENT IN ACCORDANCE WITH ACI 315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES", AND ACI 318, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE", LATEST EDITIONS. BARS SHALL BE SECURELY TIED IN PLACE AND PROVIDED WITH CONCRETE COVER AS SHOWN ON THE DRAWINGS,
   PER ACI 318 OR AS FOLLOWS: FOOTINGS, 3" FROM THE SOIL; FORMED CONCRETE AGAINST SOIL, 2";
   COLUMNS AND BEAMS, 1.5"; INTERIOR FACE OF WALLS, ¾";
   EXTERIOR FACE OF WALLS, 1.5".
3. SUBMIT SHOP DRAWINGS INDICATING BAR SIZE, SPACING, LAYOUT AND DETAILS, INCLUDING ELEVATIONS OF ALL CONCRETE WALLS FOR REVIEW PRIOR TO FABRICATION.
4. PLACE ALL SLAB-ON-GRADE BETWEEN CONSTRUCTION JOINTS ALLOWING A MINIMUM OF 24 HOURS BETWEEN ADJACENT POURS.

### CAST-IN-PLACE CONCRETE

REFER TO DIVISION 3 SPECIFICATION SECTION - CONCRETE - FOR REQUIREMENTS IN ADDITION TO THOSE LISTED.

1. PROVIDE MIX DESGIN AS FOLLOWS:

   PORTLAND CEMENT ASTM C150 TYPE I/II
   WATER CEMENT RATIO = .45 MAXIMUM (INCLUDES FLY ASH)
   28 DAY f'c = 4000 PSI, SLUMP = 4"
   ENTRAINED AIR 5%-7%
   3/4" MAX. NORMAL WEIGHT AGGREGATE

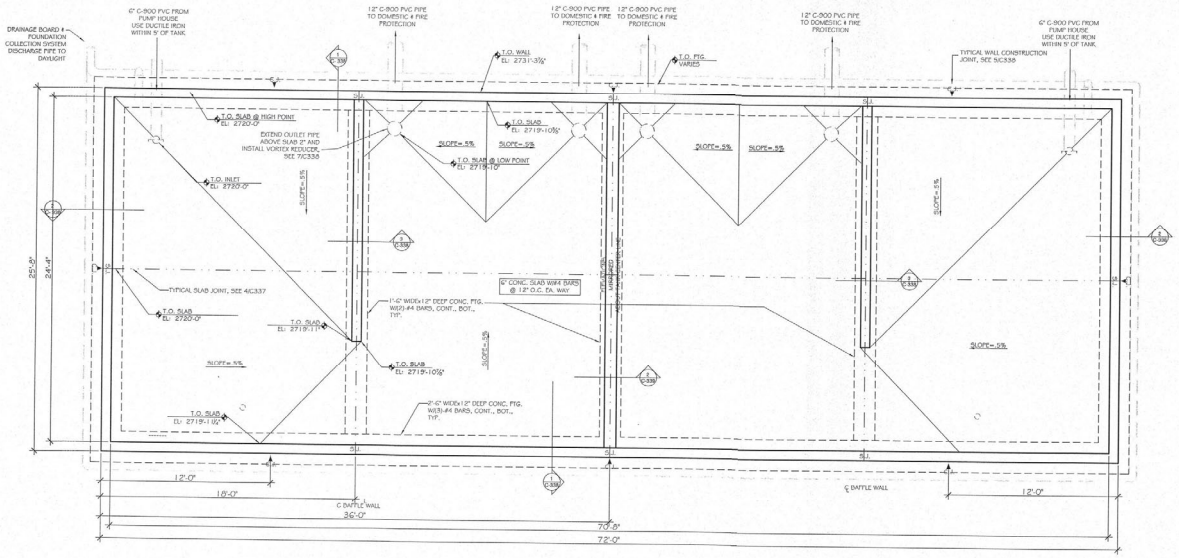
2. CURING COMPOUND: ASTM C309, TYPE 2, CLASS B
3. PROVIDE AIR-ENTRAINMENT IN ALL CONCRETE AS SET FORTH IN THE SPECIFICATIONS.
4. UNAUTHORIZED ADDITIONS TO THE MIX SHALL NOT BE MADE AT THE JOB SITE
5. DO NOT USE CALCIUM CHLORIDE IN ANY CONCRETE.
6. CONCRETE SHALL BE PLACED AND CURED IN ACCORDANCE WITH IBC AND ACI STANDARDS.
7. SUBMIT ENGINEERED CONCRETE MIX DESIGNS, INCLUDING REQUIRED BACKUP DATA, FOR EACH TYPE OF CONCRETE PROPOSED FOR USE TO THE STRUCTURAL ENGINEER FOR REVIEW BEFORE COMMENCING WITH CONCRETE WORK.

### PRE-CAST/PRE-STRESS CONCRETE

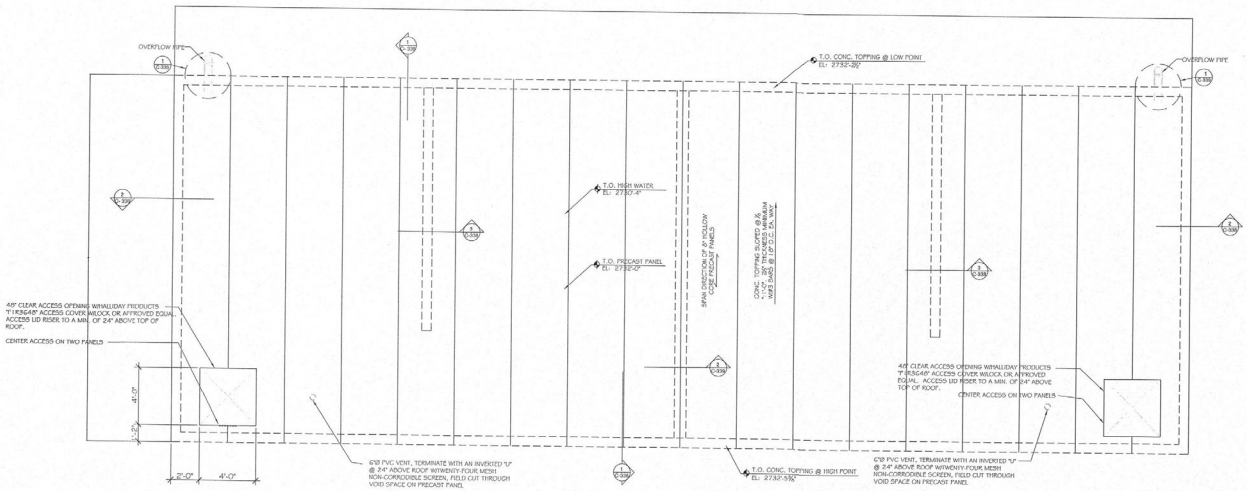
1. 12- INCH HOLLOWCORE (H.C.) COMPOSITE FLOOR SYSTEM MANUFACTURED BY "CENTRAL PRE-MIX PRE-STRESS COMPANY," SPOKANE, WASHINGTON.

| | |
|---|---|
| PANEL WIDTH: | 4'-0" NOMINAL |
| SECTION PROPERTIES: | Ag =363 SQ. IN.; I = 8390 IN4; Yb = 7.5 IN; WEIGHT = 114 PSF (WITH TOPPING) |
| CONCRETE STRENGTH: | H.C. f'c = 6000 PSI (@28 DAYS); TOPPING f'c = 4000 PSI (@28 DAYS) |
| RESTRESS STANDS: | TYPE AND PATTERN PER CENTRAL PRE-MIX |

2. INSTILLATION GUIDE PROVIDED BY "CENTAL PRE-MIX"
3. PENETRATION REQUIREMENTS, HANGERS AND SUSPENDING GUIDLINES PER "CENTRAL PRE-MIX"
4. PROVIDE SHOP DRAWINGS & SUBMITTALS INCLUDING H.C. LAYOUT, DETAIL AND DESIGN CALCULATIONS TO ENGINEER FOR REVIEW PRIOR TO FABRICATION.




RESERVOIR FOUNDATION PLAN
1/4"=1'-0"




RESERVOIR LID PLAN
1/4"=1'-0"

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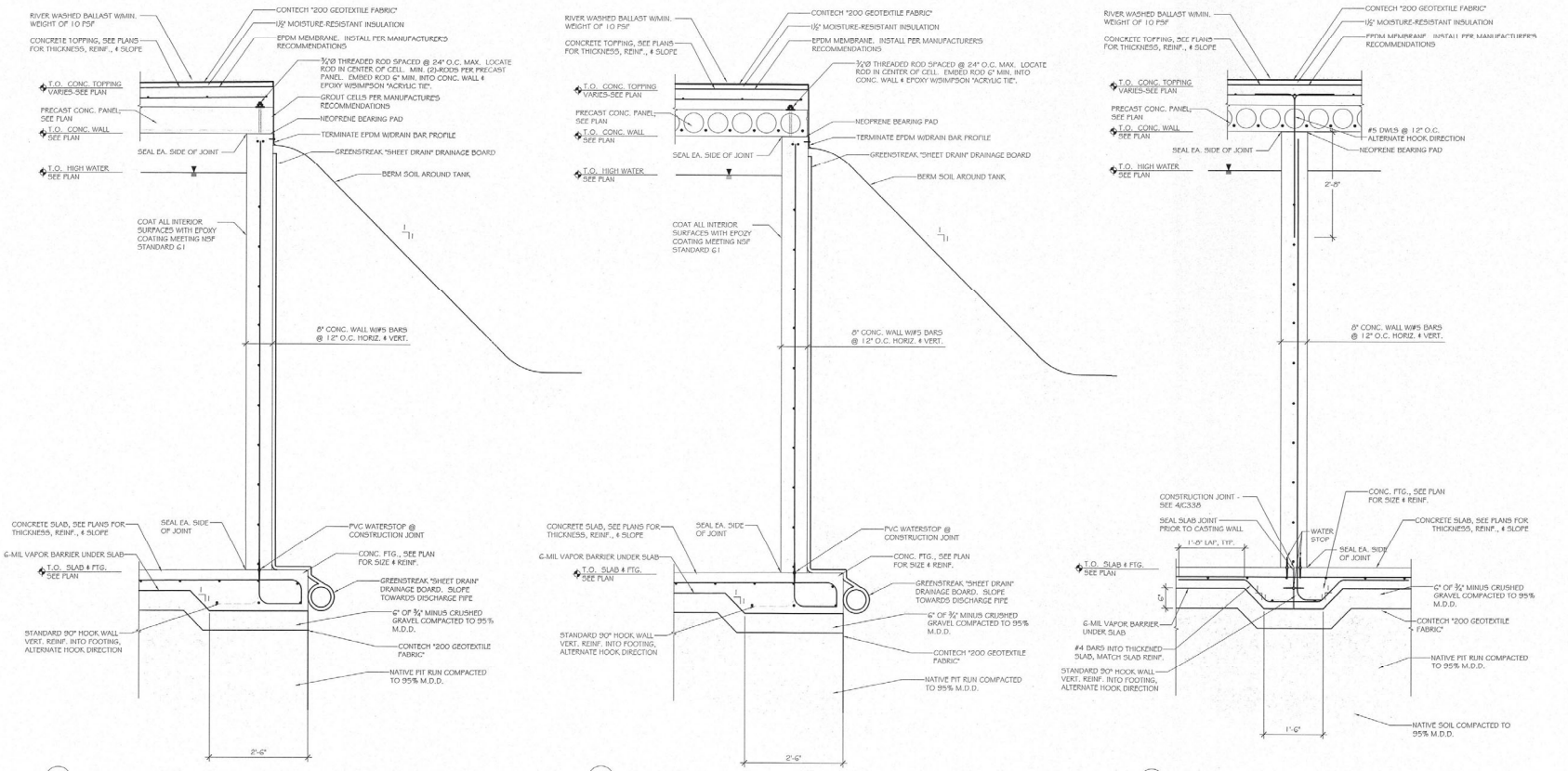

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WATER STORAGE RESERVOIR PLAN

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 3-12-2007

C
337

RECORD DRAWINGS - APRIL 2010




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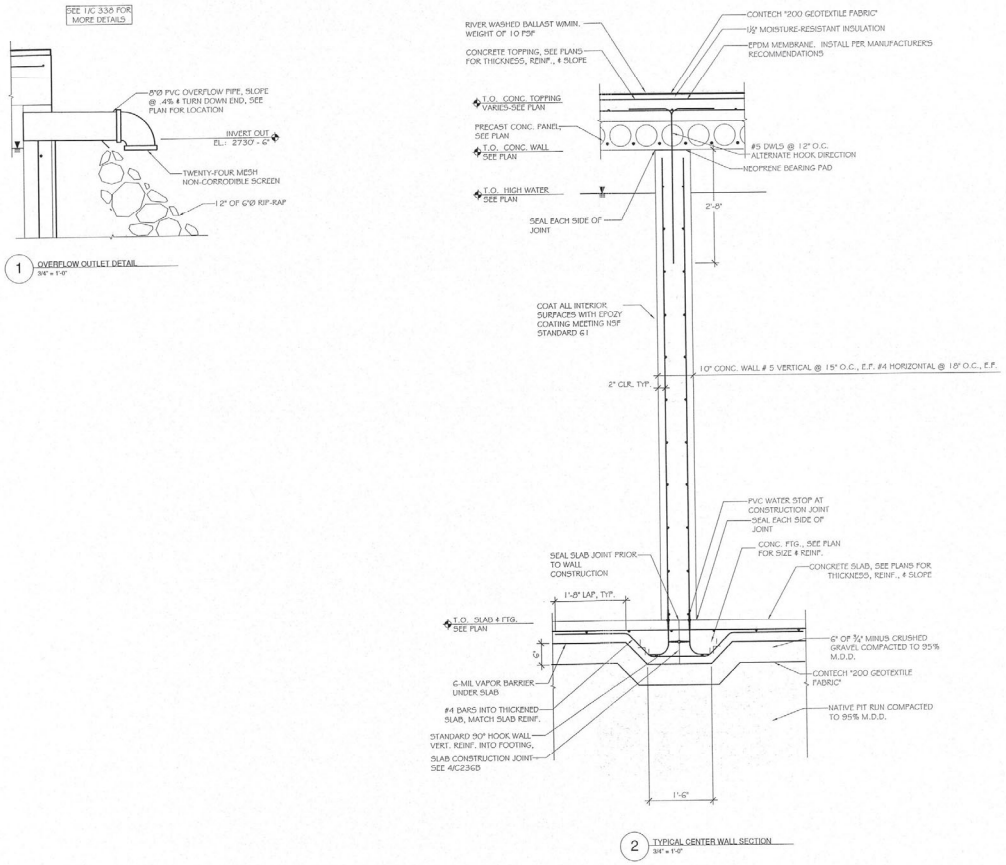
WATER RESERVOIR DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AIM
DATE: 9-12-2007

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338

RECORD DRAWINGS - APRIL 2010




REVISIONS:

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SEC. 28, 29, 32, & 33, T37N, R27W, LINCOLN COUNTY, STATE OF MONTANA

WATER RESERVOIR DETAILS

JOB NUMBER: 1213.05
DRAWN BY: AJM
DATE: 3-12-2007

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339

# APPENDIX B

# SOIL REPORT AND TEST PITS

**Site Evaluation Form**

| | |
|---|---|
| Project: | Wilderness Club |
| Client | Escalante Wilderness Preserve |
| Site Evaluator: | Zach Maassen, PE |
| County: | Lincoln |

Test Pit: **11A**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-73" | 73" | Fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 73-96" | 23" | Course Sand | 90% | Granular | none | >1" | gravels are very fine/crushed |

**11A Reserve**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-48" | 48" | Fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 48-94" | 36" | Silt Loam | none | Granular | some | >1" | No limiting layers. Profile was consistent the entire depth |
| 94-96" | 2" | darker topsoil / grey clay | none | Granular | some | >1" | potentially limiting with grey clay |



**Site Evaluation Form**

Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 11B**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-94" | 94" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 94-96" | 2" | Course Sand | 90% | Granular | none | >1" | gravels are very fine/crushed |



**Site Evaluation Form**

| | |
|---|---|
| Project: | Wilderness Club |
| Client | |
| Site Evaluator: | Zach Maassen, PE |
| County: | Lincoln |

**Test Pit:** **11C**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-96" | 96" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |



**Site Evaluation Form**

Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 11D**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-60 | 60" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 60-96" | 36" | Course Sand | 95% | Granular | none | >1" | Gravels are crushed, some cobbles and larger diameter rocks |



**Site Evaluation Form**

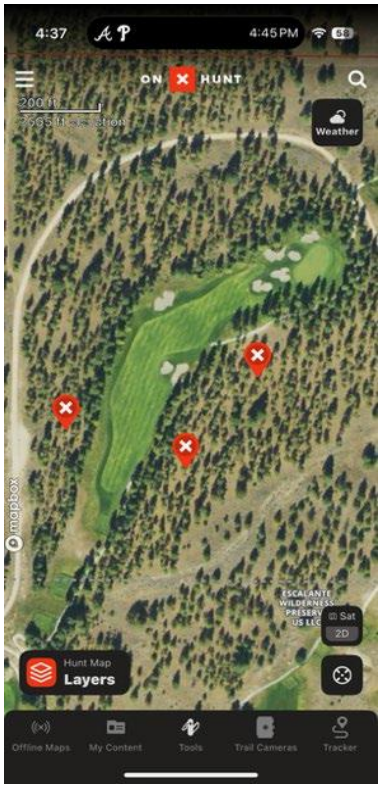
| | |
|---|---|
| Project: | Wilderness Club |
| Client | |
| Site Evaluator: | Zach Maassen, PE |
| County: | Lincoln |

**Test Pit:** **11E**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-96" | 96" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |

**11 RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-21" | 21" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 21-96" | 75" | Course Sand | 90% | Granular | none | >1" | gravels are very fine/crushed; some larger rocks present |



**Site Evaluation Form**

Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 12A**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-96" | 96" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |

**12A RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-44 | 44 | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 44-96 | 52" | Course Sand | 90% | Granular | none | >1" | gravels are very fine/crushed; some larger rocks present |



**Site Evaluation Form**

Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 12B**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-96" | 96" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |

**12A RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-55 | 55" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 55-96 | 41" | Course Sand | 90% | Granular | none | >1" | gravels are very fine/crushed; some larger rocks present |



**Site Evaluation Form**

Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 13**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-96 | 96" | fine sandy loam | none | NA | some | NA | |

**RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-72" | 72" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 72-96" | 14" | course sand | 95% | Granular | none | >1" | Potentially limiting, gravels are fine though |

**BACKUP towards 7 tee box**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-90" | 90" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 90-96" | 6" | course sand | 95% | Granular | none | >1" | Potentially limiting, gravels are fine though |



**Site Evaluation Form**

Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 14A (NEW)**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-48" | 48" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 48-96" | 48" | course sand | 95% | Granular | none | >1" | Potentially limiting, gravels are fine though |

*Moved location further to the south due to water lines present in area

**RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-96" | 96" | fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |



**Site Evaluation Form**

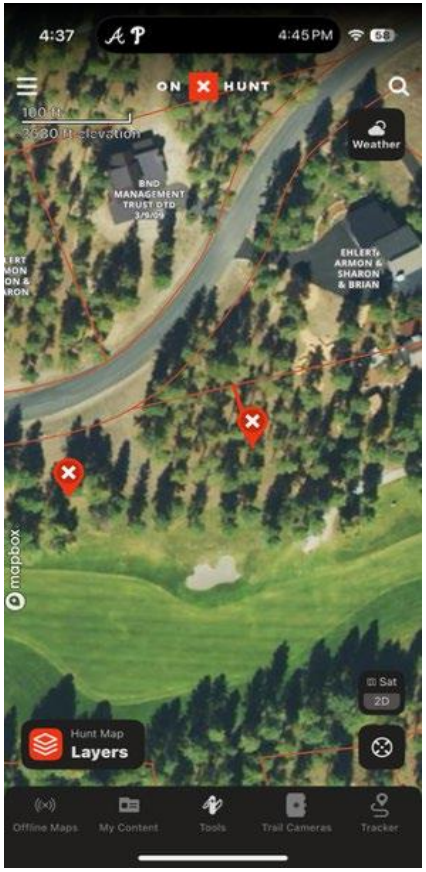
| | |
|---|---|
| Project: | Wilderness Club |
| Client | |
| Site Evaluator: | Zach Maassen, PE |
| County: | Lincoln |

**Test Pit:** **14B**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-96" | 96" | fine sandy loam | none | NA | none | NA | |

**RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-96" | 96" | fine sandy loam | none | NA | none | NA | Brian (Owner) wants relocated due to property expansion |



**Site Evaluation Form**

| | |
|---|---|
| Project: | Wilderness Club |
| Client | |
| Site Evaluator: | Zach Maassen, PE |
| County: | Lincoln |

**Test Pit:** **14C**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-2" | 2" | topsoil | 5-10% | NA | none | NA | Tree roots/various grasses and organic material |
| 2-84" | 82" | Fine sandy loam | none | Granular | none | >1" | No limiting layers. Profile was consistent the entire depth |
| 84"-96" | 12" | course sand | 95% | Granular | none | >1" | Potentially limiting, gravels are fine though |



**Site Evaluation Form**

| | |
|---|---|
| Project: | Wilderness Club |
| Client | |
| Site Evaluator: | Zach Maassen, PE |
| County: | Lincoln |

**Test Pit:** **14D**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-8" | 8" | light brown/sandy loam/topsoil | 5% | NA | Dry | NA | Tree roots/various grasses and organic material |
| 8-77" | 69" | fine sandy loam | 0% | Granular | Dry | >1" | No limiting layers. Profile was consistent the entire depth |
| 77" - 96" | 19" | course sand | 95% | Granular | Dry | >1" | Potentially limiting, gravels are fine though |



**Site Evaluation Form**

Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 14E**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0"-6" | 6 | topsoil | none | Granular | none | >1" | roots/vegetation |
| 6"-51" | 45" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |

**14E RESERVE**

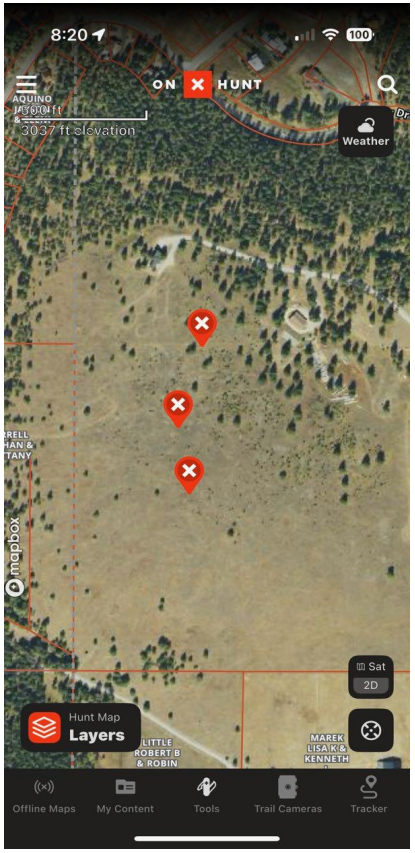
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-8 | 8 | topsoil | none | Granular | none | >1" | roots/vegetation |
| 8"-56" | 48" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |

**ENTRANCE RESERVE RELOCATE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-18" | 18" | topsoil | none | Granular | none | >1" | roots/vegetation |
| 18"-48" | 30" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |

**ENTRANCE RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-72" | 72" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |




*Samples taken down as far as excavator could dig without having to come back out with larger machine. Due to sand mounds being 48" tall, excavating down 48" minimum should be adequate for the first series of test pits

**Site Evaluation Form**

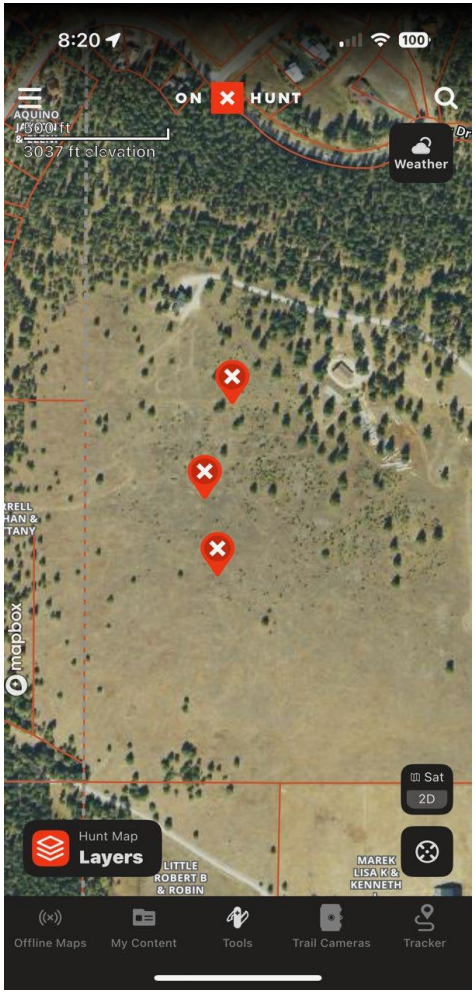
| | |
|---|---|
| Project: | Wilderness Club |
| Client | |
| Site Evaluator: | Zach Maassen, PE |
| County: | Lincoln |

**Test Pit:** **15A**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0"-6" | 6 | topsoil | none | Granular | none | >1" | roots/vegetation |
| 6"-54" | 48" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |

**15A RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-53" | 53" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |




*Samples taken down as far as excavator could dig without having to come back out with larger machine. Due to sand mounds being 48" tall, excavating down 48" minimum should be adequate for the first series of test pits

**Site Evaluation Form**

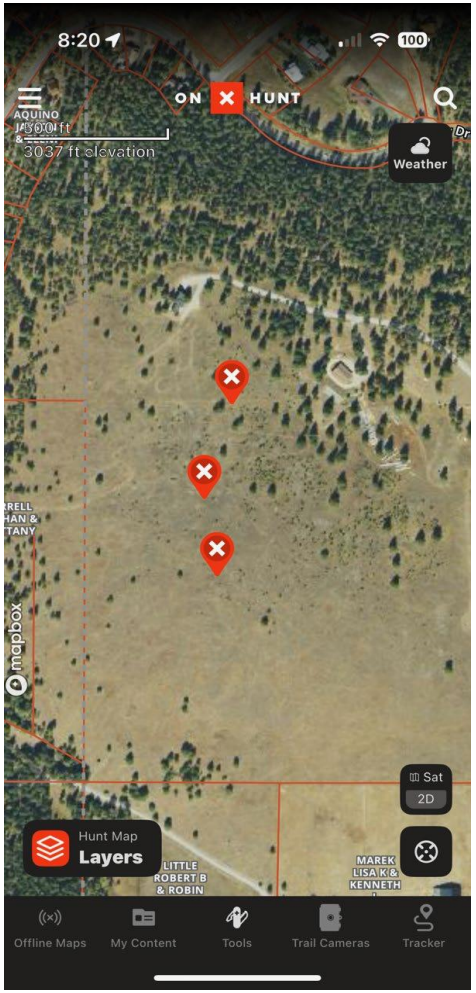
Project: Wilderness Club
Client
Site Evaluator: Zach Maassen, PE
County: Lincoln

**Test Pit: 15B**

| Depth (in) | Thickness (in) | Soil Type/Texture | Stoniness | Structure | Moisture | Length of Ribbon | Other Comments |
|---|---|---|---|---|---|---|---|
| 0-5" | 5" | topsoil | none | Granular | none | >1" | roots/vegetation |
| 5-64" | 59" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |

**15B RESERVE**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0-57" | 57" | sandy loam with cobbles | 50% | Granular | none | >1" | various size cobbles |




*Samples taken down as far as excavator could dig without having to come back out with larger machine. Due to sand mounds being 48" tall, excavating down 48" minimum should be adequate for the first series of test pits

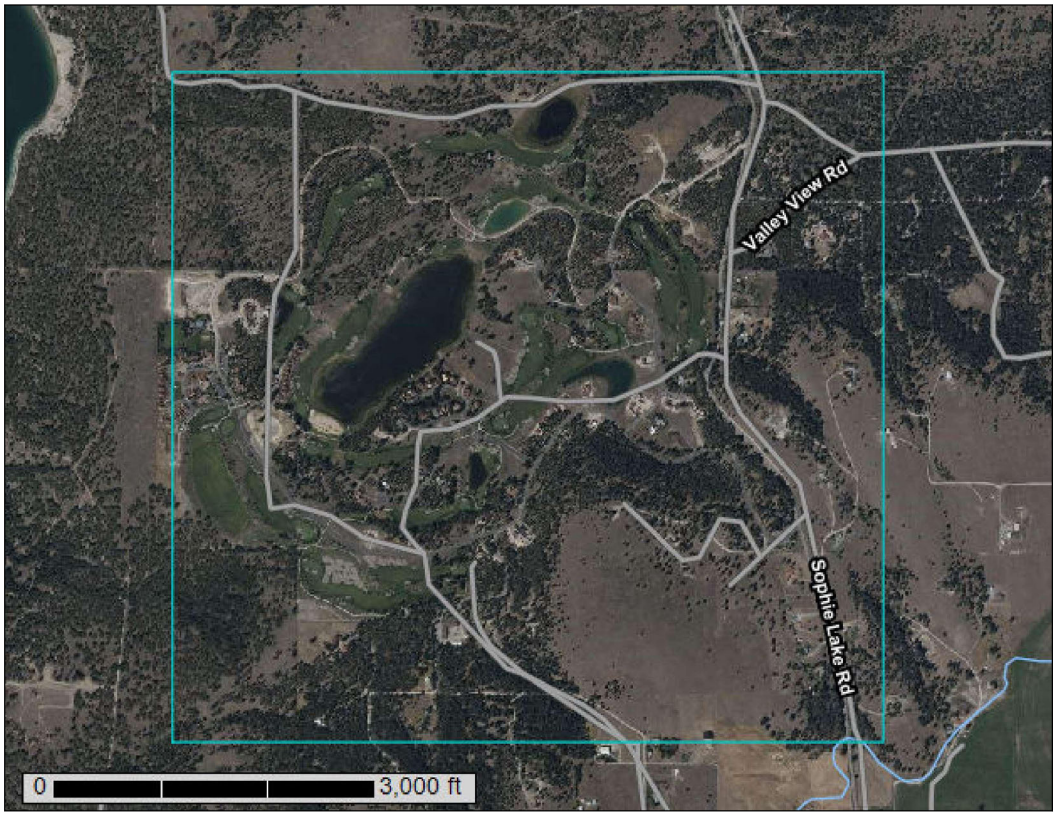
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

# Custom Soil Resource Report for Kootenai National Forest Area, Montana-Idaho




May 8, 2025

# Preface

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

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

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

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

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

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

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# How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

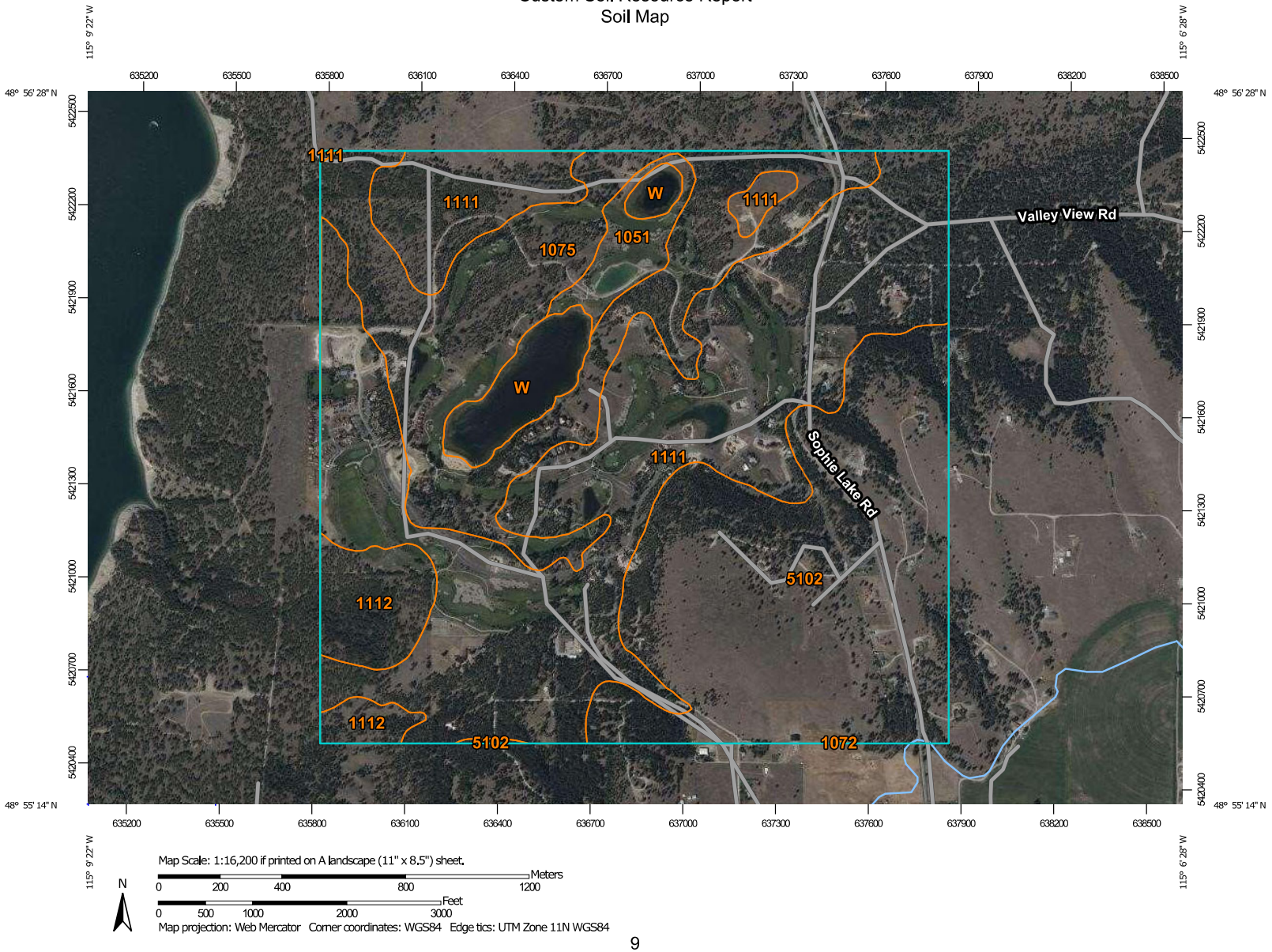
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

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

# Custom Soil Resource Report
## Soil Map



## 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.

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: Kootenai National Forest Area, Montana-Idaho
Survey Area Data: Version 24, Sep 16, 2024

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

Date(s) aerial images were photographed: Jul 14, 2023—Aug 13, 2023

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 |
|---|---|---|---|
| 1051 | Bohnly-Seelovers-Newbar family complex, 0 to 15 percent slopes | 21.1 | 2.2% |
| 1072 | McCollum-Buist family, stony-Downey, bouldery complex, 0 to 10 percent slopes | 0.1 | 0.0% |
| 1075 | Tetrault-Canusa-Jocko complex, 1 to 20 percent slopes | 196.1 | 20.3% |
| 1111 | Canusa-Felt family complex, 0 to 15 percent slopes | 404.6 | 42.0% |
| 1112 | Canusa sandy loam, 1 to 20 percent slopes | 42.0 | 4.4% |
| 5102 | Niarada-Niarada, greater slopes-Roosville complex, 2 to 30 percent slopes | 266.5 | 27.6% |
| W | Water | 33.5 | 3.5% |
| **Totals for Area of Interest** | | **963.9** | **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.

# Kootenai National Forest Area, Montana-Idaho

## 1051—Bohnly-Seelovers-Newbar family complex, 0 to 15 percent slopes

### Map Unit Setting

*National map unit symbol:* 2v5vq
*Elevation:* 2,710 to 3,890 feet
*Mean annual precipitation:* 15 to 25 inches
*Mean annual air temperature:* 39 to 44 degrees F
*Frost-free period:* 64 to 102 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Bohnly and similar soils:* 30 percent
*Seelovers and similar soils:* 25 percent
*Newbar and similar soils:* 20 percent
*Minor components:* 25 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Bohnly

#### Setting

*Landform:* Valley flats
*Down-slope shape:* Linear
*Across-slope shape:* Concave
*Parent material:* Alluvium

#### Typical profile

*Ap - 0 to 10 inches:* silt loam
*Bw - 10 to 18 inches:* silt loam
*Cg1 - 18 to 46 inches:* silt loam
*Cg2 - 46 to 60 inches:* fine sandy loam

#### Properties and qualities

*Slope:* 0 to 4 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* About 12 to 24 inches
*Frequency of flooding:* Rare
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 5 percent
*Available water supply, 0 to 60 inches:* High (about 10.0 inches)

#### Interpretive groups

*Land capability classification (irrigated):* 5w
*Land capability classification (nonirrigated):* 5w
*Hydrologic Soil Group:* B/D
*Ecological site:* R044AP806MT - Subirrigated Grassland Group
*Hydric soil rating:* Yes

### Description of Seelovers

#### Setting

*Landform:* Valley flats

*Down-slope shape:* Linear
*Across-slope shape:* Concave
*Parent material:* Alluvium

**Typical profile**

*A - 0 to 10 inches:* silt loam
*Bg - 10 to 27 inches:* silt loam
*Cg - 27 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 4 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* About 12 to 24 inches
*Frequency of flooding:* Rare
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 15 percent
*Available water supply, 0 to 60 inches:* High (about 11.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 5w
*Land capability classification (nonirrigated):* 5w
*Hydrologic Soil Group:* B/D
*Ecological site:* R044AP806MT - Subirrigated Grassland Group
*Hydric soil rating:* Yes

**Description of Newbar**

**Setting**

*Landform:* Flood plains
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Alluvium

**Typical profile**

*A - 0 to 7 inches:* very gravelly sandy loam
*C1 - 7 to 20 inches:* very gravelly loamy sand
*C2 - 20 to 37 inches:* extremely gravelly loamy sand
*C3 - 37 to 60 inches:* very gravelly loamy sand

**Properties and qualities**

*Slope:* 0 to 15 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Somewhat poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.13 to 7.09 in/hr)
*Depth to water table:* About 24 to 42 inches
*Frequency of flooding:* Occasional
*Frequency of ponding:* None
*Available water supply, 0 to 60 inches:* Very low (about 2.2 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 6w
*Land capability classification (nonirrigated):* 6w
*Hydrologic Soil Group:* B

*Ecological site:* R044AH134MT - Shallow to Gravel Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Minor Components**

**Heiseton**
*Percent of map unit:* 10 percent
*Landform:* Flood plains
*Down-slope shape:* Linear
*Across-slope shape:* Concave
*Ecological site:* R044AH036MT - Droughty Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Fortine**
*Percent of map unit:* 10 percent
*Landform:* Outwash terraces
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Ecological site:* R044AH032MT - Loamy Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Water**
*Percent of map unit:* 3 percent
*Hydric soil rating:* Unranked

**Barzee**
*Percent of map unit:* 2 percent
*Landform:* Valley flats
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Ecological site:* R044AH004MT - Montane Rich to Intermediate Basin Plate Type Fen Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* Yes

## 1072—McCollum-Buist family, stony-Downey, bouldery complex, 0 to 10 percent slopes

**Map Unit Setting**
*National map unit symbol:* 2v5vs
*Elevation:* 2,610 to 2,800 feet
*Mean annual precipitation:* 15 to 18 inches
*Mean annual air temperature:* 43 to 45 degrees F
*Frost-free period:* 105 to 117 days
*Farmland classification:* Prime farmland if irrigated

**Map Unit Composition**

*Mccollum and similar soils:* 50 percent
*Buist, stony, and similar soils:* 30 percent
*Downey, bouldery, and similar soils:* 20 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Mccollum**

**Setting**

*Landform:* Outwash plains
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Outwash

**Typical profile**

*A - 0 to 14 inches:* silt loam
*Bw - 14 to 54 inches:* fine sandy loam
*C - 54 to 60 inches:* very gravelly sand

**Properties and qualities**

*Slope:* 0 to 5 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 5 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Moderate (about 8.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 3e
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* B
*Ecological site:* R044AH032MT - Loamy Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Description of Buist, Stony**

**Setting**

*Landform:* Outwash plains
*Down-slope shape:* Convex
*Across-slope shape:* Linear
*Parent material:* Outwash and/or till

**Typical profile**

*A1 - 0 to 7 inches:* loam
*A2 - 7 to 13 inches:* gravelly loam
*Bw - 13 to 34 inches:* very cobbly loam
*Bk - 34 to 60 inches:* extremely cobbly loam

**Properties and qualities**

*Slope:* 1 to 10 percent
*Surface area covered with cobbles, stones or boulders:* 0.1 percent

*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 15 percent
*Available water supply, 0 to 60 inches:* Low (about 5.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 4e
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* B
*Ecological site:* R044AH036MT - Droughty Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Description of Downey, Bouldery**

**Setting**

*Landform:* Outwash plains
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Outwash and/or till

**Typical profile**

*A - 0 to 8 inches:* silt loam
*AB - 8 to 14 inches:* gravelly loam
*2Bk1 - 14 to 20 inches:* extremely gravelly loamy coarse sand
*2Bk2 - 20 to 60 inches:* extremely gravelly coarse sand

**Properties and qualities**

*Slope:* 0 to 5 percent
*Surface area covered with cobbles, stones or boulders:* 0.1 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Somewhat excessively drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 24 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Very low (about 3.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 6s
*Land capability classification (nonirrigated):* 6s
*Hydrologic Soil Group:* B
*Ecological site:* R044AH036MT - Droughty Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

## 1075—Tetrault-Canusa-Jocko complex, 1 to 20 percent slopes

### Map Unit Setting

*National map unit symbol:* 2v5vv
*Elevation:* 2,530 to 2,720 feet
*Mean annual precipitation:* 14 to 16 inches
*Mean annual air temperature:* 43 to 45 degrees F
*Frost-free period:* 108 to 115 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Tetrault and similar soils:* 50 percent
*Canusa and similar soils:* 30 percent
*Jocko and similar soils:* 20 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Tetrault

#### Setting

*Landform:* Outwash terraces
*Down-slope shape:* Convex
*Across-slope shape:* Linear
*Parent material:* Sandy and gravelly glaciofluvial deposits

#### Typical profile

*Oi - 0 to 1 inches:* slightly decomposed plant material
*A - 1 to 9 inches:* sandy loam
*2BCk - 9 to 25 inches:* very gravelly coarse sand
*2C - 25 to 60 inches:* coarse sand

#### Properties and qualities

*Slope:* 3 to 20 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Excessively drained
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.13 to 7.09 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 15 percent
*Available water supply, 0 to 60 inches:* Low (about 3.0 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 6e
*Hydrologic Soil Group:* A
*Ecological site:* F044AH001MT - Montane Warm Dry Coniferous Seeley, Swan, Flathead and Tobacco Valleys

*Other vegetative classification:* ponderosa pine/Idaho fescue-rough fescue phase (PK142)
*Hydric soil rating:* No

**Description of Canusa**

**Setting**
*Landform:* Dune fields
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex
*Parent material:* Eolian sands over sandy and gravelly glaciofluvial deposits

**Typical profile**
*Oi - 0 to 1 inches:* slightly decomposed plant material
*A - 1 to 4 inches:* sandy loam
*Bk1 - 4 to 16 inches:* sandy loam
*Bk2 - 16 to 38 inches:* sandy loam
*2BCk - 38 to 60 inches:* sand

**Properties and qualities**
*Slope:* 1 to 6 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.13 to 7.09 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 15 percent
*Available water supply, 0 to 60 inches:* Low (about 5.9 inches)

**Interpretive groups**
*Land capability classification (irrigated):* 4e
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* A
*Ecological site:* F044AH001MT - Montane Warm Dry Coniferous Seeley, Swan, Flathead and Tobacco Valleys
*Other vegetative classification:* ponderosa pine/Idaho fescue-rough fescue phase (PK142)
*Hydric soil rating:* No

**Description of Jocko**

**Setting**
*Landform:* Outwash terraces
*Down-slope shape:* Convex
*Across-slope shape:* Linear
*Parent material:* Outwash

**Typical profile**
*A - 0 to 5 inches:* very gravelly loam
*Bw - 5 to 13 inches:* very gravelly loam
*Bk1 - 13 to 20 inches:* extremely gravelly coarse sandy loam
*Bk2 - 20 to 60 inches:* extremely gravelly loamy coarse sand

**Properties and qualities**
*Slope:* 2 to 15 percent
*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Excessively drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 35 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Very low (about 2.6 inches)

**Interpretive groups**
*Land capability classification (irrigated):* 6e
*Land capability classification (nonirrigated):* 6e
*Hydrologic Soil Group:* B
*Ecological site:* R044AH038MT - Droughty Steep Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

## 1111—Canusa-Felt family complex, 0 to 15 percent slopes

**Map Unit Setting**
*National map unit symbol:* 2v5vy
*Elevation:* 2,510 to 2,660 feet
*Mean annual precipitation:* 14 to 16 inches
*Mean annual air temperature:* 43 to 45 degrees F
*Frost-free period:* 106 to 115 days
*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**
*Canusa and similar soils:* 75 percent
*Felt and similar soils:* 25 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Canusa**

**Setting**
*Landform:* Dune fields
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex
*Parent material:* Eolian sands

**Typical profile**
*Oi - 0 to 1 inches:* slightly decomposed plant material
*A - 1 to 4 inches:* sandy loam
*Bk1 - 4 to 16 inches:* sandy loam
*Bk2 - 16 to 38 inches:* sandy loam
*2BCk - 38 to 60 inches:* sand

**Properties and qualities**
*Slope:* 1 to 15 percent

*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.13 to 7.09 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 15 percent
*Available water supply, 0 to 60 inches:* Low (about 5.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 4e
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* A
*Ecological site:* F044AH001MT - Montane Warm Dry Coniferous Seeley, Swan, Flathead and Tobacco Valleys
*Other vegetative classification:* ponderosa pine/Idaho fescue-rough fescue phase (PK142)
*Hydric soil rating:* No

## Description of Felt

**Setting**

*Landform:* Outwash terraces
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Eolian deposits over outwash

**Typical profile**

*A - 0 to 7 inches:* silt loam
*Bk1 - 7 to 20 inches:* fine sandy loam
*2Bk2 - 20 to 34 inches:* sand
*2Bkq - 34 to 60 inches:* extremely gravelly coarse sand

**Properties and qualities**

*Slope:* 0 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Somewhat excessively drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 28 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Low (about 4.2 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 3e
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* B
*Ecological site:* F044AH003MT - Montane Moderately Warm Dry Coniferous Seeley, Swan, Flathead and Tobacco Valleys
*Other vegetative classification:* ponderosa pine/Idaho fescue-rough fescue phase (PK142)
*Hydric soil rating:* No

## 1112—Canusa sandy loam, 1 to 20 percent slopes

### Map Unit Setting

*National map unit symbol:* 2v5vz
*Elevation:* 2,460 to 2,610 feet
*Mean annual precipitation:* 14 to 16 inches
*Mean annual air temperature:* 43 to 45 degrees F
*Frost-free period:* 107 to 116 days
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Canusa and similar soils:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Canusa

#### Setting

*Landform:* Dune fields
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex
*Parent material:* Eolian sands

#### Typical profile

*Oi - 0 to 1 inches:* slightly decomposed plant material
*A - 1 to 4 inches:* sandy loam
*Bk1 - 4 to 16 inches:* sandy loam
*Bk2 - 16 to 38 inches:* sandy loam
*2BCk - 38 to 60 inches:* sand

#### Properties and qualities

*Slope:* 1 to 20 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.13 to 7.09 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 15 percent
*Available water supply, 0 to 60 inches:* Low (about 5.9 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 6e
*Hydrologic Soil Group:* A
*Ecological site:* F044AH001MT - Montane Warm Dry Coniferous Seeley, Swan, Flathead and Tobacco Valleys
*Other vegetative classification:* ponderosa pine/Idaho fescue-rough fescue phase (PK142)
*Hydric soil rating:* No

## 5102—Niarada-Niarada, greater slopes-Roosville complex, 2 to 30 percent slopes

### Map Unit Setting

*National map unit symbol:* 2v5w5
*Elevation:* 2,640 to 3,120 feet
*Mean annual precipitation:* 15 to 19 inches
*Mean annual air temperature:* 42 to 45 degrees F
*Frost-free period:* 101 to 111 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Niarada and similar soils:* 55 percent
*Niarada, greater slopes, and similar soils:* 20 percent
*Roosville and similar soils:* 15 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Niarada

#### Setting

*Landform:* Drumlins
*Landform position (two-dimensional):* Backslope, footslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear
*Parent material:* Till

#### Typical profile

*A - 0 to 9 inches:* gravelly loam
*Bw - 9 to 14 inches:* gravelly loam
*Bk1 - 14 to 22 inches:* very gravelly loam
*Bk2 - 22 to 60 inches:* very gravelly loam

#### Properties and qualities

*Slope:* 6 to 15 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 35 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Moderate (about 6.2 inches)

#### Interpretive groups

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

*Ecological site:* R044AH036MT - Droughty Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Description of Niarada, Greater Slopes**

**Setting**
*Landform:* Drumlins
*Landform position (two-dimensional):* Shoulder, backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Linear
*Parent material:* Till

**Typical profile**
*A - 0 to 9 inches:* gravelly loam
*Bw - 9 to 14 inches:* gravelly loam
*Bk1 - 14 to 22 inches:* very gravelly loam
*Bk2 - 22 to 60 inches:* very gravelly loam

**Properties and qualities**
*Slope:* 15 to 30 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.71 to 2.13 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 35 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Moderate (about 6.2 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 6e
*Hydrologic Soil Group:* B
*Ecological site:* R044AH038MT - Droughty Steep Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Description of Roosville**

**Setting**
*Landform:* Drumlins
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear
*Parent material:* Till

**Typical profile**
*A - 0 to 11 inches:* gravelly silt loam
*Bt - 11 to 18 inches:* gravelly sandy clay loam
*Btk - 18 to 35 inches:* very gravelly sandy clay loam
*Bk - 35 to 60 inches:* very gravelly sandy clay loam

**Properties and qualities**

*Slope:* 2 to 15 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.21 to 0.71 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum content:* 15 percent
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* Moderate (about 7.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 4e
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* C
*Ecological site:* R044AH032MT - Loamy Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

**Minor Components**

**Roosville, greater slopes**

*Percent of map unit:* 10 percent
*Landform:* Drumlins
*Landform position (two-dimensional):* Shoulder, backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Linear
*Across-slope shape:* Convex, linear
*Ecological site:* R044AH040MT - Loamy Steep Seeley, Swan, Flathead and Tobacco Valleys
*Hydric soil rating:* No

## W—Water

**Map Unit Composition**

*Water:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

# Soil Information for All Uses

## Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

## Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

### Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Depth* to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

*Sand* as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

*Silt* as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is

given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Saturated hydraulic conductivity (Ksat)* refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Linear extensibility* refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause

damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

*Erosion factors* are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor Kw* indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

*Erosion factor Kf* indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

*Wind erodibility index* is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

| Physical Soil Properties–Kootenai National Forest Area, Montana-Idaho | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map symbol and soil name | Depth | Sand | Silt | Clay | Moist bulk density | Saturated hydraulic conductivity | Available water capacity | Linear extensibility | Organic matter | Erosion factors | | | Wind erodibility group | Wind erodibility index |
| | | | | | | | | | | Kw | Kf | T | | |
| | *In* | *Pct* | *Pct* | *Pct* | *g/cc* | *micro m/sec* | *In/In* | *Pct* | *Pct* | | | | | |
| 1051—Bohnly-Seelovers-Newbar family complex, 0 to 15 percent slopes | | | | | | | | | | | | | | |
| Bohnly | 0-10 | 0-11- 15 | 58-67- 79 | 18-22- 27 | 1.18-1.39 | 5.00-15.00 | 0.19-0.23 | 1.7-3.4 | 4.0-8.0 | .32 | .32 | 5 | 6 | 48 |
| | 10-18 | 0- 7- 15 | 58-70- 82 | 18-23- 27 | 1.32-1.36 | 5.00-15.00 | 0.17-0.19 | 1.9-4.0 | 1.0-2.0 | .49 | .49 | | | |
| | 18-46 | 0- 7- 15 | 56-70- 82 | 18-23- 32 | 1.33-1.44 | 5.00-15.00 | 0.15-0.19 | 1.8-4.9 | 0.5-1.0 | .49 | .49 | | | |
| | 46-60 | 52-68- 75 | 10-22- 38 | 5-10- 15 | 1.48-1.65 | 15.00-50.00 | 0.10-0.14 | 0.3-1.5 | 0.0-0.5 | .32 | .32 | | | |
| Seelovers | 0-10 | 5-11- 25 | 50-69- 85 | 10-20- 27 | 0.97-1.31 | 5.00-15.00 | 0.19-0.23 | 0.8-3.2 | 4.0-12.0 | .32 | .32 | 5 | 6 | 48 |
| | 10-27 | 0-10- 15 | 51-64- 80 | 18-26- 34 | 1.23-1.30 | 5.00-15.00 | 0.19-0.21 | 1.7-5.4 | 1.0-5.0 | .37 | .37 | | | |
| | 27-60 | 0-12- 20 | 53-63- 78 | 18-25- 27 | 1.33-1.36 | 5.00-15.00 | 0.16-0.20 | 1.7-3.7 | 0.5-2.0 | .49 | .49 | | | |
| Newbar | 0-7 | 65-69- 75 | 17-24- 32 | 3- 7- 8 | 1.43-1.60 | 15.00-50.00 | 0.07-0.11 | 0.0-0.5 | 2.5-4.0 | .05 | .15 | 5 | 6 | 48 |
| | 7-20 | 75-80- 92 | 4-17- 25 | 0- 3- 8 | 1.49-1.60 | 50.00-150.00 | 0.02-0.06 | 0.0-0.4 | 0.0-1.0 | .05 | .15 | | | |
| | 20-37 | 75-78- 85 | 7-16- 25 | 0- 6- 8 | 1.52-1.61 | 50.00-150.00 | 0.01-0.02 | 0.0-0.2 | 0.0-1.0 | .02 | .15 | | | |
| | 37-60 | 70-78- 85 | 0-16- 30 | 0- 6- 17 | 1.56-1.71 | 50.00-150.00 | 0.02-0.06 | 0.0-0.9 | 0.0-1.0 | .02 | .15 | | | |

| Physical Soil Properties–Kootenai National Forest Area, Montana-Idaho | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map symbol and soil name | Depth | Sand | Silt | Clay | Moist bulk density | Saturated hydraulic conductivity | Available water capacity | Linear extensibility | Organic matter | Erosion factors | | | Wind erodibility group | Wind erodibility index |
| | | | | | | | | | | Kw | Kf | T | | |
| | *In* | *Pct* | *Pct* | *Pct* | *g/cc* | *micro m/sec* | *In/In* | *Pct* | *Pct* | | | | | |
| 1072—McCollum-Buist family, stony-Downey, bouldery complex, 0 to 10 percent slopes | | | | | | | | | | | | | | |
| Mccollum | 0-14 | 15-30- 38 | 50-54- 67 | 12-16- 18 | 1.21-1.35 | 5.00-15.00 | 0.19-0.23 | 1.1-2.0 | 3.0-5.0 | .28 | .28 | 4 | 5 | 56 |
| | 14-54 | 50-69- 70 | 12-16- 32 | 12-15- 18 | 1.44-1.53 | 15.00-50.00 | 0.11-0.15 | 1.0-1.9 | 0.5-2.0 | .24 | .24 | | | |
| | 54-60 | 85-90- 99 | 0- 2- 14 | 0- 8- 10 | 1.59-1.64 | 150.00-700.00 | 0.01-0.03 | 0.0-0.7 | 0.0-0.5 | .02 | .02 | | | |
| Buist, stony | 0-7 | 32-44- 51 | 37-40- 50 | 12-16- 18 | 1.34-1.50 | 5.00-15.00 | 0.16-0.20 | 1.0-2.0 | 1.0-3.0 | .28 | .28 | 3 | 5 | 56 |
| | 7-13 | 25-37- 45 | 37-47- 60 | 12-16- 18 | 1.32-1.52 | 5.00-15.00 | 0.12-0.16 | 0.8-1.8 | 0.5-2.0 | .20 | .37 | | | |
| | 13-34 | 25-40- 50 | 32-45- 60 | 12-15- 18 | 1.38-1.53 | 5.00-15.00 | 0.07-0.11 | 0.4-1.2 | 0.0-0.5 | .17 | .43 | | | |
| | 34-60 | 40-48- 70 | 18-38- 48 | 12-14- 18 | 1.46-1.61 | 5.00-15.00 | 0.03-0.07 | 0.2-0.9 | 0.0-0.5 | .10 | .43 | | | |
| Downey, bouldery | 0-8 | 20-30- 40 | 50-56- 70 | 9-14- 17 | 1.19-1.34 | 5.00-15.00 | 0.17-0.21 | 0.7-1.9 | 3.0-5.0 | .32 | .32 | 2 | 5 | 56 |
| | 8-14 | 35-45- 52 | 31-41- 54 | 9-14- 17 | 1.37-1.60 | 5.00-15.00 | 0.13-0.17 | 0.5-1.5 | 0.5-2.0 | .20 | .32 | | | |
| | 14-20 | 80-82- 95 | 0-10- 16 | 4- 8- 12 | 1.56-1.65 | 50.00-150.00 | 0.01-0.03 | 0.0-0.5 | 0.0-0.5 | .02 | .05 | | | |
| | 20-60 | 85-92- 99 | 0- 6- 15 | 0- 2- 8 | 1.53-1.64 | 150.00-700.00 | 0.01-0.02 | 0.0-0.3 | 0.0-0.5 | .02 | .02 | | | |

| Physical Soil Properties–Kootenai National Forest Area, Montana-Idaho | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map symbol and soil name | Depth | Sand | Silt | Clay | Moist bulk density | Saturated hydraulic conductivity | Available water capacity | Linear extensibility | Organic matter | Erosion factors | | | Wind erodibility group | Wind erodibility index |
| | | | | | | | | | | Kw | Kf | T | | |
| | *In* | *Pct* | *Pct* | *Pct* | *g/cc* | *micro m/sec* | *In/In* | *Pct* | *Pct* | | | | | |
| 1075—Tetrault-Canusa-Jocko complex, 1 to 20 percent slopes | | | | | | | | | | | | | | |
| Tetrault | 0-1 | — | — | — | 0.10-0.30 | 50.00-700.00 | 0.15-0.45 | — | 65.0-95.0 | | | 5 | 3 | 86 |
| | 1-9 | 52-66- 75 | 8-19- 35 | 9-15- 17 | 1.35-1.52 | 15.00-50.00 | 0.15-0.19 | 0.8-2.0 | 3.0-5.0 | .10 | .10 | | | |
| | 9-25 | 82-92- 99 | 0- 6- 18 | 0- 2- 10 | 1.55-1.64 | 150.00-700.00 | 0.01-0.03 | 0.0-0.6 | 0.0-0.5 | .02 | .10 | | | |
| | 25-60 | 85-93-100 | 0- 7- 15 | 0- 1- 5 | 1.55-1.65 | 150.00-700.00 | 0.02-0.04 | 0.0-0.3 | 0.0-0.5 | .10 | .10 | | | |
| Canusa | 0-1 | — | — | — | 0.10-0.30 | 50.00-700.00 | 0.15-0.45 | — | 65.0-95.0 | | | 3 | 3 | 86 |
| | 1-4 | 55-63- 70 | 13-27- 40 | 5-10- 18 | 1.44-1.54 | 15.00-50.00 | 0.14-0.18 | 0.4-2.0 | 2.0-4.0 | .17 | .17 | | | |
| | 4-16 | 45-65- 70 | 12-23- 42 | 5-12- 18 | 1.40-1.60 | 15.00-50.00 | 0.10-0.15 | 0.3-1.9 | 0.5-1.0 | .24 | .24 | | | |
| | 16-38 | 45-60- 70 | 12-28- 47 | 5-12- 18 | 1.57-1.62 | 15.00-50.00 | 0.11-0.15 | 0.2-1.8 | 0.0-0.5 | .32 | .32 | | | |
| | 38-60 | 80-89- 98 | 1- 6- 18 | 1- 5- 8 | 1.60-1.68 | 150.00-700.00 | 0.02-0.06 | 0.0-0.7 | 0.0-0.5 | .10 | .10 | | | |
| Jocko | 0-5 | 35-40- 50 | 31-43- 50 | 12-17- 25 | 1.24-1.37 | 5.00-15.00 | 0.11-0.15 | 0.5-2.4 | 3.0-5.0 | .10 | .24 | 3 | 7 | 38 |
| | 5-13 | 40-43- 65 | 22-39- 48 | 12-18- 25 | 1.39-1.49 | 5.00-15.00 | 0.08-0.12 | 0.4-2.1 | 0.5-1.0 | .15 | .37 | | | |
| | 13-20 | 70-75- 98 | 1-18- 29 | 1- 7- 10 | 1.58-1.62 | 50.00-150.00 | 0.02-0.06 | 0.0-0.2 | 0.0-0.5 | .02 | .15 | | | |
| | 20-60 | 75-80- 98 | 1-15- 24 | 1- 5- 10 | 1.54-1.64 | 50.00-150.00 | 0.01-0.03 | 0.0-0.2 | 0.0-0.5 | .02 | .10 | | | |

| Physical Soil Properties–Kootenai National Forest Area, Montana-Idaho | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map symbol and soil name | Depth | Sand | Silt | Clay | Moist bulk density | Saturated hydraulic conductivity | Available water capacity | Linear extensibility | Organic matter | Erosion factors | | | Wind erodibility group | Wind erodibility index |
| | | | | | | | | | | Kw | Kf | T | | |
| | *In* | *Pct* | *Pct* | *Pct* | *g/cc* | *micro m/sec* | *In/In* | *Pct* | *Pct* | | | | | |
| 1111—Canusa-Felt family complex, 0 to 15 percent slopes | | | | | | | | | | | | | | |
| Canusa | 0-1 | — | — | — | 0.10-0.30 | 50.00-700.00 | 0.15-0.45 | — | 65.0-95.0 | | | 3 | 3 | 86 |
| | 1-4 | 55-63- 70 | 13-27- 40 | 5-10- 18 | 1.44-1.54 | 15.00-50.00 | 0.14-0.18 | 0.4-2.0 | 2.0-4.0 | .17 | .17 | | | |
| | 4-16 | 45-65- 70 | 12-23- 42 | 5-12- 18 | 1.40-1.60 | 15.00-50.00 | 0.10-0.15 | 0.3-1.9 | 0.5-1.0 | .24 | .24 | | | |
| | 16-38 | 45-60- 70 | 12-28- 47 | 5-12- 18 | 1.57-1.62 | 15.00-50.00 | 0.11-0.15 | 0.2-1.8 | 0.0-0.5 | .32 | .32 | | | |
| | 38-60 | 80-89- 98 | 1- 6- 18 | 1- 5- 8 | 1.60-1.68 | 150.00-700.00 | 0.02-0.06 | 0.0-0.7 | 0.0-0.5 | .10 | .10 | | | |
| Felt | 0-7 | 20-30- 40 | 50-55- 69 | 9-15- 17 | 1.19-1.34 | 5.00-15.00 | 0.19-0.23 | 0.8-1.9 | 3.0-5.0 | .32 | .32 | 3 | 5 | 56 |
| | 7-20 | 50-60- 70 | 14-28- 44 | 5-12- 16 | 1.50-1.58 | 15.00-50.00 | 0.11-0.15 | 0.2-1.5 | 0.0-0.5 | .32 | .32 | | | |
| | 20-34 | 85-89- 99 | 0- 6- 14 | 1- 5- 8 | 1.60-1.70 | 150.00-700.00 | 0.02-0.06 | 0.0-0.7 | 0.0-0.5 | .02 | .02 | | | |
| | 34-60 | 80-93- 99 | 0- 7- 19 | 0- 1- 6 | 1.56-1.63 | 150.00-700.00 | 0.01-0.03 | 0.0-0.1 | 0.0-0.5 | .02 | .02 | | | |
| 1112—Canusa sandy loam, 1 to 20 percent slopes | | | | | | | | | | | | | | |
| Canusa | 0-1 | — | — | — | 0.10-0.30 | 50.00-700.00 | 0.15-0.45 | — | 65.0-95.0 | | | 3 | 3 | 86 |
| | 1-4 | 55-63- 70 | 13-27- 40 | 5-10- 18 | 1.44-1.54 | 15.00-50.00 | 0.14-0.18 | 0.4-2.0 | 2.0-4.0 | .17 | .17 | | | |
| | 4-16 | 45-65- 70 | 12-23- 42 | 5-12- 18 | 1.40-1.60 | 15.00-50.00 | 0.10-0.15 | 0.3-1.9 | 0.5-1.0 | .24 | .24 | | | |
| | 16-38 | 45-60- 70 | 12-28- 47 | 5-12- 18 | 1.57-1.62 | 15.00-50.00 | 0.11-0.15 | 0.2-1.8 | 0.0-0.5 | .32 | .32 | | | |
| | 38-60 | 80-89- 98 | 1- 6- 18 | 1- 5- 8 | 1.60-1.68 | 150.00-700.00 | 0.02-0.06 | 0.0-0.7 | 0.0-0.5 | .10 | .10 | | | |

| Physical Soil Properties–Kootenai National Forest Area, Montana-Idaho | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map symbol and soil name | Depth | Sand | Silt | Clay | Moist bulk density | Saturated hydraulic conductivity | Available water capacity | Linear extensibility | Organic matter | Erosion factors | | | Wind erodibility group | Wind erodibility index |
| | | | | | | | | | | Kw | Kf | T | | |
| | *In* | *Pct* | *Pct* | *Pct* | *g/cc* | *micro m/sec* | *In/In* | *Pct* | *Pct* | | | | | |
| 5102—Niarada-Niarada, greater slopes-Roosville complex, 2 to 30 percent slopes | | | | | | | | | | | | | | |
| Niarada | 0-9 | 35-40- 50 | 32-45- 50 | 10-15- 20 | 1.26-1.43 | 5.00-15.00 | 0.14-0.18 | 0.6-2.0 | 3.0-5.0 | .15 | .28 | 5 | 6 | 48 |
| | 9-14 | 35-45- 52 | 28-40- 50 | 10-15- 20 | 1.39-1.51 | 5.00-15.00 | 0.10-0.14 | 0.4-1.7 | 0.5-1.0 | .20 | .43 | | | |
| | 14-22 | 40-45- 52 | 28-37- 48 | 10-18- 20 | 1.41-1.54 | 5.00-15.00 | 0.07-0.11 | 0.2-1.1 | 0.0-0.5 | .15 | .37 | | | |
| | 22-60 | 40-48- 60 | 20-34- 49 | 10-18- 20 | 1.43-1.51 | 5.00-15.00 | 0.07-0.11 | 0.2-1.0 | 0.0-0.5 | .10 | .37 | | | |
| Niarada, greater slopes | 0-9 | 35-40- 50 | 32-45- 50 | 10-15- 20 | 1.26-1.43 | 5.00-15.00 | 0.14-0.18 | 0.6-2.0 | 3.0-5.0 | .15 | .28 | 5 | 6 | 48 |
| | 9-14 | 35-45- 52 | 28-40- 50 | 10-15- 20 | 1.39-1.51 | 5.00-15.00 | 0.10-0.14 | 0.4-1.7 | 0.5-1.0 | .20 | .43 | | | |
| | 14-22 | 40-45- 52 | 28-37- 48 | 10-18- 20 | 1.41-1.54 | 5.00-15.00 | 0.07-0.11 | 0.2-1.1 | 0.0-0.5 | .15 | .37 | | | |
| | 22-60 | 40-48- 60 | 20-34- 49 | 10-18- 20 | 1.43-1.51 | 5.00-15.00 | 0.07-0.11 | 0.2-1.0 | 0.0-0.5 | .10 | .37 | | | |
| Roosville | 0-11 | 12-30- 38 | 50-55- 68 | 12-15- 20 | 1.32-1.43 | 5.00-15.00 | 0.13-0.17 | 0.9-2.0 | 1.0-3.0 | .28 | .43 | 3 | 6 | 48 |
| | 11-18 | 40-55- 62 | 6-17- 34 | 20-28- 32 | 1.61-1.66 | 1.50-5.00 | 0.12-0.16 | 1.3-4.2 | 0.0-0.5 | .15 | .24 | | | |
| | 18-35 | 42-56- 65 | 5-18- 34 | 20-26- 30 | 1.58-1.62 | 5.00-15.00 | 0.10-0.14 | 0.8-3.0 | 0.0-0.5 | .10 | .24 | | | |
| | 35-60 | 45-59- 65 | 7-18- 32 | 20-23- 28 | 1.49-1.61 | 5.00-15.00 | 0.09-0.13 | 0.7-2.8 | 0.0-0.5 | .10 | .24 | | | |
| W—Water | | | | | | | | | | | | | | |
| Water | — | — | — | — | — | — | — | — | — | | | | | |

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# APPENDIX C

# K-Value Calculation and Supporting Well Logs

**K-Value Using Cooper**

| | |
|---|---|
| Project: | Wilderness Club |
| Date: | 7/7/2025 |

T = 33.6((Q*192.5)/s)^0.67 Average K= 911.31

Q=gpm
S=drawdown

| WC North Well #4 | | WC South Well #3 | | WC Well #5 | |
|---|---|---|---|---|---|
| GWIC Well # | 235581 | GWIC Well # | 235580 | GWIC Well # | 243807 |
| Yield in GPM | 1000 | Yield in GPM | 1000 | Yield in GPM | 210 |
| Static Water Level | 11.37 | Static Water Level | 14.15 | Static Water Level | 57.65 |
| Pumping Water Level | 40 | Pumping Water Level | 40 | Pumping Water Level | 115 |
| Drawdown | 28.63 | Drawdown | 25.85 | Drawdown | 57.35 |
| T= | 12326.44 | T= | 13199.56 | T= | 2720.05 |
| Well Depth | 154 | Well Depth | 60 | Well Depth | 57 |
| Casing Depth | 154 | Casing Depth | 60 | Casing Depth | 57 |
| Slot Length | NA | Slot Length | NA | Slot Length | 15 |
| Open Bottom | 10 | Open Bottom | 10 | Open Bottom | NA |
| Open Hole | NA | Open Hole | NA | Open Hole | NA |
| Aquifer Depth | 10 | Aquifer Depth | 10 | Aquifer Depth | 15 |
| K=T/b | 1232.64 | K=T/b | 1319.96 | K=T/b | 181.34 |

# APPENDIX D

# Background Nitrate Reference

# ANALYTICAL REPORT

**Montana Environmental Laboratory LLC**
1170 N. Meridian Rd., P.O. Box 8900, Kalispell, MT 59904-1900
Phone: 406-755-2131 Fax: 406-257-5359 www.melab.us

Kent Hayes
Wilderness Preserve
1885 Sophie Lake Rd
Eureka, MT 59917

PWS ID: 04748
Project: Nitrate

**Client Sample ID:** CH001, EP502
**Matrix:** DRINKING WATER
**Collected:** 03/11/2024 8:05
**Lab ID:** 2402146-01
**Received:** 03/11/2024 10:05

| Analyses | Result | Units | RL | MCL | Method | Prepared | Analyzed | Analyst |
|---|---|---|---|---|---|---|---|---|
| Nitrate + Nitrite, Total | **0.65** | mg/L | 0.01 | 10 | E353.2 | | 03/12/2024 14:32 | BLW |

MCL = Maximum Contaminant Limit ND = Not Detected
RL = Reporting Limit

**MEL REVIEW:** RSB 3-25-24

# ANALYTICAL REPORT

## Montana Environmental Laboratory LLC

1170 N. Meridian Rd., P.O. Box 8900, Kalispell, MT 59904-1900
Phone: 406-755-2131 Fax: 406-257-5359 www.melab.us

Kent Hayes
Wilderness Preserve
1885 Sophie Lake Rd
Eureka, MT 59917

PWS ID: 04748
Project: Nitrate

MONTANA ENVIRONMENTAL LABORATORY, LLC. 2146

Certified by the EPA
and the Montana Department of Health
According to Federal Drinking Water Standards

Kalispell, MT 59904
Phone: (406) 755-2131
Fax: (406) 257-5359

**CUSTOMER MAILING ADDRESS:**

Name: Wilderness Club

Address: _____

City: _____ State: _____ Zip: _____

One copy of the analytical report will be mailed to the above address. There is an additional charge of $1.00 for each extra copy mailed or faxed.

Please fax an additional copy of my results to:

_____

Please mail an additional copy of my results to:

_____

_____

_____

**SAMPLE INFORMATION:** CH001, EP502

Address and specific location where sample was collected, i.e.: kitchen sink, west yard hydrant, EP502, etc.

Address: 1885 Sophie lake rd
Location: Pump House
Date / Time collected: 3-11-24 8:05AM
Who collected the sample: M Kent Hayes
Phone #: 406 291 6276

Public Water Supply Name:
Wilderness Club
PWSID#: 0004748

LAB USE ONLY:
Lab #: 2146
Date / Time Received: CB 3-11-24 10:05
Payment Received: CC

**REQUESTED ANALYSIS**

| | | | |
|---|---|---|---|
| ☐ | Alkalinity | $25 | |
| ☐ | Chloride | $22 | |
| ☐ | Chlorine | $15 | |
| ☐ | Fluoride | $22 | |
| ☐ | Hardness, Total | $22 | |
| ☐ | Iron Bacteria | $50 | |
| ☐ | Microscopic Analysis | $50 | |
| ☐ | Nitrate | $22 | |
| ☐ | Nitrite | $22 | |
| ☒ | Nitrate + Nitrite, Total | ~~$22~~ $21 | |
| ☐ | Organic Carbon, Total (TOC) | $47 | |
| ☐ | pH | $12 | |
| ☐ | Specific Conductance | $12 | |
| ☐ | Sulfate | $22 | |
| ☐ | Total Dissolved Solids (TDS) | $20 | |
| ☐ | Total Suspended Solids (TSS) | $15 | |
| ☐ | Turbidity | $20 | |

Metals:

| | | |
|---|---|---|
| ☐ | Aluminum | $15 |
| ☐ | Arsenic | $15 |
| ☐ | Barium | $15 |
| ☐ | Cadmium | $15 |
| ☐ | Calcium | $15 |
| ☐ | Chromium | $15 |
| ☐ | Copper | $15 |
| ☐ | Iron | $15 |
| ☐ | Lead | $15 |
| ☐ | Magnesium | $15 |
| ☐ | Manganese | $15 |
| ☐ | Mercury | $30 |
| ☐ | Potassium | $15 |
| ☐ | Selenium | $15 |
| ☐ | Silver | $15 |
| ☐ | Sodium | $15 |
| ☐ | Zinc | $15 |

If samples are mailed back to the lab using our postage paid mailer tubes then add $5.00 postage and handling per tube. **Payment must accompany sample.**

Total price of tests: _____
Return postage: $5.00
Additional copies or faxes: _____
TOTAL ENCLOSED: _____

MCL = Maximum Contaminant Limit ND = Not Detected
RL = Reporting Limit

**MEL REVIEW:**

# APPENDIX E

# WWTS Sizing

**Wilderness Club Preliminary Plat**
**Wastewater Treatment Systems Sizing (Sand Mound)**



Assumptions

| Phase | Soil Unit | Soil Type* | Application Rate** (gpd/ft^2) |
|---|---|---|---|
| 11 | 5102 | Gravelly Loam (Loam) | 0.5 |
| 12 | 1075 | Sandy Loam | 0.5 |
| 13 | 1075 | Sandy Loam | 0.5 |
| 14 | 1075 | Sandy Loam | 0.5 |
| 15 | 1112 | Sandy Loam | 0.5 |

*per NRCS Soils Report
** per Circular DEQ-4

**TABLE 2.1-1**
**Soil Texture Descriptions are found in Appendix B**

| Texture | Percolation Rate (minutes per inch) | Application rate (gpd/ft$^2$) (a) (b) |
|---|---|---|
| Gravel, gravelly sand, or very coarse sand (c) | <3 | 0.8 |
| Loamy sand, coarse sand (d) | 3-<6 | 0.8 |
| Medium sand, sandy loam | 6- <10 | 0.6 |
| Fine sandy loam, loam | 10- <16 | 0.5 |
| Very fine sand, sandy clay loam, silt loam | 16-<31 | 0.4 |
| Clay loam, silty clay loam | 31-<51 | 0.3 |
| Sandy clay | 51-<121 | 0.2 |
| Clays, silts, silty clays (e) | 121- <240 | 0.15 |
| Clays, silts, silty clays (f) | >240 | Additional Soil Information Required |

| Phase | Total Wastewater Flow (gpd) | Application Rate* (gpd/ft^2) | Sand Mound Basal Area (ft^2) | Basal L/W Ratio | Basal Length (ft) | Basal Width (ft) | Basal Area Check (ft^2) | Notes |
|---|---|---|---|---|---|---|---|---|
| 11A - SFH | 5250 | 0.5 | 10500 | 3:1 | 177 | 59 | 10500 | Best Strategy is to flow everything to one location and build in 'three phases' and utilize distribution valve. |
| 11B - SFH | 5250 | 0.5 | 10500 | 3:1 | 177 | 59 | 10500 | Best Strategy is to flow everything to one location and build in 'three phases' and utilize distribution valve. |
| 11C - SFH | 5250 | 0.5 | 10500 | 3:1 | 177 | 59 | 10500 | Best Strategy is to flow everything to one location and build in 'three phases' and utilize distribution valve. |
| 11D - Condo | 5600 | 0.5 | 11200 | 3:1 | 183 | 61 | 11200 | 16 units on west side |
| 11D - Condo | 4900 | 0.5 | 9800 | 3:1 | 171 | 57 | 9800 | 14 units on north side |
| 12A | 5950 | 0.5 | 11900 | 3:1 | 189 | 63 | 11900 | |
| 12B | 5950 | 0.5 | 11900 | 3:1 | 189 | 63 | 11900 | |
| 13 | 5250 | 0.5 | 10500 | 3:1 | 177 | 59 | 10500 | |
| 14A | 5950 | 0.5 | 11900 | 3:1 | 189 | 63 | 11900 | |
| 14B | 5950 | 0.5 | 11900 | 3:1 | 189 | 63 | 11900 | |
| 14C | 5950 | 0.5 | 11900 | 3:1 | 189 | 63 | 11900 | |
| 14D | 5950 | 0.5 | 11900 | 3:1 | 189 | 63 | 11900 | |
| 14E | 5950 | 0.5 | 11900 | 3:1 | 189 | 63 | 11900 | |
| 15A | 4550 | 0.5 | 9100 | 3:1 | 165 | 55 | 9100 | |
| 15B | 4200 | 0.5 | 8400 | 3:1 | 159 | 53 | 8400 | Probably upsize to match 15A so same dosing pumps can be used |

# APPENDIX F

# NITRATE SENSITIVITY AND CUMULATIVE EFFECTS SPREADSHEET

# Appendix E

## MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## NITRATE SENSITIVITY ANALYSIS

**SITE NAME:** Wilderness Club
**COUNTY:** Lincoln
**NOTES:**

**BY:**
**DATE:** 09/22/25

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reference** | **USDA Soil Survey** | | Pot. M | max 5( | from WWTS siz | constar | constar | TKN Et | from WWTS siz | | Climate & | | constant | | | | | | | |

**Nitrate at end of mixing zone(s) with no cumulative effects**

| Variable | Map Unit Syr | (K) | (I) | (D) | (L) | (Y) | (Ng) | (Nr) | (Ne) | (#I) | (QI) | (P) | (V) | (W) | (Am) | (As) | (Qg) | (Qr) | (Qe) | Nt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Mix | Mixing | Drain- | Back- | Nitrate | Effluent | # of | Quantity | | | Down- | Mix | Mix. zone | Ground | | | |
| | | Hydr. | Hydr. | zone | Zone | field | ground | in | Nitrate | single | of | Annual | Percent | grad. | zone | surface | water | Recharge | Effluent | Resulting |
| | | cond. | grad. | thick | Length | width | nitrate | precip | conc. | family | Effluent | precip. | precip. | width | area | area | flow | flow | flow | nitrate (N) |
| **LOT #** | | (ft/day) | (ft/ft) | (feet) | (feet) | (feet) | (mg/l) | (mg/l) | (mg/l) | homes | (ft3/day) | (in/yr) | recharge | (feet) | ($ft^2$) | ($ft^2$) | (ft3/day) | (ft3/day) | (ft3/day) | (mg/l) |
| 11A - SFH | 1075 | 911.00 | 0.006 | 15.0 | 100 | 190 | 0.65 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 207.50 | 3112.50 | 20750.00 | 17012.93 | 15.89 | 400.50 | **1.78** |
| 11B - SFH | 1075 | 911.00 | 0.006 | 15.0 | 100 | 190 | 0.65 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 207.50 | 3112.50 | 20750.00 | 17012.93 | 15.89 | 400.50 | **1.78** |
| 11C - SFH | 1075 | 911.00 | 0.006 | 15.0 | 100 | 190 | 0.65 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 207.50 | 3112.50 | 20750.00 | 17012.93 | 15.89 | 400.50 | **1.78** |
| 11D - Condo | 1075 | 911.00 | 0.006 | 15.0 | 100 | 159 | 0.65 | 1.0 | 50.0 | 16.0 | 26.70 | 16.8 | 0.2 | 176.50 | 2647.50 | 17650.00 | 14471.24 | 13.52 | 427.20 | **2.06** |
| 11E - Condo | 1075 | 911.00 | 0.006 | 15.0 | 100 | 81 | 0.65 | 1.0 | 50.0 | 14.0 | 26.70 | 16.8 | 0.2 | 98.50 | 1477.50 | 9850.00 | 8076.02 | 7.54 | 373.80 | **2.83** |
| 12A | 1111 | 911.00 | 0.006 | 15.0 | 100 | 164 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 181.50 | 2722.50 | 18150.00 | 14881.19 | 13.90 | 453.90 | **2.11** |
| 12B | 1111 | 911.00 | 0.006 | 15.0 | 100 | 164 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 181.50 | 2722.50 | 18150.00 | 14881.19 | 13.90 | 453.90 | **2.11** |
| 13 | 1111 | 911.00 | 0.006 | 15.0 | 100 | 111 | 0.65 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 128.50 | 1927.50 | 12850.00 | 10535.72 | 9.84 | 400.50 | **2.46** |
| 14A | 1111 | 911.00 | 0.006 | 15.0 | 100 | 111 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 128.50 | 1927.50 | 12850.00 | 10535.72 | 9.84 | 453.90 | **2.69** |
| 14B | 1075 | 911.00 | 0.006 | 15.0 | 100 | 189 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 206.50 | 3097.50 | 20650.00 | 16930.94 | 15.81 | 453.90 | **1.94** |
| 14C | 1111 | 911.00 | 0.006 | 15.0 | 100 | 182 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 199.50 | 2992.50 | 19950.00 | 16357.01 | 15.28 | 453.90 | **1.98** |
| 14D | 1111 | 911.00 | 0.006 | 15.0 | 100 | 182 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 199.50 | 2992.50 | 19950.00 | 16357.01 | 15.28 | 453.90 | **1.98** |
| 14E | 5102 | 911.00 | 0.006 | 15.0 | 100 | 170 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 187.50 | 2812.50 | 18750.00 | 15373.13 | 14.36 | 453.90 | **2.06** |
| 15A | 5102 | 911.00 | 0.006 | 15.0 | 100 | 71 | 0.65 | 1.0 | 50.0 | 13.0 | 26.70 | 16.8 | 0.2 | 88.50 | 1327.50 | 8850.00 | 7256.12 | 6.78 | 347.10 | **2.90** |
| 15B | 5102 | 911.00 | 0.006 | 15.0 | 100 | 170 | 0.65 | 1.0 | 50.0 | 12.0 | 26.70 | 16.8 | 0.2 | 187.50 | 2812.50 | 18750.00 | 15373.13 | 14.36 | 320.40 | **1.66** |

**Nitrate at end of mixing zones with cumulative effects**

| LOT # | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11A - SFH | 911.00 | 0.006 | 15.0 | 462 | 190 | 0.65 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 270.85 | 4062.75 | 125132.70 | 22206.99 | 95.82 | 400.50 | **1.52** |
| 11B - SFH | 911.00 | 0.006 | 15.0 | 100 | 190 | 1.52 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 207.50 | 3112.50 | 20750.00 | 17012.93 | 15.89 | 400.50 | **2.64** |
| 11C - SFH | 911.00 | 0.006 | 15.0 | 100 | 190 | 0.65 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 207.50 | 3112.50 | 20750.00 | 17012.93 | 15.89 | 400.50 | **1.78** |
| 11D - Condo | 911.00 | 0.006 | 15.0 | 538 | 159 | 0.65 | 1.0 | 50.0 | 16.0 | 26.70 | 16.8 | 0.2 | 253.15 | 3797.25 | 136194.70 | 20755.77 | 104.29 | 427.20 | **1.64** |
| 11E - Condo | 911.00 | 0.006 | 15.0 | 362 | 81 | 1.64 | 1.0 | 50.0 | 14.0 | 26.70 | 16.8 | 0.2 | 144.35 | 2165.25 | 52254.70 | 11835.26 | 40.01 | 373.80 | **3.12** |
| 12A | 911.00 | 0.006 | 15.0 | 278 | 164 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 212.57 | 3188.60 | 59001.76 | 17428.86 | 45.18 | 453.90 | **1.90** |
| 12B | 911.00 | 0.006 | 15.0 | 100 | 164 | 1.90 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 181.50 | 2722.50 | 18150.00 | 14881.19 | 13.90 | 453.90 | **3.32** |
| 13 | 911.00 | 0.006 | 15.0 | 532 | 111 | 0.65 | 1.0 | 50.0 | 15.0 | 26.70 | 16.8 | 0.2 | 204.15 | 3062.31 | 108673.35 | 16738.61 | 83.22 | 400.50 | **1.80** |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14A | | 911.00 | 0.006 | 15.0 | 100 | 111 | 1.80 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 128.50 | 1927.50 | 12850.00 | 10535.72 | 9.84 | 453.90 | **3.79** |
| 14B | | 911.00 | 0.006 | 15.0 | 100 | 189 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 206.50 | 3097.50 | 20650.00 | 16930.94 | 15.81 | 453.90 | **1.94** |
| 14C | | 911.00 | 0.006 | 15.0 | 759 | 182 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 314.77 | 4721.61 | 238822.37 | 25808.34 | 182.88 | 453.90 | **1.50** |
| 14D | | 911.00 | 0.006 | 15.0 | 100 | 182 | 1.50 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 199.50 | 2992.50 | 19950.00 | 16357.01 | 15.28 | 453.90 | **2.81** |
| 14E | | 911.00 | 0.006 | 15.0 | 532 | 170 | 0.65 | 1.0 | 50.0 | 17.0 | 26.70 | 16.8 | 0.2 | 263.07 | 3946.11 | 139915.77 | 21569.42 | 107.14 | 453.90 | **1.66** |
| 15A | | 911.00 | 0.006 | 15.0 | 100 | 71 | 1.66 | 1.0 | 50.0 | 13.0 | 26.70 | 16.8 | 0.2 | 88.50 | 1327.50 | 8850.00 | 7256.12 | 6.78 | 347.10 | **3.87** |
| 15B | | 911.00 | 0.006 | 15.0 | 100 | 170 | 0.65 | 1.0 | 50.0 | 12.0 | 26.70 | 16.8 | 0.2 | 187.50 | 2812.50 | 18750.00 | 15373.13 | 14.36 | 320.40 | **1.66** |

*REV. 03/20005*

**NOTES:**

= fill in values in these cells

= these cells are calculated for you

| | | |
|---|---|---|
| Hydr. cond. = | *K* | Hydraulic Conductivity |
| Hydr. grad. = | *I* | Hydraulic Gradient |
| Mix zone thick = | *D* | Thickness of Mixing Zone up to a Maximum of 15 feet (usually constant at 15 feet) |
| Down grad. distance = | *L* | Mixing Zone Length (see ARM 17.30.517(1)(d)(viii), or this may also be the distance to end of last mixing zone when calculating cumulative effects. |
| Drainfield width = | *Y* | Width of Drainfield Perpendicular to Ground Water Flow |
| Background nitrate = | *Ng* | Background Nitrate (as Nitrogen) Concentration |
| Nitrate in precip. = | *Nr* | Nitrate (as Nitrogen) Concentration in Precipitation (usually constant at 1.0 mg/L) |
| Effluent Nitrate conc. = | *Ne* | Nitrate (as Nitrogen) Concentration in Effluent (50 for conventional; 24 for level II; 30 for level 1a; 40 for level 1b) |
| # single family homes = | *#I* | Number of Single Family Homes on the Drainfield (leave as 1 if effluent volume in next column is adjusted to equal total effluent from drainfield) |
| Effluent per drain. = | *QI* | Quantity of Effluent from drainfield (average rate varies depending on number of bedrooms) |
| Annual precip. = | *P* | Annual local Precipitation |
| Percent precip recharge = | *V* | Percent of Precipitation Recharging Ground Water (usually constant at 0.2) |
| Down grad. width = | *W* | Width of Mixing Zone Perpendicular to Ground Water Flow = (0.175)(L) + (Y) |
| Mix zone area = | *Am* | Cross Sectional Area of Aquifer Mixing Zone = (D)(W) |
| Mix zone surface area = | *As* | Surface Area of Mixing Zone = (L)(W) |
| Ground water flow = | *Qg* | Ground Water Flow Rate = (K)(I)(Am) |
| Recharge flow = | *Qr* | Recharge Flow Rate = (As)(P/12/365)(V) |
| Effluent flow = | *Qe* | Effluent Flow Rate = (#I)(QI) |
| Resulting nitrate (N) = | *Nt* | Nitrate (as Nitrogen) Concentration at End of Mixing Zone = ((Ng)(Qg) + (Nr)(Qr) + (Ne)(Qe)) / ((Qg) + (Qr) + (Qe)) |
| | | (or nitrate concentration to use as background nitrate for next downgradient drainfield when determining cumulative effects) |

# APPENDIX G

# PHOSPHORUS BREAKTHROUGH ANALYSIS SPREADSHEET

| Phase | Breakthrough Time to Surface Water (years) | Distance to Water Body |
|---|---|---|
| 11A | 1507.72 | 11800.00 |
| 11B | 1438.51 | 11500.00 |
| 11C | 1370.92 | 11200.00 |
| 11D | 1211.68 | 11000.00 |
| 11E | 1200.08 | 10600.00 |
| 12A | 1111.51 | 7400.00 |
| 12B | 1085.02 | 7300.00 |
| 13 | 2055.81 | 10000.00 |
| 14A | 1815.73 | 10000.00 |
| 14B | 754.06 | 8600.00 |
| 14C | 1608.48 | 9000.00 |
| 14D | 1361.93 | 8200.00 |
| 14E | 934.24 | 9800.00 |
| 15A | 1038.25 | 9500.00 |
| 15B | 1366.75 | 10000.00 |

| Variable | Soil Map Unit Symbol | Phosphoru Depth to Limiting Layer from Bottom of Drainfield Laterals* | | |
|---|---|---|---|---|
| **LOT #** | | | | |
| 11A - SFH | 1075.00 | 0.50 | 6.66 | More than 80 inches |
| 11B - SFH | 1075.00 | 0.50 | 6.66 | More than 80 inches |
| 11C - SFH | 1075.00 | 0.50 | 6.66 | More than 80 inches |
| 11D - Condo | 1075.00 | 0.50 | 6.66 | More than 80 inches |
| 11E - Condo | 1075.00 | 0.50 | 6.66 | More than 80 inches |
| 12A | 1111.00 | 1.00 | 6.66 | More than 80 inches |
| 12B | 1111.00 | 1.00 | 6.66 | More than 80 inches |
| 13.00 | 1111.00 | 1.00 | 6.66 | More than 80 inches |
| 14A | 1111.00 | 1.00 | 6.66 | More than 80 inches |
| 14B | 1075.00 | 0.50 | 6.66 | More than 80 inches |
| 14C | 1111.00 | 1.00 | 6.66 | More than 80 inches |
| 14D | 1111.00 | 1.00 | 6.66 | More than 80 inches |
| 14E | 5102.00 | 0.50 | 6.66 | More than 80 inches |
| 15A | 5102.00 | 0.50 | 6.66 | More than 80 inches |
| 15B | 5102.00 | 0.50 | 6.66 | More than 80 inches |

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 11A- 15 Lots
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 190.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 177.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 59.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 11800.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #l | Number of Single Family Homes on the Drainfield | 15.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#l) | 96.60 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 6955038.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 721275000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 145646.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1507.7 | years |

BY:
DATE: September 22, 2025

***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 11B
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 190.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 177.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 59.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 11500.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 15.0 | |
| **CONSTANTS** | | | |
| PI | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (PI)(#I) | 96.60 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 6955038.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 687843750.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 138959.8 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1438.5 | years |

BY:
DATE: September 22, 2025

***NOTES:*** ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 11C
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 190.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 177.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 59.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 11200.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 15.0 | |
| **CONSTANTS** | | | |
| PI | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (PI)(#I) | 96.60 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 6955038.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 655200000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 132431.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1370.9 | years |

BY:
DATE: September 22, 2025

***NOTES:*** ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 11D
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 159.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 183.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 61.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 11000.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 16.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 103.04 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7434558.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 616825000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 124851.9 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1211.7 | years |

BY:
DATE: September 22, 2025

***NOTES:*** ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 11E
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 81.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 171.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 57.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 10600.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #l | Number of Single Family Homes on the Drainfield | 14.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#l) | 90.16 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 6491502.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 534505000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 108199.3 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1200.1 | years |

BY:
DATE: September 22, 2025

***NOTES:*** ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

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## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 12A
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 164.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 189.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 63.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 7400.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 1.0 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 17.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 109.48 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7930062.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 600510000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 121688.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1111.5 | years |

BY:
DATE: September 22, 2025

***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 12B
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 164.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 189.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 63.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 7300.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 1.0 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 17.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 109.48 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7930062.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 586007500.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 118787.5 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1085.0 | years |

BY:
DATE: September 22, 2025

***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

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## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 13
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 111.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 177.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 59.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 10000.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 1.0 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 15.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 96.60 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 6955038.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 986000000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 198591.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 2055.8 | years |

BY:
DATE: September 22, 2025

***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 14A
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 111.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 189.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 63.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 10000.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 1.0 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 17.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 109.48 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7930062.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 986000000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 198786.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1815.7 | years |

BY:
DATE: September 22, 2025

***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 14B
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 189.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 189.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 63.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 8600.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 17.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 109.48 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7930062.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 404845000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 82555.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 754.1 | years |

BY:
DATE: September 22, 2025

***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 14C
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 182.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 189.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 63.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 9000.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 1.0 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 17.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 109.48 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7930062.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 872550000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 176096.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1608.5 | years |

BY:
DATE: September 22, 2025

***NOTES:*** ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 14D
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 182.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 189.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 63.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 8200.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 1.0 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 17.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 109.48 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7930062.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 737590000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 149104.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1361.9 | years |

BY:
DATE: September 22, 2025

***NOTES:*** ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 14E
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 170.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 189.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 63.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 9800.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 17.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 109.48 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 7930062.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 503475000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 102281.0 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 934.2 | years |

BY:
DATE: September 22, 2025

***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 15A
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 71.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 165.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 55.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 9500.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #l | Number of Single Family Homes on the Drainfield | 13.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#l) | 83.72 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 6043950.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 428568750.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 86922.5 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1038.3 | years |

BY:
DATE: September 22, 2025

***NOTES:*** ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

*REV. 12/2007*

## Appendix N

# MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

## PHOSPHORUS BREAKTHROUGH ANALYSIS

**SITE NAME:** Wilderness Club Subdivision
**COUNTY:** Lincoln County
**LOT #:** Phase 15B
**NOTES:**

| VARIABLES | DESCRIPTION | VALUE | UNITS |
|---|---|---|---|
| Lg | Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow | 170.0 | ft |
| L | Length of Primary Drainfield's Long Axis | 159.0 | ft |
| W | Width of Primary Drainfield's Short Axis | 53.0 | ft |
| B | Depth to Limiting Layer from Bottom of Drainfield Laterals* | 6.7 | ft |
| D | Distance from Drainfield to Surface Water | 10000.0 | ft |
| T | Phosphorus Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)** | 0.5 | ft |
| Sw | Soil Weight (usually constant) | 100.0 | lb/ft3 |
| Pa | Phosphorus Adsorption Capacity of Soil (usually constant) | 200.0 | ppm |
| #I | Number of Single Family Homes on the Drainfield | 12.0 | |
| **CONSTANTS** | | | |
| Pl | Phosphorus Load per Single Family Home (constant) | 6.44 | lbs/yr |
| X | Conversion Factor for ppm to percentage (constant) | 1.0E+06 | |
| **EQUATIONS** | | | |
| Pt | Total Phosphorus Load = (Pl)(#I) | 77.28 | lbs/yr |
| W1 | Soil Weight under Drainfield = (L)(W)(B)(Sw) | 5612382.0 | lbs |
| W2 | Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw) | 522500000.0 | lbs |
| P | Total Phosphorus Adsorption by Soils = (W1 + W2)[(Pa)/(X)] | 105622.5 | lbs |
| **SOLUTION** | | | |
| **BT** | **Breakthrough Time to Surface Water = P / Pt** | 1366.8 | years |

BY:
DATE: September 22, 2025

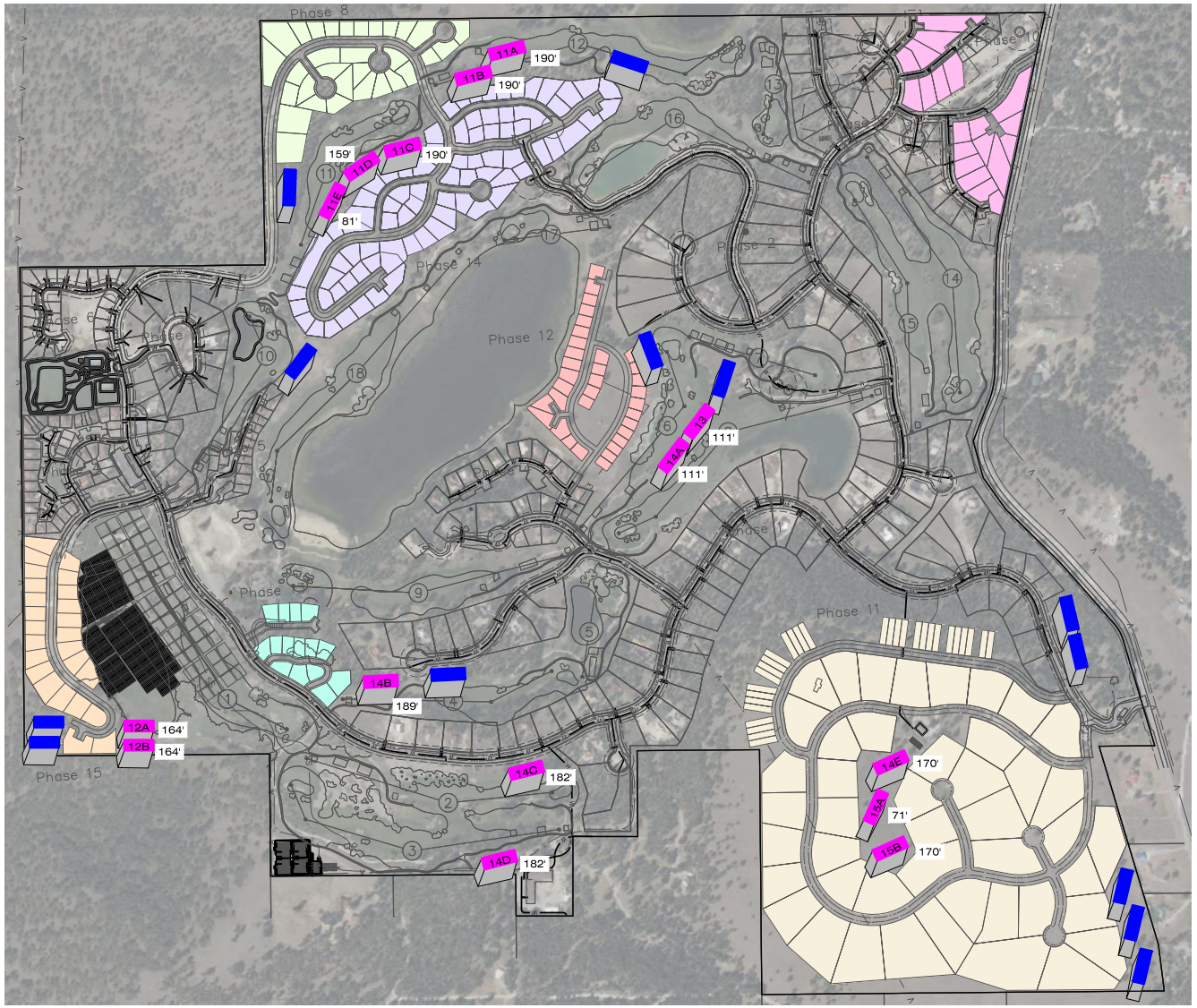
***NOTES:***

** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

# APPENDIX H

# PROPOSED PROJECT DRAWINGS




C:\zworking\wesd01\d4245648\Preliminary SS Layout.dwg, 10/22/2025 2:41 PM, WRIGHT, JOEL

| ISSUE | DATE | DESCRIPTION |
|---|---|---|

PROJECT MANAGER

PROJECT NUMBER

**WILDERNESS CLUB**
**MONTANA**

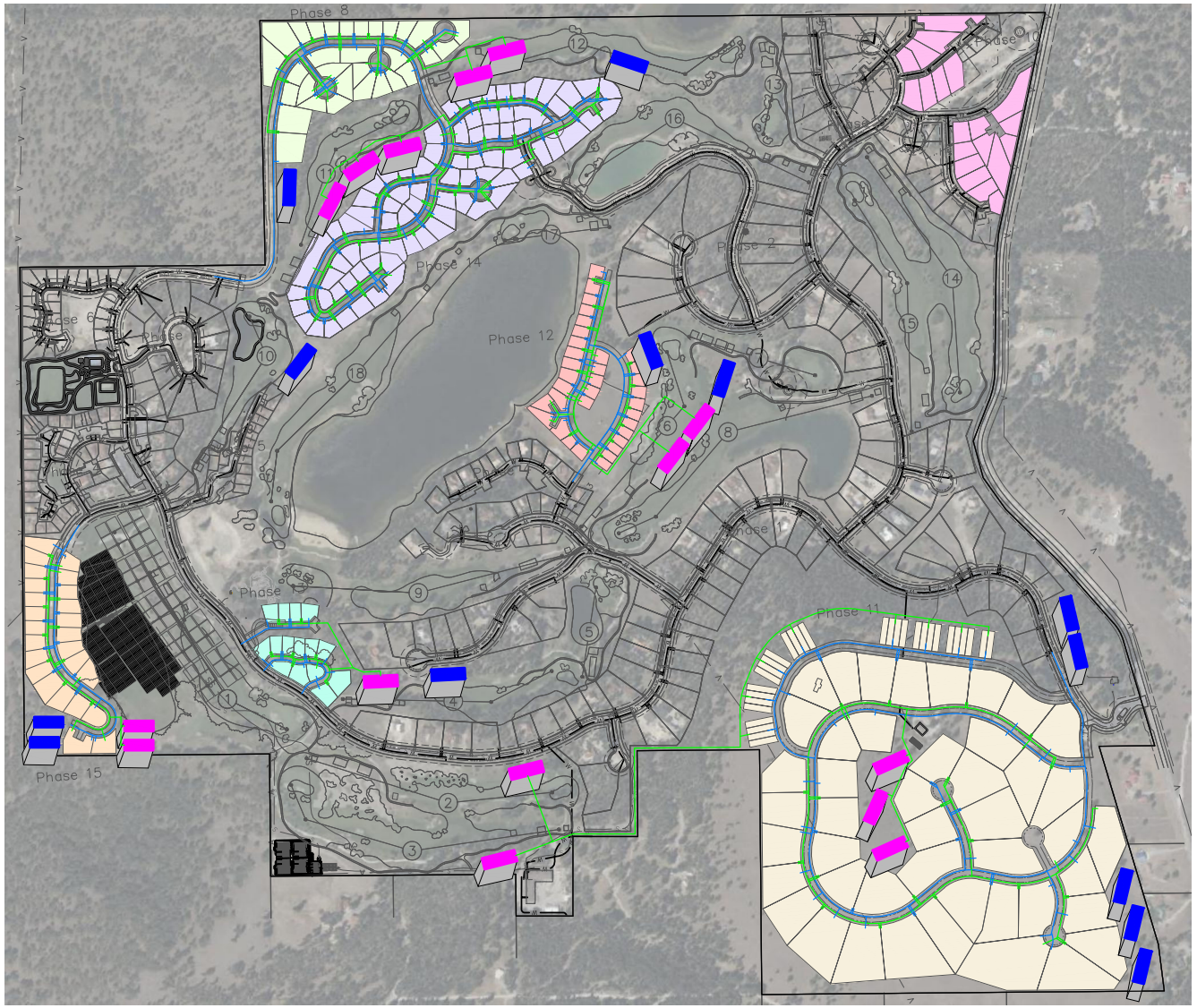
**PRELIMINARY SEWER**
**CONCEPTUAL SITE LAYOUT**

0 1" 2"

FILENAME

SCALE 1" = 300'

SHEET **EX-1**




N

300 0 300 600
SCALE IN FEET

LEGEND

- PRIMARY WITH MIXING ZONE
- REPLACEMENT WITH MIXING ZONE
- PHASE 8
- PHASE 10
- PHASE 11
- PHASE 12
- PHASE 13
- PHASE 14
- PHASE 15
- PROPOSED SEWER
- PROPOSED WATER

C:\jsworkingwest01\d4245648\Preliminary SS Layout.dwg, 10/22/2025 2:41 PM, WRIGHT, JOEL

| ISSUE | DATE | DESCRIPTION |
|---|---|---|

PROJECT MANAGER

PROJECT NUMBER

**WILDERNESS CLUB**
**MONTANA**

**PRELIMINARY SEWER**
**SEWER AND WATER SCHEMATIC**

0 1" 2"

FILENAME

SCALE 1" = 300'

SHEET
**EX-2**

406 ENGINEERING

35 8th Street East | Kalispell, MT 59901 | 406.257.0679 | www.406engineeringinc.com

September 26, 2025

The Wilderness Club
1885 Sophie Lake Road
Eureka, MT 59917

***via email:***
***brian.ehlert@thewildernessclub.com***

RE: Request to connect to The Wilderness Club Public Water System (MT0004748) for the proposed **Escalante Wilderness Preserve Subdivision** in the SE ¼ of Section 29, NW ¼ of 32, and SW ¼ of Section 33, T37N, R27W, PMM, Lincoln County; located at 1885 Sophie Lake Road, Eureka, MT.

To Whom It May Concern:

We are writing to you today on behalf of the Escalante Wilderness Preserve US, LLC. Our client is proposing 234 additional residential lots acting as infill within the existing boundaries of the Wilderness Club Resort, developed over 5 phases. As part of this process, we are required by the Montana Department of Environmental Quality to request permission to connect to any public water supply systems within 500 feet of the proposal's boundaries (ARM 17.36.123). The Wilderness Club Public Water Supply System (PWS MT0004748) is located adjacent to the property and therefore we are submitting this letter requesting your permission to connect to the water system. The Wilderness Club PWS has no obligation to grant the Escalante Wilderness Preserve subdivision permission to connect.

Below you will find space to respond to our request. We would appreciate a response to this request either by returned letter or via email.

Sincerely,
406 Engineering, Inc.

Maggie Leysens

Maggie Leysens, PE

X Yes, the Wilderness Club PWS is willing to consider granting connection to the Escalante Wilderness Preserve subdivision. Please contact me for further discussion.

Contact Name and Phone Number: Brian Ehlert (406) 890-0002

_____ No, the Wilderness Club PWS does not grant permission to connect to our water system.

| Signature | Name | Title | Date |
|---|---|---|---|
| | Brian Ehlert | Managing Partner | Sept. 29, 2025 |

406 ENGINEERING

35 8th Street East | Kalispell, MT 59901 | 406.257.0679 | www.406engineeringinc.com

September 24, 2025

The Wilderness Club
1885 Sophie Lake Road
Eureka, MT 59917

***via email:***
***brian.ehlert@thewildernessclub.com***

RE: Request to connect to The Wilderness Club Public Subsurface Wastewater Treatment System for the proposed **Escalante Wilderness Preserve Subdivision** in the SE ¼ of Section 29, NW ¼ of 32, and SW ¼ of Section 33, T37N, R27W, PMM, Lincoln County; located at 1885 Sophie Lake Road, Eureka, MT.

To Whom It May Concern:

We are writing to you today on behalf of the Escalante Wilderness Preserve US, LLC. Our client is proposing 234 additional residential lots acting as infill within the existing boundaries of the Wilderness Club Resort, developed over 5 phases. As part of this process, we are required by the Montana Department of Environmental Quality to request permission to connect to any public wastewater treatment supply systems within 500 feet of the proposal's boundaries (ARM 17.36.123). The Wilderness Club Public Subsurface Wastewater Treatment System is located adjacent to the property and therefore we are submitting this letter requesting your permission to connect to the wastewater treatment system. The Wilderness Club Public Wastewater Treatment System has no obligation to grant the Escalante Wilderness Preserve subdivision permission to connect.

Below you will find space to respond to our request. We would appreciate a response to this request either by a returned letter or sent via email.

Sincerely,
406 Engineering, Inc.

Maggie Leysens

Maggie Leysens, PE

_____ Yes, the Wilderness Club Public Wastewater Treatment System is willing to consider granting connection to the Escalante Wilderness Preserve subdivision. Please contact me for further discussion.

Contact Name and Phone Number: Brian Ehlert (406) 890-0002

__X__ No, the Wilderness Club Public Wastewater Treatment System does not grant permission to connect to our wastewater treatment system.

| Signature | Name | Title | Date |
|---|---|---|---|
| | Brian Ehlert | Managing Partner | Sept. 29, 2025 |

*https://406engineeringinc.sharepoint.com/Shared Documents/406 Work/1_Projects/2023 Projects/23-077 Drew Bailey/3_DESIGN & PERMITTING/1_DEQ JOINT APP/3.Appendix B - Water Supply/2024-02-05.FCWD 8 permission.docx Friday, September 26, 2025, 9:08 AM Friday, September 26, 20253:25 PM*

# STORM DRAINAGE REPORT

PREPARED IN ACCORDANCE WITH
MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ) CIRCULAR 8

**Phase 11- Wilderness Escalante Preserve**

On property located at Sophie Lake Road
legally described as COS 4389
in S28, 29, 32 & 33, T37N, R27W, PMM, Lincoln County.

Published: January 7, 2026

**Prepared For:**
Escalante Wilderness
Preserve US LP
PO Box 2092
Eureka, MT 59917

**Prepared By:**
406 Engineering, Inc.
35 8th Street East
Kalispell, MT 59901

## 1.0 GENERAL

Escalante Wilderness Preserve US LP owns the above referenced property, which is a portion of the property generally known as the Wilderness Club. The owners intend to develop Phase 11 of the project which includes the development of 45 residential lots and 36 condos. The new development will include a road extension, 45 single-family homes, 36 condo lots, landscaping, and undeveloped natural land. The property is currently partially developed with a gravel road, concrete slabs, utilities, and buildings, and undeveloped natural land. The remaining portions of the property are to remain undeveloped.

This report aims to outline the current hydrological conditions of this site compared to the hydrological conditions that will exist after the proposed development. This report is prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The organization of the report follows the outlined requirements of DEQ-8. The report identifies storm water management with routing and storage requirements based on the analysis of the pre-development and post-development conditions.

This report and any attachments shall be submitted to the DEQ or to a delegated division of local government for review and approval. The report and attachments demonstrate that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owner. This report qualifies as a “Standard Plan” per DEQ-8.

## 2.0 SITE INFORMATION

GEOTECHNICAL INFORMATION:

Hydrologic soil groups are based on the estimates of runoff potential. The proposed development consists of hydrologic soil group B soils. Group B soils have moderate infiltration rates when thoroughly wet. These moderately deep and moderately well-drained soils have a similarly moderate rate of water transmission. Refer to the appendices for the NRCS Hydrologic Soil Group map.

PRE-DEVELOPED CONDITIONS:

For this report, the predeveloped conditions of the site are assumed to be undeveloped. The existing project site is 77 acres, with ground cover consisting of open space in good condition. The property slopes to the north, east, west, and south direction with slopes ranging from 0%-35%.

POST-DEVELOPED CONDITIONS:

The developed conditions of the 77-acre property will include the development of a road extension, 45 single-family homes and 36 condo lots. The remaining portions of the property will remain undeveloped. The development will result in a minor increase in impervious surfaces but will not change the overall drainage pattern or discharge point. Retention structures are proposed to manage the increased runoff from the development.

## 3.0 DRAINAGE DESIGN CRITERIA AND METHODS USED

The SCS method was used to estimate the storm runoff and volume for the property. Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2023 was used to analyze basin runoff. The runoff volume and peak flows for the 2, 10, and 100-year 24-hour storm events were analyzed for pre-developed and post-developed basins.

Primary inputs for the SCS methods are as follows:

- Basin Area: A basin is generally defined as an area that drains to a single point.
- Curve Number: A composite curve number (CN) for a basin is determined based on the hydrologic soil group, ground cover type, treatment, and hydraulic conditions. NRCS TR-55 Runoff CN tables are used to select the appropriate number.
- Time of Concentration: The time of concentration is the theoretical time it takes for runoff to travel to a point of interest from the hydraulically most distant point. Calculating a time of concentration involves summing flow times for runoff as sheet flow, shallow concentrated flow, and channel flow if applicable.
- Manning's Number: A n-value is designated for each surface type, providing an effective roughness coefficient for the water path selected to calculate the time of concentration. Standard tables and figures provided by *Technical Release 55 – Urban Hydrology for Small Watersheds* (TR-55) were used to select the appropriate number.
- Design Storm Depth: The SCS Method uses 24-hour storm depths developed by the National Oceanic and Atmospheric Administration (NOAA), with a selected design recurrence interval, such as 2, 10, or 100 years.
- Storm Distribution: To evaluate the peak flows, selecting a design storm hydrograph or rainfall time distribution pattern is necessary. A Type I storm distribution was utilized for sizing control facilities.

The selection of the curve number enables the SCS method to model the soil capacity and land cover to capture and infiltrate rainfall. The model is highly non-linear, meaning a relatively small percent increase in rainfall can lead to larger increases in runoff. This occurs because as the infiltrative capacity of the soil is used up, a higher percentage of precipitation will run off.

Both the TR-55 Manual and DEQ-8 have been used as reference for the SCS method in this report. The SCS method uses 24-hour storm depths developed by the NOAA with a selected design recurrence interval, such as 2, 10, 50, or 100-year storms. The precipitation data used in this report were obtained from NOAA Atlas 14 and can be seen below in Table 1.

Table 1: NOAA Precipitation Depths

| Recurrence Interval | 2-year | 10-year | 100-year |
|---|---|---|---|
| 24-hour Precipitation Depth (in) | 1.24 | 1.74 | 2.55 |

This report is proposed as a Standard Plan per DEQ 8 and therefore must address storm water drainage peak flow and volume. Standard Plans must also demonstrate that the proposed development will not allow storm water to do any of the following:

- Exceed the pre-development runoff to an adjoining property during the 2-year storm event;
- Overtop roadways or driveways during a 10-year storm event; or
- Inundate any buildings or drainfields during a 100-year storm event. This may be demonstrated through either narrative descriptions or calculations.

**4.0 DELINEATION OF DRAINAGE BASINS**

For this report section, the property is considered to have 14 drainage basins and 5 sub-basins varying in size, and one typical basin representing lots that slope away from the proposed stormwater facilities. The proposed property boundaries, the proposed development, and the topography across the site defined the drainage study extent. Although the proposed development will alter the localized drainage pattern, the overall drainage pattern will remain the same. Therefore, the pre-development and post-development drainage basins will remain the same size and shape.

PRE-DEVELOPED ON-SITE DRAINAGE BASINS:

For the pre-developed drainage basins, storm water moves as sheet flow with slopes ranging between 0%-35%. The basins are considered vacant, undeveloped land with no existing structures or impervious areas. No significant storm water runoff concerns are known to exist on the property. The composite CN for the pre-developed site is based on the ground cover conditions of the open space in good condition for the soil group B (CN 61). Refer to the appendices for the TR-55 Runoff curve number tables and the TR-55 time of concentration calculations. Table 2 provides a summary of the pre-developed time of concentrations and curve numbers.

Table 2: Pre-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 6.01 | 61 | 24.9 |
| Basin 2 | 0.82 | 61 | 17.9 |
| Sub-Basin 3A | 3.21 | 61 | 18.4 |
| Sub-Basin 3B | 5.85 | 61 | 21.9 |
| Sub-Basin 3C | 5.83 | 61 | 20.8 |
| Sub-Basin 3D | 3.06 | 61 | 18.1 |
| Sub-Basin 3e | 2.57 | 61 | 26 |
| Basin 3-Total | 39.56 | 61 | 22.4 |
| Basin 4 | 10.19 | 61 | 22.6 |
| Basin 5 | 1.62 | 61 | 26 |
| Basin 6 | 0.49 | 61 | 9.4 |
| Basin 7 | 0.50 | 61 | 9.8 |
| Basin 8 | 0.49 | 61 | 10 |
| Basin 9 | 0.49 | 61 | 9.2 |
| Basin 10 | 0.48 | 61 | 6.9 |
| Basin 11 | 0.48 | 61 | 7.2 |
| Basin 12 | 0.48 | 61 | 7.4 |
| Basin 13 | 0.49 | 61 | 8.4 |
| Basin 14 | 0.48 | 61 | 7.8 |
| "Typical Basin" Lot 17 | 1.72 | 0 | 17.9 |

POST-DEVELOPED ON-SITE DRAINAGE BASINS:

As mentioned above, the post-development drainage basins will remain the same size and shape as the pre-development drainage basins. The post-development conditions for the basins include the proposed development of the land including the 45 single-family homes, 36 condo lots and asphalt roads. The composite CN is calculated land cover of open space in good condition for soil group B (CN 61), rooftops (98), and asphalt for soil group B (98). Table 3 provides a summary of the post-developed time of concentrations and curve numbers.

Table 3: Post-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 6.01 | 67 | 24.9 |
| Basin 2 | 0.82 | 82 | 17.9 |
| Sub-Basin 3A | 3.21 | 69 | 18.4 |
| Sub-Basin 3B | 5.85 | 68 | 21.9 |
| Sub-Basin 3C | 5.83 | 68 | 20.8 |
| Sub-Basin 3D | 3.06 | 69 | 18.1 |
| Sub-Basin 3e | 2.57 | 71 | 26 |
| Basin 3-Total | 39.56 | 67 | 22.4 |
| Basin 4 | 10.19 | 65 | 22.6 |
| Basin 5 | 1.62 | 83 | 26 |
| Basin 6 | 0.49 | 82 | 9.4 |
| Basin 7 | 0.50 | 82 | 9.8 |
| Basin 8 | 0.49 | 84 | 10 |
| Basin 9 | 0.49 | 84 | 9.2 |
| Basin 10 | 0.48 | 82 | 6.9 |
| Basin 11 | 0.48 | 83 | 7.2 |
| Basin 12 | 0.48 | 83 | 7.4 |
| Basin 13 | 0.49 | 85 | 8.4 |
| Basin 14 | 0.48 | 77 | 7.8 |
| "Typical Basin" Lot 17 | 1.72 | 66 | 17.9 |

OFF-SITE BASINS:

The property is surrounded by land with similar ground cover. No off-site flows contribute to flows onto the property. All off-site flows are negligible and have not been considered in this drainage analysis.

## 5.0 RUNOFF VOLUMES AND FLOWS

Utilizing the procedures outlined in DEQ 8, runoff volumes and peak flows for the 2-year, 10-year, and 100-year 24-hour storm events were evaluated for the pre- and post-developed drainage basins. Refer to the attached calculations for the pre-developed and post-developed peak flows and runoff volumes.

## 6.0 PROVISIONS TO MITIGATE ON-SITE STORM WATER FLOWS

INITIAL STORM WATER FACILITY

Utilizing the procedures identified in DEQ-8, the initial storm water facilities has been sized to infiltrate, evapotranspire, and/or capture the post-development runoff generated from the first 0.5 inches of rainfall on the impervious areas. The required volume of the initial storm water facilities has been included in the design of the proposed retention facility. Refer to Table 5 for the initial storm water facility volume for the drainage basins.

CONVEYANCE FACILITIES

Driveway culverts are proposed to be installed under the driveways corresponding to all the residential lots in Phase 11 to convey stormwater from swale A to swale A. Each culvert has been designed to be 12" in diameter. Each driveway culvert will be corrugated metal pipe (CMP), and approximately 24 linear feet at a slope of 0.33% with a capacity of 0.5 cfs. The capacity exceeds the 2-year and 10-year, 24-hour storm event peak flows from the post-developed basins as described in Table 4.

Conveyance swales will be used along all roadways to capture runoff from driveways, rooftops, and roadways, as well as the runoff that has been conveyed through the proposed driveway culvert. Conveyance swale A is 1.0 foot deep with 3 to 1 side slopes. The capacity of the swale was determined to be 12.78 cfs. The design capacity exceeds all 2-year, 10-year, 100-year and 24-hour storm event flows from the post-developed basins as described in Table 4. Refer to the attachments for peak flows of each basin.

Table 4: Post-Developed Peak Flows

| Basin ID | 2-year | | 10-year | | 100-year | |
|---|---|---|---|---|---|---|
| | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) |
| Basin 1 | 0.011 | 269 | 0.05 | 2155 | 0.413 | 8103 |
| Basin 2 | 0.048 | 637 | 0.178 | 1441 | 0.453 | 3080 |
| Sub-Basin 3A | 0.009 | 281 | 0.036 | 1547 | 0.397 | 5172 |
| Sub-Basin 3B | 0.013 | 386 | 0.057 | 2506 | 0.539 | 8860 |
| Sub-Basin 3C | 0.013 | 384 | 0.057 | 2497 | 0.537 | 8829 |
| Sub-Basin 3D | 0.008 | 268 | 0.035 | 1474 | 0.378 | 4930 |
| Sub-Basin 3e | 0.072 | 365 | 0.342 | 1562 | 0.381 | 4741 |
| Basin 3-Total | 0.01 | 1834 | 0.04 | 14665 | 2.921 | 55153 |
| Basin 4 | 0.01 | 180 | 0.069 | 2737 | 0.462 | 11909 |
| Basin 5 | 0.105 | 1387 | 0.339 | 3032 | 0.826 | 6331 |
| Basin 6 | 0.041 | 381 | 0.144 | 861 | 0.359 | 1841 |
| Basin 7 | 0.042 | 389 | 0.147 | 879 | 0.366 | 1878 |
| Basin 8 | 0.06 | 490 | 0.167 | 1038 | 0.381 | 2118 |
| Basin 9 | 0.067 | 475 | 0.181 | 1007 | 0.414 | 2054 |
| Basin 10 | 0.04 | 373 | 0.141 | 844 | 0.352 | 1803 |
| Basin 11 | 0.052 | 417 | 0.159 | 913 | 0.378 | 1906 |
| Basin 12 | 0.052 | 417 | 0.159 | 913 | 0.378 | 1906 |
| Basin 13 | 0.02 | 187 | 0.071 | 422 | 0.176 | 902 |
| Basin 14 | 0.005 | 198 | 0.064 | 551 | 0.235 | 1345 |
| "Typical Basin" Lot 17 | 0.002 | 51.2 | 0.013 | 537 | 0.105 | 2161 |

**Swale A**

- Side slope: 3:1
- Depth: 1 ft
- Cross-Sectional Area: 3 sf
- Capacity: 12.78 cfs

**Driveway Culvert**

- Diameter: 12”
- Length: 24’
- Capacity: 0.5 cfs
- Material: CMP

RETENTION AND DETENTION FACILITIES

Utilizing the procedures outlined in DEQ-8, the required and provided retention facility size for each basin can be seen in Table 5. With the existing topography on the property where storm water naturally sheets, the storm water will collect in the proposed conveyance swale A and conveyed to the retention facilities. See the attached Drainage Basin Exhibit to find the locations of the proposed retention facilities. The proposed retention facilities has been sized to retain the post-developed 2-year runoff volume and the Initial Storm Water Facility volume. Refer to Table 5 and to the attached calculations for more detail.

Table 5: Drainage Basin Storage Volumes

| Basin ID | Post-Dev. 2-Year Runoff Volume (cf) | Initial Storm Water Facility Volume (cf) | Proposed Retention Structure | Proposed Retention Facility Volume (cf) |
|---|---|---|---|---|
| Basin 1 | 269 | 1672 | Swale B w/ Check Dam and Sump | 1689 |
| Basin 2 | 637 | 833 | Swale B w/ Check Dam and Sump | 849 |
| Sub-Basin 3A | 281 | 1181 | Retention Pond A | 11497 |
| Sub-Basin 3B | 386 | 1952 | Swale B w/ Check Dam and Sump | 1778 |
| Sub-Basin 3C | 384 | 1743 | Retention Pond A | 11497 |
| Sub-Basin 3D | 268 | 1181 | Retention Pond A | 11497 |
| Sub-Basin 3e | 365 | 1192 | Retention Pond A | 11497 |
| Basin 3-Total | 1834 | 10433 | Retention Pond A | 11497 |
| Basin 4 | 180 | 1946 | Swale B w/ Check Dam and Sump | 1931 |
| Basin 5 | 1387 | 1697 | Swale B w/ Check Dam and Sump | 1728 |
| Basin 6 | 381 | 497 | Sump | 330 |
| Basin 7 | 389 | 502 | Sump | 330 |
| Basin 8 | 490 | 541 | Sump | 330 |
| Basin 9 | 475 | 537 | Sump | 330 |
| Basin 10 | 373 | 490 | Sump | 330 |
| Basin 11 | 417 | 512 | Sump | 330 |
| Basin 12 | 417 | 517 | Sump | 330 |
| Basin 13 | 187 | 551 | Sump | 330 |
| Basin 14 | 198 | 369 | Sump | 330 |
| "Typical Basin" Lot 17 | 51.2 | 366 | Sump | 330 |

**Retention Pond A**

- Side slope: 5:1
- Depth: 2 ft
- Bottom Area: 35’x117’
- Total Dimensions: 45’x137’
- Volume: 11497 cf

**Swale B**

- Side slope: 3:1
- Depth: 2 ft
- Cross-Sectional Area: 12 sf

**Typical Check Dam**

- Side slope: 3:1
- Depth: 1.75 ft
- Area of Dam: 5.25 sf

DRAINAGE BASIN 1

Drainage Basin 1 represents runoff from the area of development including lots 42-39 and the roadway sloping from the normal crown. This parcel generally slopes to the southwest. Runoff from this basin will be stored in swale B utilizing check dams and sumps, and is designed to retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 2

Drainage Basin 2 represents runoff from the area of development including the driveways from lots 11-17 and the roadway sloping from the normal crown. This parcel generally slopes to the southwest. Runoff from this basin will be stored in swale B utilizing check dams and sumps, and is designed to retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE SUB-BASIN 3A

Drainage Sub-Basin 3A represents runoff from the area of development including lots 43-45 and the roadway sloping from the normal crown. This parcel generally slopes to the north. Runoff from this basin will be conveyed via swale A and driveway culverts, to combine with basin 3 runoff in the proposed retention pond A and is designed to retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE SUB-BASIN 3B

Drainage Sub-Basin 3B represents runoff from the area of development including lots 18-21, driveway runoff from lots 22-26 and the roadway sloping from the normal crown. This parcel generally slopes to the south. Runoff from this basin will be conveyed via swale A and driveway culverts, to be stored in swale B utilizing check damns and sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE SUB-BASIN 3C

Drainage Sub-Basin 3C represents runoff from the area of development including lots 36-38, driveway runoff from lot 32-35, and the roadway sloping from the normal crown. This parcel generally slopes to the south. Runoff from this basin will be conveyed via swale A and driveway culverts, to combine with basin 3 runoff in the proposed retention pond A and is designed to retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE SUB-BASIN 3D

Drainage Sub-Basin 3D represents runoff from the area of development including lot 32 and lot 33, driveway runoff from lots 28-30, and the roadway sloping from the normal crown. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via swale A and driveway culverts, to combine with basin 3 runoff in the proposed retention pond A and is designed to retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE SUB-BASIN 3E

Drainage Sub-Basin 3E represents runoff from the area of development including lot 1 and the roadway sloping from the normal crown. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via swale A to combine with basin 3 runoff in the proposed retention pond A and is designed to retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 3

Drainage Basin 3 represents runoff from the area of development including the lots within sub-basin 3A, 3B, 3C, 3D, 3E and the roadway sloping from the normal crown. This parcel generally slopes to the northeast. Runoff from this basin will be stored in retention pond A and is designed to retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 4

Drainage Basin 4 represents runoff from the area of development including lots 2-9 and the roadway sloping from the normal crown. This parcel generally slopes to the north. Runoff from this basin will be conveyed via swale A and driveway culverts, to be stored in swale B utilizing check dams and sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 5

Drainage Basin 5 represents runoff from the area of development including driveway runoff from the condo lots 101-136 and the roadway sloping from the normal crown. This parcel generally slopes to the north. Runoff from this basin will be conveyed via swale A and driveway culverts, to be stored in swale B utilizing check dams and sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 6

Drainage Basin 6 represents runoff from the area of development condo lots 101-104. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 7

Drainage Basin 7 represents runoff from the area of development condo lots 105-108. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 8

Drainage Basin 8 represents runoff from the area of development condo lots 109-112. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 9

Drainage Basin 9 represents runoff from the area of development condo lots 113-116. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 10

Drainage Basin 10 represents runoff from the area of development condo lots 121-124. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 11

Drainage Basin 11 represents runoff from the area of development condo lots 125-128. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 12

Drainage Basin 12 represents runoff from the area of development condo lots 129-132. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 13

Drainage Basin 13 represents runoff from the area of development condo lots 133-136. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 14

Drainage Basin 14 represents runoff from the area of development condo lots 117-120. This parcel generally slopes to the north. Runoff from this basin will sheet flow into sumps that retain the post-developed 2-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will no inundate drainfields and buildings during the 100-year storm event.

INFILTRATION FACILITIES

Infiltration sumps are proposed to be installed throughout the development. These will capture any runoff not retained in check dams, and the retention pond. Not taking into consideration infiltration, each sump is capable of storing 165 cubic feet of runoff volume. Lots 10-17, 22-27, and condo lots 101-136 will require sumps to be installed after development. Refer to attachments for more detail on sump locations and storage calculations.

PRE-TREATMENT FACILITIES

The rural nature of the site will provide superb pretreatment of any storm water before leaving the site.

## 7.0 OPERATION AND MAINTENANCE

The operation and maintenance of the storm water management infrastructure are essential to the longevity of the storm water treatment. The lot layout includes an Operation and Maintenance Plan.

## 8.0 CONCLUSIONS

This report was prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The development of the 77-acre property will include a road extension, 45 single-family homes, 36 condo lots, landscaping, and undeveloped natural land, which will increase the impervious area and therefore increase both runoff rates and volume. The proposed conveyance and retention structures have been sized to collect storm water and ensure that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owners. The plan was developed to ensure that storm water does not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event

Prepared by:
**406 Engineering, Inc.**

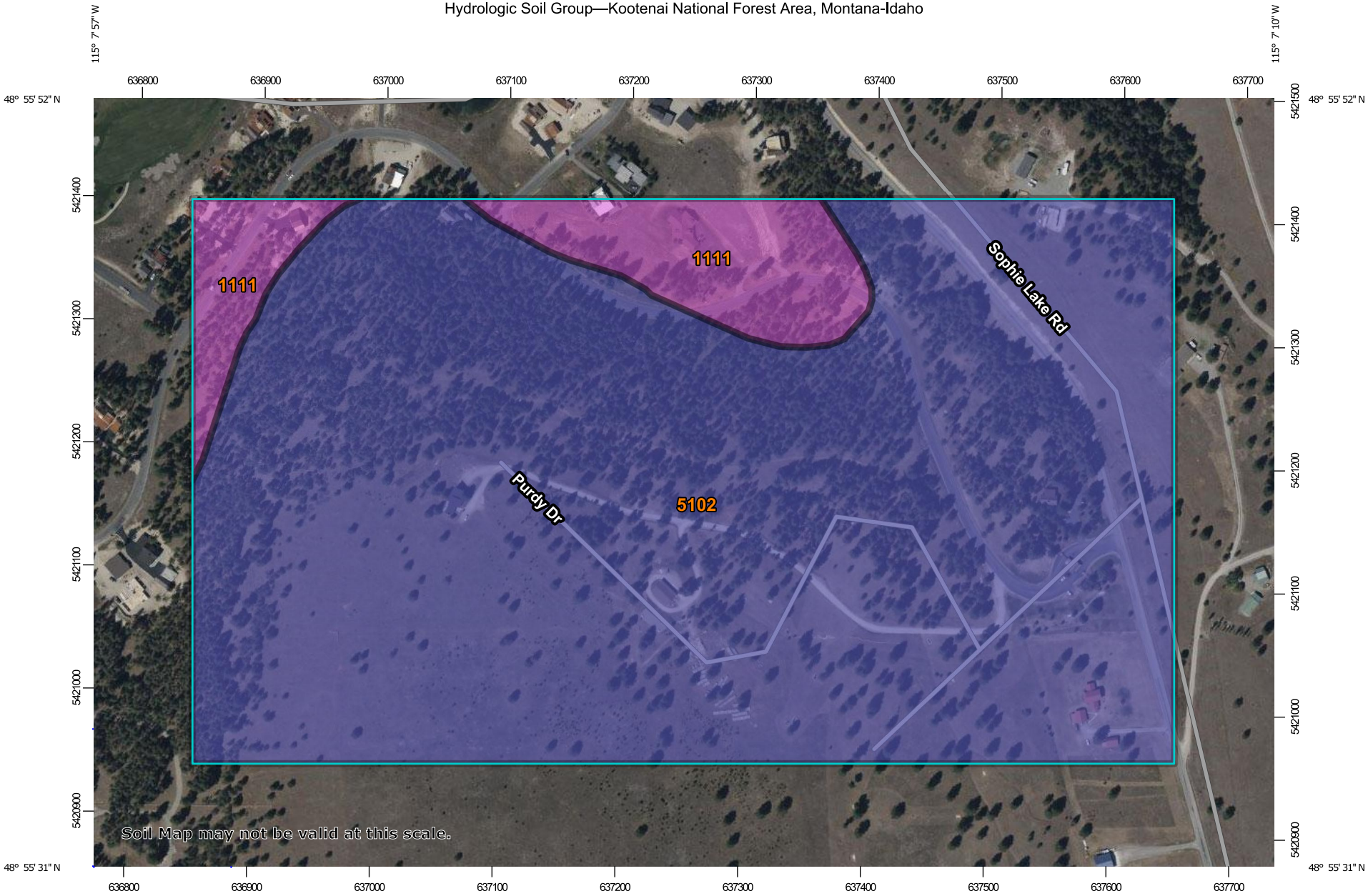


Hailley Jones, Staff Engineer

**ATTACHMENTS**

- ✓ *NRCS Hydrologic Soil Group (4 pages)*
- ✓ *NOAA Precipitation Data (4 pages)*
- ✓ *TR-55 Curve Number Values (2 pages)*
- ✓ *Composite Curve Number Calculations (1 page)*
- ✓ *Hydraflow Time of Concentration and Runoff Calculations (46 pages)*
- ✓ *Retention Pond A Sizing*
- ✓ *Swale A Sizing (1 page)*
- ✓ *Swale B Sizing (1 page)*
- ✓ *Typical Check Dam Sizing (1 page)*
- ✓ *Typical Driveway Culvert Sizing (1 page)*

*https://406engineeringinc.sharepoint.com/406 Work/1_Projects/2021 Projects/21-007K Escalante Wilderness Preserve/ 3_DESIGN & PERMITTING/1_DEQ JOINT APP/5.Appendix E-Drainage Report/Phase 11/rpt.2025-09.02.CLIENT.DEQ 8.docx*
*Wednesday, January 7, 2026, 8:47 AM*




Map Scale: 1:4,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Lines**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Points**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Water Features**

- Streams and Canals

**Transportation**

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

**Background**

- Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Kootenai National Forest Area, Montana-Idaho
Survey Area Data: Version 24, Sep 16, 2024

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

Date(s) aerial images were photographed: Jul 14, 2023—Aug 13, 2023

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.

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1111 | Canusa-Felt family complex, 0 to 15 percent slopes | A | 8.8 | 9.7% |
| 5102 | Niarada-Niarada, greater slopes-Roosville complex, 2 to 30 percent slopes | B | 82.2 | 90.3% |
| **Totals for Area of Interest** | | | **91.0** | **100.0%** |

## Description

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.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

**NOAA Atlas 14, Volume 12, Version 2**
**Location name: Eureka, Montana, USA***
**Latitude: 48.9386°, Longitude: -115.1253°**
**Elevation: 2656 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Carl Trypaluk, Dale Unruh, Michael St.Laurent, Austin Jordan, Rama Sesha Sridhar Mantripragada, Sandra Pavlovic, Greg Fall, Fernando Salas

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.139** (0.122-0.157) | **0.182** (0.161-0.209) | **0.251** (0.219-0.292) | **0.307** (0.263-0.362) | **0.380** (0.314-0.458) | **0.435** (0.346-0.533) | **0.488** (0.370-0.613) | **0.539** (0.389-0.703) | **0.605** (0.409-0.837) | **0.652** (0.429-0.947) |
| 10-min | **0.192** (0.170-0.218) | **0.253** (0.224-0.289) | **0.348** (0.303-0.405) | **0.425** (0.364-0.502) | **0.527** (0.435-0.636) | **0.603** (0.480-0.739) | **0.677** (0.514-0.850) | **0.748** (0.540-0.976) | **0.839** (0.568-1.16) | **0.904** (0.596-1.31) |
| 15-min | **0.223** (0.197-0.253) | **0.294** (0.260-0.336) | **0.405** (0.353-0.471) | **0.494** (0.423-0.583) | **0.613** (0.506-0.739) | **0.701** (0.558-0.859) | **0.786** (0.597-0.987) | **0.869** (0.627-1.13) | **0.974** (0.660-1.35) | **1.05** (0.692-1.53) |
| 30-min | **0.272** (0.241-0.309) | **0.358** (0.317-0.410) | **0.494** (0.430-0.574) | **0.602** (0.516-0.711) | **0.747** (0.616-0.901) | **0.854** (0.680-1.05) | **0.958** (0.728-1.20) | **1.06** (0.764-1.38) | **1.19** (0.804-1.64) | **1.28** (0.843-1.86) |
| 60-min | **0.326** (0.288-0.369) | **0.427** (0.378-0.489) | **0.588** (0.512-0.684) | **0.717** (0.614-0.846) | **0.888** (0.733-1.07) | **1.02** (0.809-1.24) | **1.14** (0.865-1.43) | **1.26** (0.909-1.64) | **1.41** (0.956-1.96) | **1.52** (1.00-2.21) |
| 2-hr | **0.419** (0.377-0.469) | **0.527** (0.473-0.596) | **0.698** (0.617-0.802) | **0.837** (0.727-0.974) | **1.02** (0.860-1.22) | **1.16** (0.947-1.41) | **1.30** (1.02-1.61) | **1.43** (1.07-1.85) | **1.60** (1.13-2.20) | **1.73** (1.19-2.50) |
| 3-hr | **0.492** (0.448-0.546) | **0.600** (0.544-0.672) | **0.773** (0.690-0.879) | **0.914** (0.803-1.05) | **1.10** (0.942-1.30) | **1.25** (1.04-1.50) | **1.39** (1.11-1.71) | **1.54** (1.18-1.97) | **1.72** (1.25-2.34) | **1.85** (1.32-2.66) |
| 6-hr | **0.642** (0.589-0.704) | **0.753** (0.689-0.831) | **0.935** (0.843-1.04) | **1.08** (0.965-1.22) | **1.29** (1.12-1.48) | **1.45** (1.23-1.70) | **1.61** (1.33-1.94) | **1.77** (1.42-2.23) | **1.98** (1.52-2.65) | **2.14** (1.60-3.02) |
| 12-hr | **0.846** (0.776-0.925) | **0.978** (0.895-1.08) | **1.20** (1.08-1.32) | **1.38** (1.23-1.54) | **1.63** (1.43-1.84) | **1.82** (1.58-2.10) | **2.02** (1.71-2.39) | **2.22** (1.84-2.73) | **2.48** (2.00-3.24) | **2.69** (2.11-3.68) |
| 24-hr | **1.08** (0.990-1.19) | **1.24** (1.14-1.37) | **1.52** (1.37-1.68) | **1.74** (1.56-1.94) | **2.06** (1.82-2.31) | **2.30** (2.01-2.62) | **2.55** (2.19-2.97) | **2.80** (2.36-3.39) | **3.14** (2.58-4.02) | **3.39** (2.74-4.56) |
| 2-day | **1.30** (1.18-1.42) | **1.49** (1.36-1.64) | **1.82** (1.64-2.02) | **2.09** (1.87-2.33) | **2.47** (2.18-2.79) | **2.76** (2.40-3.16) | **3.05** (2.62-3.58) | **3.35** (2.83-4.07) | **3.75** (3.09-4.82) | **4.06** (3.28-5.46) |
| 3-day | **1.43** (1.31-1.57) | **1.65** (1.51-1.82) | **2.01** (1.82-2.24) | **2.31** (2.07-2.59) | **2.73** (2.40-3.10) | **3.05** (2.65-3.51) | **3.38** (2.88-3.97) | **3.71** (3.11-4.52) | **4.14** (3.41-5.35) | **4.48** (3.62-6.06) |
| 4-day | **1.55** (1.41-1.70) | **1.78** (1.62-1.97) | **2.17** (1.96-2.41) | **2.50** (2.23-2.79) | **2.94** (2.58-3.34) | **3.29** (2.85-3.79) | **3.63** (3.10-4.28) | **3.98** (3.34-4.87) | **4.45** (3.66-5.76) | **4.81** (3.89-6.51) |
| 7-day | **1.83** (1.67-2.02) | **2.10** (1.91-2.32) | **2.55** (2.29-2.83) | **2.92** (2.60-3.27) | **3.43** (3.00-3.90) | **3.82** (3.30-4.41) | **4.21** (3.59-4.98) | **4.62** (3.87-5.64) | **5.15** (4.23-6.65) | **5.55** (4.49-7.50) |
| 10-day | **2.07** (1.89-2.28) | **2.37** (2.16-2.62) | **2.86** (2.57-3.18) | **3.27** (2.91-3.66) | **3.83** (3.35-4.35) | **4.26** (3.68-4.91) | **4.69** (4.00-5.54) | **5.12** (4.30-6.26) | **5.70** (4.69-7.36) | **6.14** (4.97-8.27) |
| 20-day | **2.77** (2.53-3.06) | **3.16** (2.87-3.49) | **3.77** (3.39-4.21) | **4.28** (3.81-4.81) | **4.97** (4.36-5.67) | **5.49** (4.77-6.36) | **6.01** (5.15-7.12) | **6.52** (5.52-8.00) | **7.20** (5.98-9.32) | **7.70** (6.30-10.4) |
| 30-day | **3.34** (3.05-3.69) | **3.78** (3.43-4.19) | **4.50** (4.03-5.01) | **5.07** (4.51-5.69) | **5.84** (5.13-6.66) | **6.41** (5.58-7.43) | **6.97** (6.00-8.27) | **7.52** (6.40-9.23) | **8.23** (6.89-10.6) | **8.74** (7.24-11.8) |
| 45-day | **4.12** (3.75-4.55) | **4.63** (4.19-5.12) | **5.44** (4.87-6.04) | **6.08** (5.40-6.80) | **6.92** (6.08-7.86) | **7.53** (6.57-8.70) | **8.11** (7.01-9.58) | **8.66** (7.42-10.6) | **9.34** (7.92-12.0) | **9.82** (8.32-13.2) |
| 60-day | **4.79** (4.36-5.30) | **5.36** (4.85-5.93) | **6.24** (5.58-6.93) | **6.93** (6.15-7.74) | **7.81** (6.88-8.86) | **8.44** (7.38-9.73) | **9.02** (7.83-10.6) | **9.56** (8.24-11.6) | **10.2** (8.74-13.1) | **10.6** (9.17-14.2) |

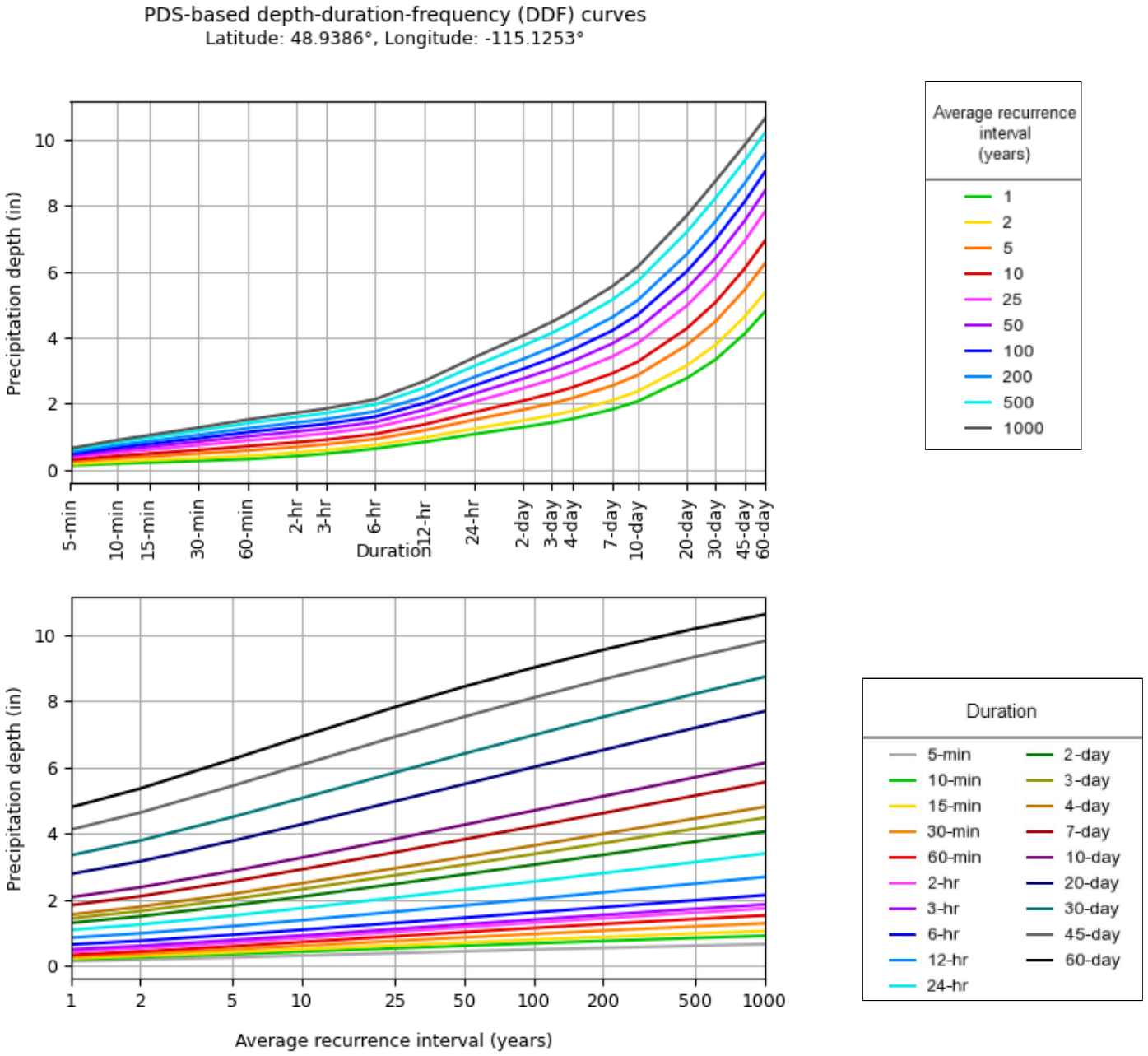
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical



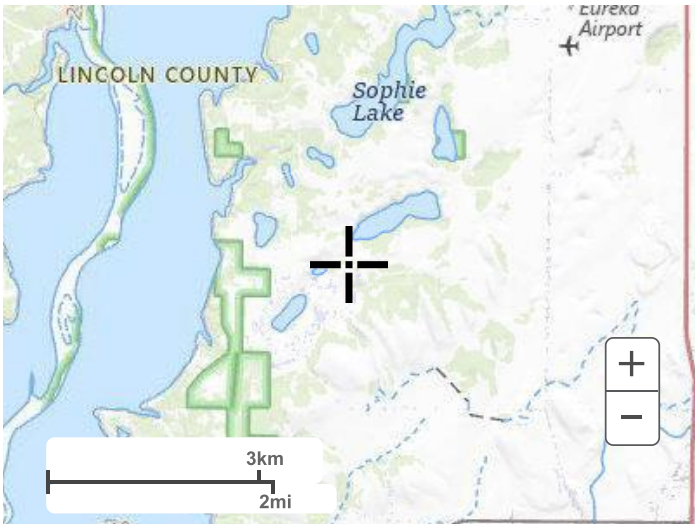

NOAA Atlas 14, Volume 12, Version 2

Created (GMT): Fri Aug 1 16:57:16 2025

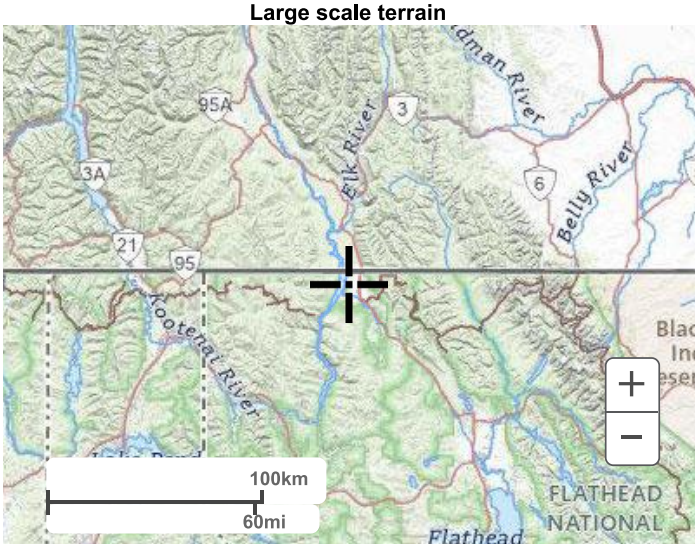
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## Maps & aerials

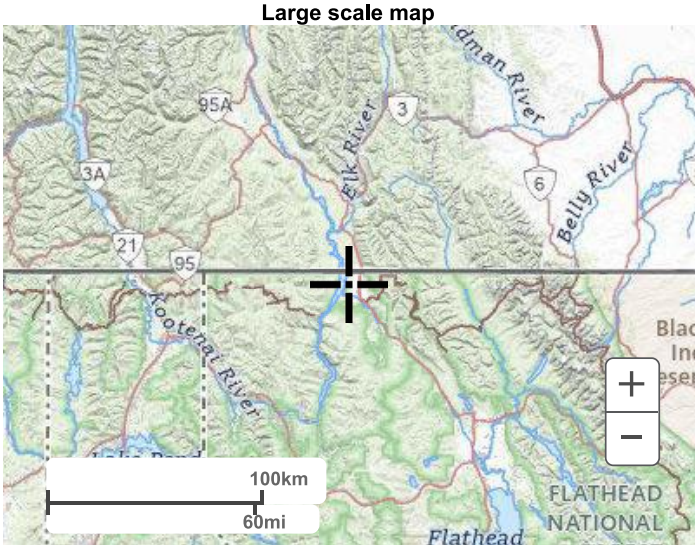
**Small scale terrain**



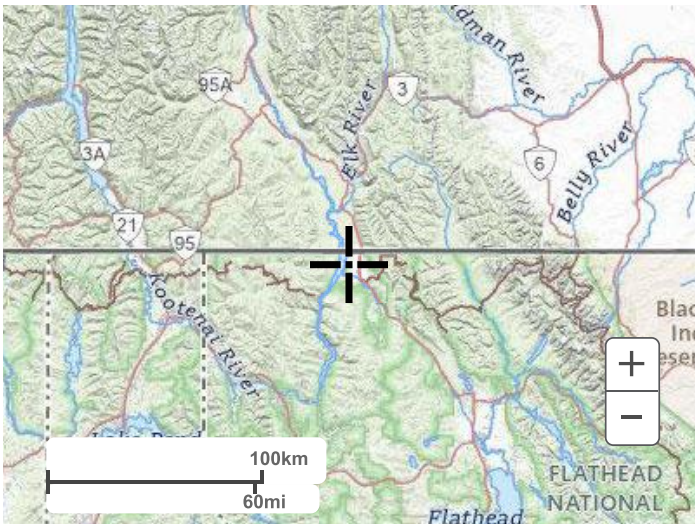

Large scale terrain




Large scale map




Large scale aerial




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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table 2-2a Runoff curve numbers for urban areas [1/]

| Cover description: Cover type and hydrologic condition | Average percent impervious area [2/] | Curve numbers for hydrologic soil group: A | B | C | D |
|---|---|---|---|---|---|
| ***Fully developed urban areas (vegetation established)*** | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only) [4/] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| ***Developing urban areas*** | | | | | |
| Newly graded areas (pervious areas only, no vegetation) [5/] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

| Cover description | | Curve numbers for hydrologic soil group | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic condition | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing. [2/] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element. [3/] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | 30 [4/] | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm). [5/] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods. [6/] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 30 [4/] | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

1 Average runoff condition, and $I_a = 0.2S$.

2 ***Poor:*** <50%) ground cover or heavily grazed with no mulch.
***Fair:*** 50 to 75% ground cover and not heavily grazed.
***Good:*** > 75% ground cover and lightly or only occasionally grazed.

3 ***Poor:*** <50% ground cover.
***Fair:*** 50 to 75% ground cover.
***Good:*** >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 ***Poor:*** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
***Fair:*** Woods are grazed but not burned, and some forest litter covers the soil.
***Good:*** Woods are protected from grazing, and litter and brush adequately cover the soil.

**Post-Developed Composite Curve Number & Initial Storm Water Facility Volume**
**PROJECT: ESCALANTE WILDERNESS PRESERVE**
**PREPARED BY: 406 Engineering Inc**
September 2, 2025

| Basin ID | Total Area | | Open Space-Good Condition | | Asphalt | | Roof | | Concrete | | Composite CN | Total Impervious Area (SF) | Initial Storm Water Facility Volume (CF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Acres) | (SF) | Area (SF) | CN | Area (SF) | CN | Area (SF) | CN | Area (SF) | CN | | | |
| Basin 1 | 6.01 | 261701 | 221579 | 61 | 20122 | 98 | 20000 | 98 | 0 | 98 | **67** | 40122 | 1672 |
| Basin 2 | 0.82 | 35651 | 15649 | 61 | 20003 | 98 | 0 | 98 | 0 | 98 | **82** | 20003 | 833 |
| Sub-Basin 3A | 3.21 | 139957 | 111624 | 61 | 13333 | 98 | 15000 | 98 | 0 | 98 | **69** | 28333 | 1181 |
| Sub-Basin 3B | 5.85 | 254828 | 207974 | 61 | 26854 | 98 | 20000 | 98 | 0 | 98 | **68** | 46854 | 1952 |
| Sub-Basin 3C | 5.83 | 253874 | 212040 | 61 | 26834 | 98 | 15000 | 98 | 0 | 98 | **68** | 41834 | 1743 |
| Sub-Basin 3D | 3.06 | 133382 | 105044 | 61 | 18338 | 98 | 10000 | 98 | 0 | 98 | **69** | 28338 | 1181 |
| Sub-Basin 3e | 2.57 | 111735 | 83136 | 61 | 23599 | 98 | 5000 | 98 | 0 | 98 | **71** | 28599 | 1192 |
| Basin 3-Total | 39.56 | 1723213 | 1474520 | 61 | 141445 | 98 | 107248 | 98 | 1700 | 98 | **67** | 250393 | 10433 |
| Basin 4 | 10.19 | 444002 | 397308 | 61 | 9890 | 98 | 36804 | 98 | 0 | 98 | **65** | 46694 | 1946 |
| Basin 5 | 1.62 | 70627 | 29909 | 61 | 40718 | 98 | 0 | 98 | 0 | 98 | **83** | 40718 | 1697 |
| Basin 6 | 0.49 | 21202 | 9263 | 61 | 2189 | 98 | 9750 | 98 | 0 | 98 | **82** | 11939 | 497 |
| Basin 7 | 0.50 | 21781 | 9726 | 61 | 2305 | 98 | 9750 | 98 | 0 | 98 | **82** | 12055 | 502 |
| Basin 8 | 0.49 | 21556 | 8579 | 61 | 3227 | 98 | 9750 | 98 | 0 | 98 | **84** | 12977 | 541 |
| Basin 9 | 0.49 | 21480 | 8583 | 61 | 3147 | 98 | 9750 | 98 | 0 | 98 | **84** | 12897 | 537 |
| Basin 10 | 0.48 | 20999 | 9233 | 61 | 2016 | 98 | 9750 | 98 | 0 | 98 | **82** | 11766 | 490 |
| Basin 11 | 0.48 | 21001 | 8724 | 61 | 2527 | 98 | 9750 | 98 | 0 | 98 | **83** | 12277 | 512 |
| Basin 12 | 0.48 | 20970 | 8553 | 61 | 2667 | 98 | 9750 | 98 | 0 | 98 | **83** | 12417 | 517 |
| Basin 13 | 0.49 | 21221 | 8007 | 61 | 3464 | 98 | 9750 | 98 | 0 | 98 | **85** | 13214 | 551 |
| Basin 14 | 0.48 | 21008 | 12155 | 61 | 1728 | 98 | 7125 | 98 | 0 | 98 | **77** | 8853 | 369 |
| "Typical Basin" Lot 17 | 1.72 | 74930 | 66139 | 61 | 4522 | 98 | 4269 | 98 | 0 | 98 | **66** | 8791 | 366 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3a |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3b |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3c |
| 6 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3d |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 8 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3e |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 10 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 11 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 12 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 7 |
| 13 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 8 |
| 14 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 9 |
| 15 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 10 |
| 16 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 11 |
| 17 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 12 |
| 18 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 13 |
| 19 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 14 |
| 20 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 17 (Typical Basi |
| 22 | SCS Runoff | 0.011 | 2 | 1292 | 269 | ------ | ------ | ------ | Developed Basin 1 |
| 23 | SCS Runoff | 0.048 | 2 | 608 | 637 | ------ | ------ | ------ | Developed Basin 2 |
| 24 | SCS Runoff | 0.009 | 2 | 1210 | 281 | ------ | ------ | ------ | Developed Sub-Basin 3a |
| 25 | SCS Runoff | 0.013 | 2 | 1250 | 386 | ------ | ------ | ------ | Developed Sub-Basin 3b |
| 26 | SCS Runoff | 0.013 | 2 | 1250 | 384 | ------ | ------ | ------ | Developed Sub-Basin 3c |
| 27 | SCS Runoff | 0.008 | 2 | 1210 | 268 | ------ | ------ | ------ | Developed Sub-Basin 3d |
| 28 | SCS Runoff | 0.072 | 2 | 1290 | 1,834 | ------ | ------ | ------ | Developed Basin 3 |
| 29 | SCS Runoff | 0.010 | 2 | 1146 | 365 | ------ | ------ | ------ | Developed Sub-Basin 3e |
| 30 | SCS Runoff | 0.010 | 2 | 1384 | 180 | ------ | ------ | ------ | Developed Basin 4 |
| 31 | SCS Runoff | 0.105 | 2 | 612 | 1,387 | ------ | ------ | ------ | Developed Basin 5 |
| 32 | SCS Runoff | 0.041 | 2 | 600 | 381 | ------ | ------ | ------ | Developed Basin 6 |
| 33 | SCS Runoff | 0.042 | 2 | 600 | 389 | ------ | ------ | ------ | Developed Basin 7 |
| 34 | SCS Runoff | 0.060 | 2 | 602 | 490 | ------ | ------ | ------ | Developed Basin 8 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 35 | SCS Runoff | 0.067 | 2 | 600 | 475 | ------ | ------ | ------ | Developed Basin 9 |
| 36 | SCS Runoff | 0.040 | 2 | 600 | 373 | ------ | ------ | ------ | Developed Basin 10 |
| 37 | SCS Runoff | 0.052 | 2 | 600 | 417 | ------ | ------ | ------ | Developed Basin 11 |
| 38 | SCS Runoff | 0.052 | 2 | 600 | 417 | ------ | ------ | ------ | Developed Basin 12 |
| 39 | SCS Runoff | 0.020 | 2 | 600 | 187 | ------ | ------ | ------ | Developed Basin 13 |
| 40 | SCS Runoff | 0.005 | 2 | 708 | 198 | ------ | ------ | ------ | Developed Basin 14 |
| 41 | SCS Runoff | 0.002 | 2 | 1332 | 51 | ------ | ------ | ------ | Developed Basin 17 (Typical Basin) |

# TR55 Tc Worksheet



## Hyd. No. 1

Pre-Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 22.97** | **+** | **0.00** | **+** | **0.00** | **=** | **22.97** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 483.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 7.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.27 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.89** | **+** | **0.00** | **+** | **0.00** | **=** | **1.89** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 24.90 min**

# TR55 Tc Worksheet



## Hyd. No. 2

Pre-Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 17.40** | **+** | **0.00** | **+** | **0.00** | **=** | **17.40** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 165.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =6.04 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.46** | **+** | **0.00** | **+** | **0.00** | **=** | **0.46** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 17.90 min**

# TR55 Tc Worksheet



## Hyd. No. 3

Pre-Developed Sub-Basin 3a

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 16.93** | **+** | **0.00** | **+** | **0.00** | **=** | **16.93** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 554.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =6.25 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.48** | **+** | **0.00** | **+** | **0.00** | **=** | **1.48** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 18.40 min**

# TR55 Tc Worksheet



## Hyd. No. 4

Pre-Developed Sub-Basin 3b

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 331.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.84 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.14** | **+** | **0.00** | **+** | **0.00** | **=** | **1.14** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 21.90 min**

# TR55 Tc Worksheet



## Hyd. No. 5

Pre-Developed Sub-Basin 3c

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 20.80 min**

# TR55 Tc Worksheet



## Hyd. No. 6

Pre-Developed Sub-Basin 3d

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 267.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.14** | **+** | **0.00** | **+** | **0.00** | **=** | **18.14** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 18.10 min**

# TR55 Tc Worksheet



## Hyd. No. 7

Pre-Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.51** | **+** | **0.00** | **+** | **0.00** | **=** | **18.51** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1294.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =5.59 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 3.86** | **+** | **0.00** | **+** | **0.00** | **=** | **3.86** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 22.40 min**

# TR55 Tc Worksheet



## Hyd. No. 8

Pre-Developed Sub-Basin 3e

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1521.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.84 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 5.24** | **+** | **0.00** | **+** | **0.00** | **=** | **5.24** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 26.00 min**

# TR55 Tc Worksheet



## Hyd. No. 9

Pre-Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.51** | **+** | **0.00** | **+** | **0.00** | **=** | **18.51** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1380.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =5.59 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.12** | **+** | **0.00** | **+** | **0.00** | **=** | **4.12** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 22.60 min**

# TR55 Tc Worksheet



## Hyd. No. 10

Pre-Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1519.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.84 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 5.23** | **+** | **0.00** | **+** | **0.00** | **=** | **5.23** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 26.00 min**

# TR55 Tc Worksheet



## Hyd. No. 11

Pre-Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 143.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.36** | **+** | **0.00** | **+** | **0.00** | **=** | **9.36** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.40 min**

# TR55 Tc Worksheet



## Hyd. No. 12

Pre-Developed Basin 7

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 152.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.83** | **+** | **0.00** | **+** | **0.00** | **=** | **9.83** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.80 min**

# TR55 Tc Worksheet



## Hyd. No. 13

Pre-Developed Basin 8

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 145.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.02** | **+** | **0.00** | **+** | **0.00** | **=** | **10.02** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 10.00 min**

# TR55 Tc Worksheet



## Hyd. No. 14

Pre-Developed Basin 9

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 144.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 16.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.17** | **+** | **0.00** | **+** | **0.00** | **=** | **9.17** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.20 min**

# TR55 Tc Worksheet



## Hyd. No. 15

Pre-Developed Basin 10

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 126.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 25.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 6.89** | **+** | **0.00** | **+** | **0.00** | **=** | **6.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.90 min**

# TR55 Tc Worksheet



## Hyd. No. 16

Pre-Developed Basin 11

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 131.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 24.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.23** | **+** | **0.00** | **+** | **0.00** | **=** | **7.23** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.20 min**

# TR55 Tc Worksheet



## Hyd. No. 17

Pre-Developed Basin 12

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 137.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 25.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.37** | **+** | **0.00** | **+** | **0.00** | **=** | **7.37** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.40 min**

# TR55 Tc Worksheet



## Hyd. No. 18

Pre-Developed Basin 13

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 140.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 19.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.37** | **+** | **0.00** | **+** | **0.00** | **=** | **8.37** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.40 min**

# TR55 Tc Worksheet



## Hyd. No. 19

Pre-Developed Basin 14

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 117.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 20.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.10** | **+** | **0.00** | **+** | **0.00** | **=** | **7.10** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.10 min**

# TR55 Tc Worksheet



## Hyd. No. 20

Pre-Developed Basin 17 (Typical Basin)

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 17.93** | **+** | **0.00** | **+** | **0.00** | **=** | **17.93** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 17.90 min**

# TR55 Tc Worksheet



## Hyd. No. 22

Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 22.97** | **+** | **0.00** | **+** | **0.00** | **=** | **22.97** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 483.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 7.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.27 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.89** | **+** | **0.00** | **+** | **0.00** | **=** | **1.89** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 24.90 min**

# TR55 Tc Worksheet



## Hyd. No. 23

Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 17.40** | **+** | **0.00** | **+** | **0.00** | **=** | **17.40** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 165.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =6.04 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.46** | **+** | **0.00** | **+** | **0.00** | **=** | **0.46** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 17.90 min**

# TR55 Tc Worksheet



## Hyd. No. 24

Developed Sub-Basin 3a

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 16.93** | **+** | **0.00** | **+** | **0.00** | **=** | **16.93** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 554.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =6.25 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.48** | **+** | **0.00** | **+** | **0.00** | **=** | **1.48** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 18.40 min**

# TR55 Tc Worksheet



## Hyd. No. 25

Developed Sub-Basin 3b

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 331.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.84 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.14** | **+** | **0.00** | **+** | **0.00** | **=** | **1.14** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 21.90 min**

# TR55 Tc Worksheet



## Hyd. No. 26

Developed Sub-Basin 3c

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 20.80 min**

# TR55 Tc Worksheet



## Hyd. No. 27

Developed Sub-Basin 3d

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 267.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.14** | **+** | **0.00** | **+** | **0.00** | **=** | **18.14** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 18.10 min**

# TR55 Tc Worksheet



## Hyd. No. 28

Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.51** | **+** | **0.00** | **+** | **0.00** | **=** | **18.51** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1294.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =5.59 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 3.86** | **+** | **0.00** | **+** | **0.00** | **=** | **3.86** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 22.40 min**

# TR55 Tc Worksheet



## Hyd. No. 29

Developed Sub-Basin 3e

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1521.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.84 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 5.24** | **+** | **0.00** | **+** | **0.00** | **=** | **5.24** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 26.00 min**

# TR55 Tc Worksheet



## Hyd. No. 30

Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.51** | **+** | **0.00** | **+** | **0.00** | **=** | **18.51** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1380.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =5.59 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.12** | **+** | **0.00** | **+** | **0.00** | **=** | **4.12** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 22.60 min**

# TR55 Tc Worksheet



## Hyd. No. 31

Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 20.77** | **+** | **0.00** | **+** | **0.00** | **=** | **20.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 1519.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 9.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =4.84 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 5.23** | **+** | **0.00** | **+** | **0.00** | **=** | **5.23** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 26.00 min**

# TR55 Tc Worksheet



## Hyd. No. 32

Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 143.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.36** | **+** | **0.00** | **+** | **0.00** | **=** | **9.36** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.40 min**

# TR55 Tc Worksheet



## Hyd. No. 33

Developed Basin 7

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 152.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.83** | **+** | **0.00** | **+** | **0.00** | **=** | **9.83** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.80 min**

# TR55 Tc Worksheet



## Hyd. No. 34

Developed Basin 8

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 145.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.02** | **+** | **0.00** | **+** | **0.00** | **=** | **10.02** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 10.00 min**

# TR55 Tc Worksheet



## Hyd. No. 35

Developed Basin 9

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 144.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 16.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.17** | **+** | **0.00** | **+** | **0.00** | **=** | **9.17** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.20 min**

# TR55 Tc Worksheet



## Hyd. No. 36

Developed Basin 10

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 126.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 25.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 6.89** | **+** | **0.00** | **+** | **0.00** | **=** | **6.89** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 6.90 min**

# TR55 Tc Worksheet



## Hyd. No. 37

Developed Basin 11

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 131.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 24.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.23** | **+** | **0.00** | **+** | **0.00** | **=** | **7.23** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.20 min**

# TR55 Tc Worksheet



## Hyd. No. 38

Developed Basin 12

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 137.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 25.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.37** | **+** | **0.00** | **+** | **0.00** | **=** | **7.37** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.40 min**

# TR55 Tc Worksheet



## Hyd. No. 39

Developed Basin 13

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 140.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 19.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.37** | **+** | **0.00** | **+** | **0.00** | **=** | **8.37** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.40 min**

# TR55 Tc Worksheet



## Hyd. No. 40

Developed Basin 14

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 131.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 20.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.78** | **+** | **0.00** | **+** | **0.00** | **=** | **7.78** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.80 min**

# TR55 Tc Worksheet



## Hyd. No. 41

Developed Basin 17 (Typical Basin)

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 17.93** | **+** | **0.00** | **+** | **0.00** | **=** | **17.93** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 17.90 min**

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.022 | 2 | 1224 | 667 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.003 | 2 | 1220 | 92 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.012 | 2 | 1220 | 362 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3a |
| 4 | SCS Runoff | 0.022 | 2 | 1224 | 671 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3b |
| 5 | SCS Runoff | 0.022 | 2 | 1224 | 669 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3c |
| 6 | SCS Runoff | 0.011 | 2 | 1220 | 345 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3d |
| 7 | SCS Runoff | 0.147 | 2 | 1224 | 4,538 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 8 | SCS Runoff | 0.009 | 2 | 1224 | 285 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3e |
| 9 | SCS Runoff | 0.038 | 2 | 1224 | 1,169 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 10 | SCS Runoff | 0.006 | 2 | 1224 | 180 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 11 | SCS Runoff | 0.002 | 2 | 1214 | 55 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 12 | SCS Runoff | 0.002 | 2 | 1214 | 56 | ------ | ------ | ------ | Pre-Developed Basin 7 |
| 13 | SCS Runoff | 0.002 | 2 | 1216 | 57 | ------ | ------ | ------ | Pre-Developed Basin 8 |
| 14 | SCS Runoff | 0.002 | 2 | 1214 | 55 | ------ | ------ | ------ | Pre-Developed Basin 9 |
| 15 | SCS Runoff | 0.002 | 2 | 1214 | 54 | ------ | ------ | ------ | Pre-Developed Basin 10 |
| 16 | SCS Runoff | 0.002 | 2 | 1214 | 54 | ------ | ------ | ------ | Pre-Developed Basin 11 |
| 17 | SCS Runoff | 0.002 | 2 | 1214 | 54 | ------ | ------ | ------ | Pre-Developed Basin 12 |
| 18 | SCS Runoff | 0.002 | 2 | 1214 | 55 | ------ | ------ | ------ | Pre-Developed Basin 13 |
| 19 | SCS Runoff | 0.002 | 2 | 1214 | 54 | ------ | ------ | ------ | Pre-Developed Basin 14 |
| 20 | SCS Runoff | 0.006 | 2 | 1220 | 194 | ------ | ------ | ------ | Pre-Developed Basin 17 (Typical Basi |
| 22 | SCS Runoff | 0.050 | 2 | 1054 | 2,155 | ------ | ------ | ------ | Developed Basin 1 |
| 23 | SCS Runoff | 0.178 | 2 | 606 | 1,441 | ------ | ------ | ------ | Developed Basin 2 |
| 24 | SCS Runoff | 0.036 | 2 | 770 | 1,547 | ------ | ------ | ------ | Developed Sub-Basin 3a |
| 25 | SCS Runoff | 0.057 | 2 | 786 | 2,506 | ------ | ------ | ------ | Developed Sub-Basin 3b |
| 26 | SCS Runoff | 0.057 | 2 | 786 | 2,497 | ------ | ------ | ------ | Developed Sub-Basin 3c |
| 27 | SCS Runoff | 0.035 | 2 | 770 | 1,474 | ------ | ------ | ------ | Developed Sub-Basin 3d |
| 28 | SCS Runoff | 0.342 | 2 | 1052 | 14,665 | ------ | ------ | ------ | Developed Basin 3 |
| 29 | SCS Runoff | 0.040 | 2 | 636 | 1,562 | ------ | ------ | ------ | Developed Sub-Basin 3e |
| 30 | SCS Runoff | 0.069 | 2 | 1104 | 2,737 | ------ | ------ | ------ | Developed Basin 4 |
| 31 | SCS Runoff | 0.339 | 2 | 610 | 3,032 | ------ | ------ | ------ | Developed Basin 5 |
| 32 | SCS Runoff | 0.144 | 2 | 600 | 861 | ------ | ------ | ------ | Developed Basin 6 |
| 33 | SCS Runoff | 0.147 | 2 | 600 | 879 | ------ | ------ | ------ | Developed Basin 7 |
| 34 | SCS Runoff | 0.167 | 2 | 602 | 1,038 | ------ | ------ | ------ | Developed Basin 8 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 35 | SCS Runoff | 0.181 | 2 | 600 | 1,007 | ------ | ------ | ------ | Developed Basin 9 |
| 36 | SCS Runoff | 0.141 | 2 | 600 | 844 | ------ | ------ | ------ | Developed Basin 10 |
| 37 | SCS Runoff | 0.159 | 2 | 600 | 913 | ------ | ------ | ------ | Developed Basin 11 |
| 38 | SCS Runoff | 0.159 | 2 | 600 | 913 | ------ | ------ | ------ | Developed Basin 12 |
| 39 | SCS Runoff | 0.071 | 2 | 600 | 422 | ------ | ------ | ------ | Developed Basin 13 |
| 40 | SCS Runoff | 0.064 | 2 | 600 | 551 | ------ | ------ | ------ | Developed Basin 14 |
| 41 | SCS Runoff | 0.013 | 2 | 1074 | 537 | ------ | ------ | ------ | Developed Basin 17 (Typical Basin) |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.107 | 2 | 766 | 4,528 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.015 | 2 | 762 | 628 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.058 | 2 | 762 | 2,457 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3a |
| 4 | SCS Runoff | 0.108 | 2 | 764 | 4,557 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3b |
| 5 | SCS Runoff | 0.108 | 2 | 764 | 4,542 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3c |
| 6 | SCS Runoff | 0.056 | 2 | 762 | 2,342 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3d |
| 7 | SCS Runoff | 0.731 | 2 | 764 | 30,818 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 8 | SCS Runoff | 0.046 | 2 | 766 | 1,936 | ------ | ------ | ------ | Pre-Developed Sub-Basin 3e |
| 9 | SCS Runoff | 0.188 | 2 | 764 | 7,938 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 10 | SCS Runoff | 0.029 | 2 | 766 | 1,221 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 11 | SCS Runoff | 0.009 | 2 | 754 | 375 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 12 | SCS Runoff | 0.009 | 2 | 754 | 383 | ------ | ------ | ------ | Pre-Developed Basin 7 |
| 13 | SCS Runoff | 0.009 | 2 | 758 | 387 | ------ | ------ | ------ | Pre-Developed Basin 8 |
| 14 | SCS Runoff | 0.009 | 2 | 754 | 375 | ------ | ------ | ------ | Pre-Developed Basin 9 |
| 15 | SCS Runoff | 0.009 | 2 | 754 | 367 | ------ | ------ | ------ | Pre-Developed Basin 10 |
| 16 | SCS Runoff | 0.009 | 2 | 754 | 367 | ------ | ------ | ------ | Pre-Developed Basin 11 |
| 17 | SCS Runoff | 0.009 | 2 | 754 | 367 | ------ | ------ | ------ | Pre-Developed Basin 12 |
| 18 | SCS Runoff | 0.009 | 2 | 754 | 375 | ------ | ------ | ------ | Pre-Developed Basin 13 |
| 19 | SCS Runoff | 0.009 | 2 | 754 | 367 | ------ | ------ | ------ | Pre-Developed Basin 14 |
| 20 | SCS Runoff | 0.031 | 2 | 762 | 1,316 | ------ | ------ | ------ | Pre-Developed Basin 17 (Typical Basi |
| 22 | SCS Runoff | 0.413 | 2 | 618 | 8,103 | ------ | ------ | ------ | Developed Basin 1 |
| 23 | SCS Runoff | 0.453 | 2 | 606 | 3,080 | ------ | ------ | ------ | Developed Basin 2 |
| 24 | SCS Runoff | 0.397 | 2 | 608 | 5,172 | ------ | ------ | ------ | Developed Sub-Basin 3a |
| 25 | SCS Runoff | 0.539 | 2 | 612 | 8,860 | ------ | ------ | ------ | Developed Sub-Basin 3b |
| 26 | SCS Runoff | 0.537 | 2 | 612 | 8,829 | ------ | ------ | ------ | Developed Sub-Basin 3c |
| 27 | SCS Runoff | 0.378 | 2 | 608 | 4,930 | ------ | ------ | ------ | Developed Sub-Basin 3d |
| 28 | SCS Runoff | 2.921 | 2 | 614 | 55,153 | ------ | ------ | ------ | Developed Basin 3 |
| 29 | SCS Runoff | 0.381 | 2 | 612 | 4,741 | ------ | ------ | ------ | Developed Sub-Basin 3e |
| 30 | SCS Runoff | 0.462 | 2 | 622 | 11,909 | ------ | ------ | ------ | Developed Basin 4 |
| 31 | SCS Runoff | 0.826 | 2 | 610 | 6,331 | ------ | ------ | ------ | Developed Basin 5 |
| 32 | SCS Runoff | 0.359 | 2 | 598 | 1,841 | ------ | ------ | ------ | Developed Basin 6 |
| 33 | SCS Runoff | 0.366 | 2 | 598 | 1,878 | ------ | ------ | ------ | Developed Basin 7 |
| 34 | SCS Runoff | 0.381 | 2 | 600 | 2,118 | ------ | ------ | ------ | Developed Basin 8 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 35 | SCS Runoff | 0.414 | 2 | 598 | 2,054 | ------ | ------ | ------ | Developed Basin 9 |
| 36 | SCS Runoff | 0.352 | 2 | 598 | 1,803 | ------ | ------ | ------ | Developed Basin 10 |
| 37 | SCS Runoff | 0.378 | 2 | 598 | 1,906 | ------ | ------ | ------ | Developed Basin 11 |
| 38 | SCS Runoff | 0.378 | 2 | 598 | 1,906 | ------ | ------ | ------ | Developed Basin 12 |
| 39 | SCS Runoff | 0.176 | 2 | 598 | 902 | ------ | ------ | ------ | Developed Basin 13 |
| 40 | SCS Runoff | 0.235 | 2 | 600 | 1,345 | ------ | ------ | ------ | Developed Basin 14 |
| 41 | SCS Runoff | 0.105 | 2 | 612 | 2,161 | ------ | ------ | ------ | Developed Basin 17 (Typical Basin) |

**Retention Sizing Calculations**

ESCALANTE WILDERNESS PRESERVE

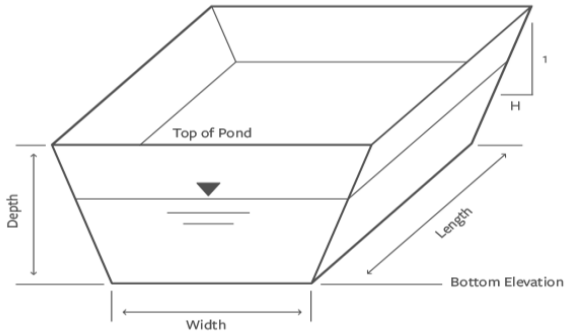
PREPARED BY: 406 Engineering Inc

September 2, 2025

| Structure Design | Pond | Units |
|---|---|---|
| depth (d) | 2 | ft |
| ratio:1 (h) | 5 | - |
| length (l) | 35 | ft |
| width (w) | 117 | ft |
| volume (v) | **11497** | cf |
| *Bottom Dimensions (ft)* | ***35x117*** | ft |
| *Outside Dimensions (ft)* | *45x137* | ft |

$$Volume = (l * w * d) + \left((l + w)h * d^2\right) + \left(\left(\frac{4}{3}\right)h^2 * d^3\right)$$

Trapezoid



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Sep 2 2025

## Swale A

**Triangular**

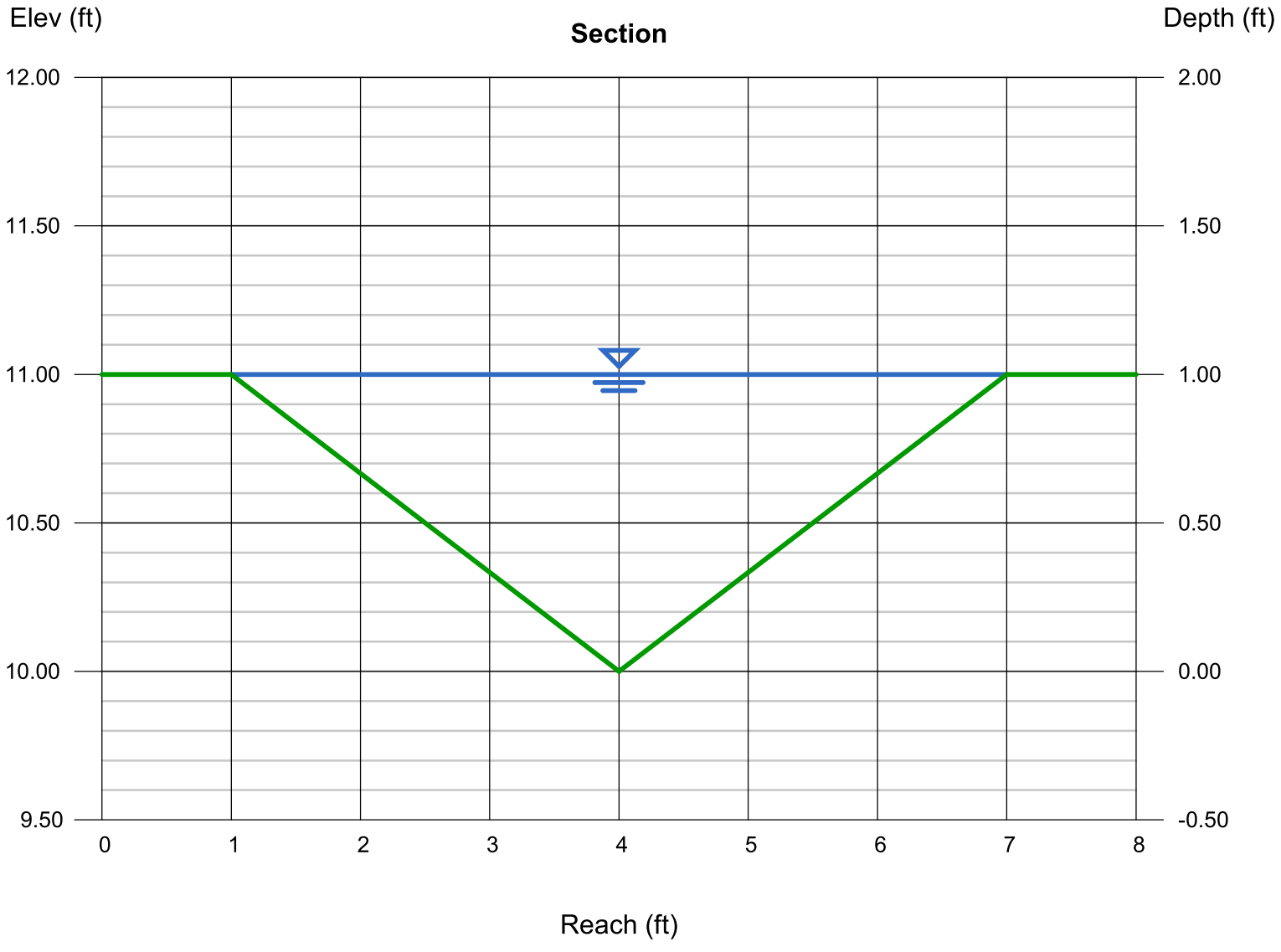
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.015 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.00 |
| Q (cfs) | = 12.78 |
| Area (sqft) | = 3.00 |
| Velocity (ft/s) | = 4.26 |
| Wetted Perim (ft) | = 6.32 |
| Crit Depth, Yc (ft) | = 1.00 |
| Top Width (ft) | = 6.00 |
| EGL (ft) | = 1.28 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Aug 28 2025

## Swable B

**Triangular**

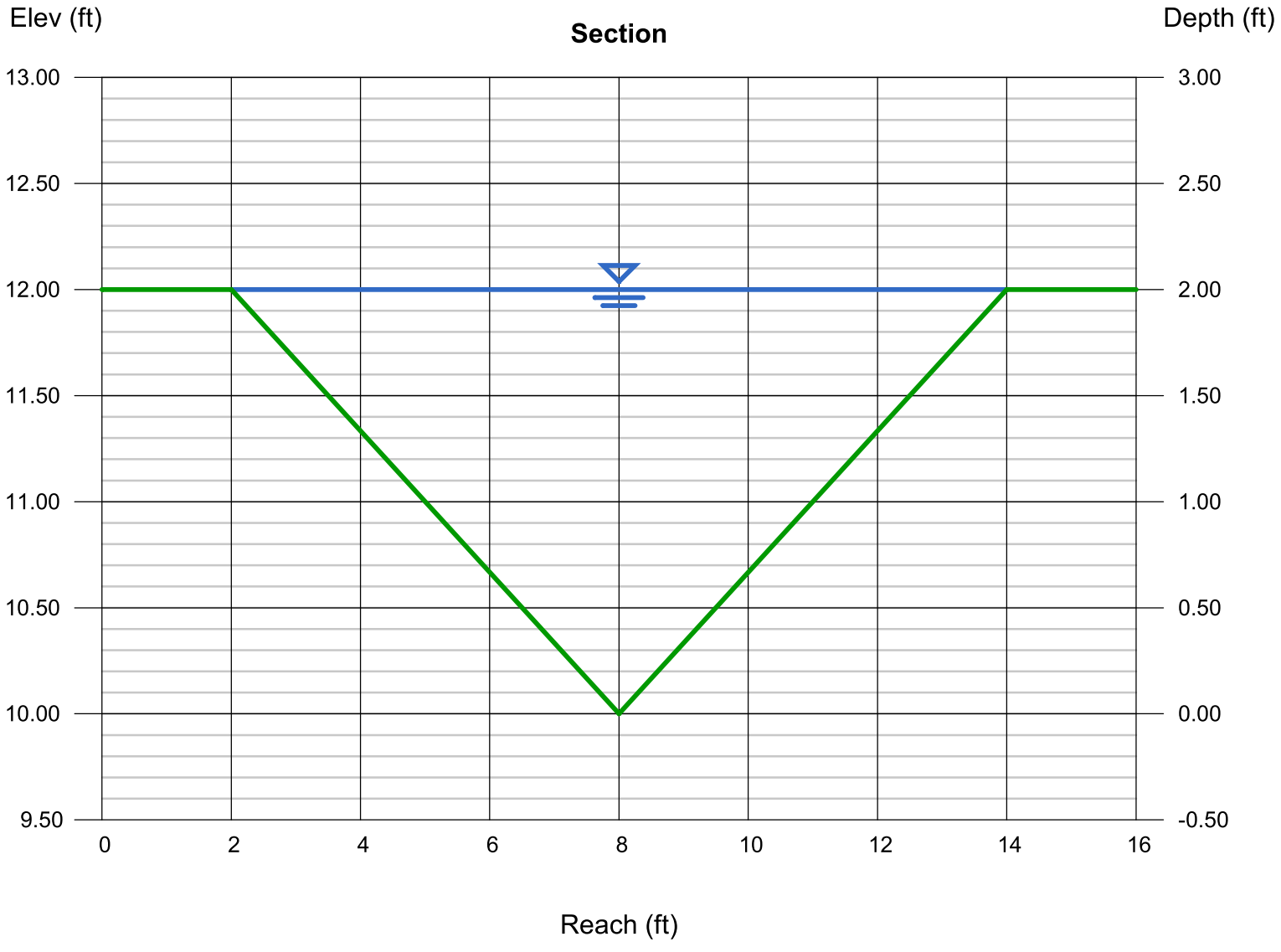
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 2.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 2.00 |
| Q (cfs) | = 8.116 |
| Area (sqft) | = 12.00 |
| Velocity (ft/s) | = 0.68 |
| Wetted Perim (ft) | = 12.65 |
| Crit Depth, Yc (ft) | = 0.86 |
| Top Width (ft) | = 12.00 |
| EGL (ft) | = 2.01 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Aug 28 2025

## Typical Check Dam

**Triangular**

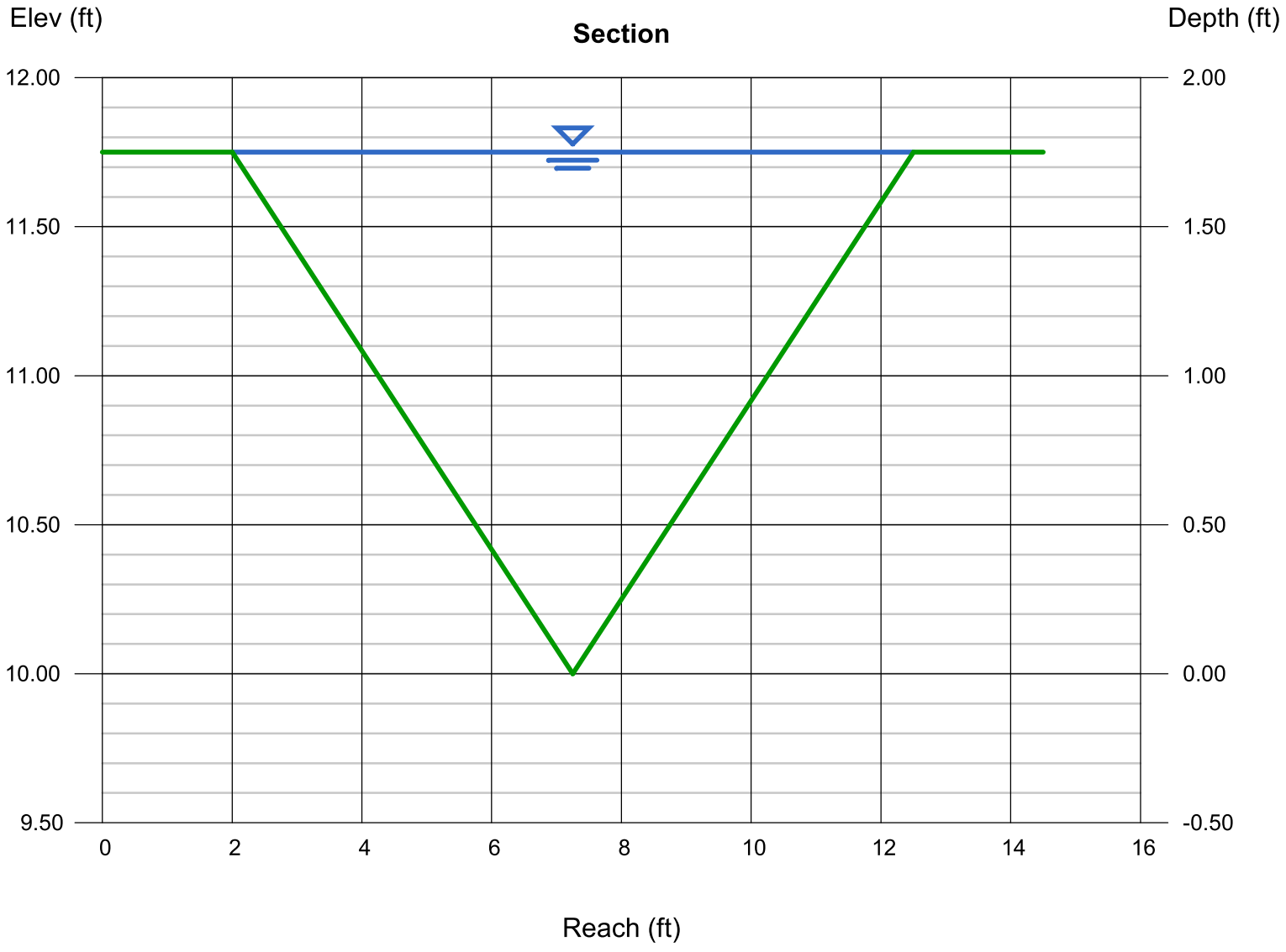
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.75 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.75 |
| Q (cfs) | = 5.684 |
| Area (sqft) | = 9.19 |
| Velocity (ft/s) | = 0.62 |
| Wetted Perim (ft) | = 11.07 |
| Crit Depth, Yc (ft) | = 0.75 |
| Top Width (ft) | = 10.50 |
| EGL (ft) | = 1.76 |



# Culvert Report



## Typical Driveway Culvert

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 10.00 |
| Pipe Length (ft) | = | 24.00 |
| Slope (%) | = | 0.33 |
| Invert Elev Up (ft) | = | 10.08 |
| Rise (in) | = | 12.0 |
| Shape | = | Circular |
| Span (in) | = | 12.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.023 |
| Culvert Type | = | Circular Corrugate Metal Pipe |
| Culvert Entrance | = | Mitered to slope (C) |
| Coeff. K,M,c,Y,k | = | 0.021, 1.33, 0.0463, 0.75, 0.7 |

**Embankment**

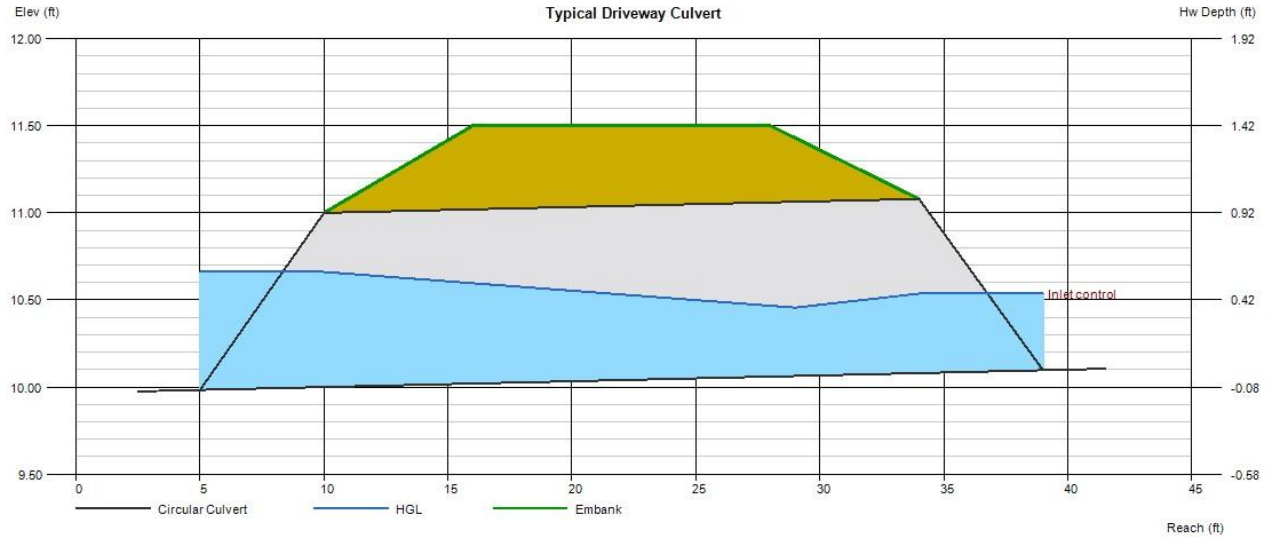
| | | |
|---|---|---|
| Top Elevation (ft) | = | 11.50 |
| Top Width (ft) | = | 12.00 |
| Crest Width (ft) | = | 6.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 0.00 |
| Qmax (cfs) | = | 0.60 |
| Tailwater Elev (ft) | = | (dc+D)/2 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 0.60 |
| Qpipe (cfs) | = | 0.60 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 1.09 |
| Veloc Up (ft/s) | = | 2.75 |
| HGL Dn (ft) | = | 10.66 |
| HGL Up (ft) | = | 10.40 |
| Hw Elev (ft) | = | 10.54 |
| Hw/D (ft) | = | 0.46 |
| Flow Regime | = | Inlet Control |



# STORM DRAINAGE REPORT

PREPARED IN ACCORDANCE WITH
MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ) CIRCULAR 8

**Phase 12- Wilderness Escalante Preserve**

On property located at Sophie Lake Road
legally described as COS 4389
in S28, 29, 32 & 33, T37N, R27W, PMM, Lincoln County.
Published: January 7, 2026

**Prepared For:**
Escalante Wilderness
Preserve US LP
PO Box 2092
Eureka, MT 59917

**Prepared By:**
406 Engineering, Inc.
35 8th Street East
Kalispell, MT 59901

## 1.0 GENERAL

Escalante Wilderness Preserve US LP owns the 8.62-acre property referenced above. The owners intend to develop Phase 12 of the project which includes the development of 38 residential lots and a road extension. The new development will include a road extension, 38 single-family homes, landscaping, and undeveloped natural land. The remaining portions of the property are to remain undeveloped.

This report aims to outline the current hydrological conditions of this site compared to the hydrological conditions that will exist after the proposed development. This report is prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The organization of the report follows the outlined requirements of DEQ-8. The report identifies storm water management with routing and storage requirements based on the analysis of the pre-development and post-development conditions.

This report and any attachments shall be submitted to the DEQ or to a delegated division of local government for review and approval. The report and attachments demonstrate that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owner. This report qualifies as a “Standard Plan” per DEQ-8.

## 2.0 SITE INFORMATION

GEOTECHNICAL INFORMATION:

Hydrologic soil groups are based on the estimates of runoff potential. The proposed development consists of hydrologic soil group A soils. Group A soils have high infiltration rates and low runoff potential, even when thoroughly wet. These deep, well-drained sands and gravels have high transmission rates. Refer to the appendices for the NRCS Hydrologic Soil Group map.

PRE-DEVELOPED CONDITIONS:

For this report, the predeveloped conditions of the site are assumed to be undeveloped. The existing project site is 8.62 acres, with ground cover consisting of open space in good condition. The property slopes north towards Grob Lake.

POST-DEVELOPED CONDITIONS:

The developed conditions of the 8.62-acre property will include the development of a road extension and 36 single-family homes. The remaining portions of the property will remain undeveloped. The development will result in a minor increase in impervious surfaces but will not change the overall drainage pattern or discharge point. Retention structures are proposed to manage the increased runoff from the development.

## 3.0 DRAINAGE DESIGN CRITERIA AND METHODS USED

The SCS method was used to estimate the storm runoff and volume for the property. Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2023 was used to analyze basin runoff. The runoff volume and peak flows for the 2, 10, and 100-year 24-hour storm events were analyzed for pre-developed and post-developed basins.

Primary inputs for the SCS methods are as follows:

- Basin Area: A basin is generally defined as an area that drains to a single point.
- Curve Number: A composite curve number (CN) for a basin is determined based on the hydrologic soil group, ground cover type, treatment, and hydraulic conditions. NRCS TR-55 Runoff CN tables are used to select the appropriate number.
- Time of Concentration: The time of concentration is the theoretical time it takes for runoff to travel to a point of interest from the hydraulically most distant point. Calculating a time of concentration involves summing flow times for runoff as sheet flow, shallow concentrated flow, and channel flow if applicable.
- Manning's Number: A n-value is designated for each surface type, providing an effective roughness coefficient for the water path selected to calculate the time of concentration. Standard tables and figures provided by *Technical Release 55 – Urban Hydrology for Small Watersheds* (TR-55) were used to select the appropriate number.
- Design Storm Depth: The SCS Method uses 24-hour storm depths developed by the National Oceanic and Atmospheric Administration (NOAA), with a selected design recurrence interval, such as 2, 10, or 100 years.
- Storm Distribution: To evaluate the peak flows, selecting a design storm hydrograph or rainfall time distribution pattern is necessary. A Type I storm distribution was utilized for sizing control facilities.

The selection of the curve number enables the SCS method to model the soil capacity and land cover to capture and infiltrate rainfall. The model is highly non-linear, meaning a relatively small percent increase in rainfall can lead to larger increases in runoff. This occurs because as the infiltrative capacity of the soil is used up, a higher percentage of precipitation will run off.

Both the TR-55 Manual and DEQ-8 have been used as reference for the SCS method in this report. The SCS method uses 24-hour storm depths developed by the NOAA with a selected design recurrence interval, such as 2, 10, 50, or 100-year storms. The precipitation data used in this report were obtained from NOAA Atlas 14, Volume 12, Version 2 and can be seen below in Table 1.

Table 1: NOAA Precipitation Depths

| Recurrence Interval | 2-year | 10-year | 100-year |
|---|---|---|---|
| 24-hour Precipitation Depth (in) | 1.24 | 1.74 | 2.55 |

This report is proposed as a Standard Plan per DEQ 8 and therefore must address storm water drainage peak flow and volume. Standard Plans must also demonstrate that the proposed development will not allow storm water to do any of the following:

- Exceed the pre-development runoff to an adjoining property during the 2-year storm event;
- Overtop roadways or driveways during a 10-year storm event; or
- Inundate any buildings or drainfields during a 100-year storm event. This may be demonstrated through either narrative descriptions or calculations.

**4.0 DELINEATION OF DRAINAGE BASINS**

For this report section, the property is considered to have nine drainage basins representing flow from the proposed home and driveway development as well as the proposed asphalt roads. One typical basin represents lots that slope away from the proposed roadside stormwater facilities. The proposed property boundaries, the proposed development, and the topography across the site defined the drainage study extent. Although the proposed development will alter the localized drainage pattern, the overall drainage pattern will remain the same. Therefore, the pre-development and post-development drainage basins will remain the same size and shape.

PRE-DEVELOPED ON-SITE DRAINAGE BASINS:

For the pre-developed drainage basins, storm water moves as sheet flow with slopes ranging between 0%-15%. The basins are considered vacant, undeveloped land with no existing structures or impervious areas. No significant storm water runoff concerns are known to exist on the property. The curve numbers (CN) for the pre-developed site is based on the ground cover conditions of the existing open space in good condition for the soil group A (CN 39). Refer to the appendices for the TR-55 Runoff curve number tables and the TR-55 time of concentration calculations. Table 2 provides a summary of the pre-developed time of concentrations and curve numbers.

Table 2: Pre-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 0.14 | 39 | 29.3 |
| Basin 2 | 1.72 | 39 | 12.3 |
| Basin 3 | 0.64 | 39 | 11.1 |
| Basin 4 | 2.25 | 39 | 18.6 |
| Basin 5 | 0.19 | 39 | 29.4 |
| Basin 6 | 0.61 | 39 | 17.6 |
| Basin 7 | 0.16 | 39 | 5 |
| Basin 8 | 0.36 | 39 | 22.1 |
| Basin 9 "Typical Basin" | 0.10 | 39 | 5.9 |

POST-DEVELOPED ON-SITE DRAINAGE BASINS:

As mentioned above, the post-development drainage basins will remain the same size and shape as the pre-development drainage basins. The post-development conditions for the basins include the proposed development of the land including the homes, proposed asphalt drives, and open space in good condition. The composite CN is calculated land cover of open space in good condition for soil groups A (CN 39), rooftops (98), and asphalt for soil group A (98). Table 3 provides a summary of the post-developed time of concentrations and curve numbers.

Table 3: Post-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 0.14 | 64 | 29.3 |
| Basin 2 | 1.72 | 59 | 12.3 |
| Basin 3 | 0.64 | 56 | 11.1 |
| Basin 4 | 2.25 | 53 | 18.6 |
| Basin 5 | 0.19 | 39 | 29.4 |
| Basin 6 | 0.61 | 39 | 17.6 |
| Basin 7 | 0.16 | 39 | 5 |
| Basin 8 | 0.36 | 65 | 22.1 |
| Basin 9 "Typical Basin" | 0.10 | 66 | 5.9 |

OFF-SITE BASINS:

The property is surrounded by land with similar ground cover. No off-site flows contribute to flows onto the property. All off-site flows are negligible and have not been considered in this drainage analysis.

## 5.0 RUNOFF VOLUMES AND FLOWS

Utilizing the procedures outlined in DEQ 8, runoff volumes and peak flows for the 2-year, 10-year, and 100-year 24-hour storm events were evaluated for the pre- and post-developed drainage basins. Refer to the attached calculations for the pre-developed and post-developed peak flows and runoff volumes.

Table 4: Post-Developed Peak Flows, Runoff Volumes and Initial Storm Water Facility Volume

| Basin ID | Post-Dev. 2-year | | Post-Dev. 10-year | | Post-Dev. 100-year | |
|---|---|---|---|---|---|---|
| | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) |
| Basin 1 | 0.0 | 1.2 | 0.001 | 30.8 | 0.005 | 146 |
| Basin 2 | 0.0 | 0.0 | 0.004 | 108 | 0.024 | 1069 |
| Basin 3 | 0.0 | 0.0 | 0.001 | 9.54 | 0.007 | 292 |
| Basin 4 | 0.0 | 0.0 | 0 | 0 | 0.015 | 511 |
| Basin 5 | 0.0 | 3.3 | 0.001 | 50.1 | 0.008 | 218 |
| Basin 6 | 0.0 | 18.2 | 0.005 | 190 | 0.037 | 766 |
| Basin 7 | 0.0 | 17.1 | 0.002 | 82.1 | 0.037 | 261 |
| Basin 8 | 0.0 | 16.7 | 0.003 | 133 | 0.027 | 502 |
| Basin 9 "Typical Basin" | 0.0 | 0.0 | 0 | 0.052 | 0.001 | 26 |

## 6.0 PROVISIONS TO MITIGATE ON-SITE STORM WATER FLOWS

INITIAL STORM WATER FACILITY

Utilizing the procedures identified in DEQ-8, the initial storm water facilities have been sized to infiltrate, evapotranspire, and/or capture the post-development runoff generated from the first 0.5 inches of rainfall on the impervious areas. The required volume of the initial storm water facilities have been included in the design of the proposed retention facility. Refer to Table 4 for the initial storm water facility volume for the drainage basins.

CONVEYANCE FACILITIES

Utilizing the procedures outlined within DEQ-8, conveyance facilities have been provided for numerous basins. Conveyance swales, check dams, and culvert have been proposed throughout the site and have been sized to convey the 10-year post developed peak flows ensuring storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event. Refer to Table 5 and the attached calculations for more detail.

Table 5: Drainage Basin Conveyance

| | | Swales | | Swales and Check Dams | | | Culverts | |
|---|---|---|---|---|---|---|---|---|
| **Basin ID** | **10-year peak flow (cfs)** | **Swale ID** | **Maximum Conveyance (cfs)** | **Retention Structure ID** | **Maximum Conveyance Through Swale (cfs)** | **Maximum Conveyance Over Check Dam (cfs)** | **Culvert ID** | **Max Conveyance (cfs)** |
| Basin 1 | 0.001 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Basin 2 | 0.004 | A | 12.78 | B | 8.11 | 5.68 | 1 | 2 |
| Basin 3 | 0.001 | A | 12.78 | B | 8.11 | 5.68 | 1 | 2 |
| Basin 4 | 0.000 | A | 12.78 | C | 3.76 | 2.317 | 1 | 2 |
| Basin 5 | 0.001 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Basin 6 | 0.005 | A | 12.78 | C | 3.76 | 2.317 | 1 | 2 |
| Basin 7 | 0.002 | A | 12.78 | N/A | N/A | N/A | 1 | 2 |
| Basin 8 | 0.003 | A | 12.78 | C | 3.76 | 2.317 | 1 | 2 |
| Basin 9 | 0.000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

**Swale A**

- Side slope: 3:1
- Depth: 1 ft
- Cross-Sectional Area: 3 sf
- Capacity: 12.78 cfs

**Driveway Culvert**

- Diameter: 12”
- Length: 14’
- Capacity: 2.0 cfs
- Material: CMP

RETENTION AND DETENTION FACILITIES

Utilizing the procedures outlined in DEQ-8, the required and provided retention facilities for each basin can be seen in Table 6. With the existing topography on the property where storm water naturally sheets, the storm water will collect in the proposed retention facilities. Check dams are proposed to collect stormwater in the roadside retention swales, and vary in storage volume. The proposed retention facilities have been sized to retain the post-developed 10-year runoff volume and the initial storm water facility volume. Refer to Table 6 and to the attached calculations for more detail.

Table 6: Drainage Basin Storage Volumes

| Basin ID | Design Storm Event | Design Volume (cf) | Proposed Retention Structure | Proposed Retention Structure Volume (cf) |
|---|---|---|---|---|
| Basin 1 | 100-year and ISWFV | 109 | Sump | 165 |
| Basin 2 | 10-year and ISWFV | 1008 | Structure B with 11 Check Dams | 1010 |
| Basin 3 | 100-year and ISWFV | 329 | 2 Sumps | 330 |
| Basin 4 | 100-year and ISWFV | 932 | Structure C with 12 Check Dams & 3 Sumps | 956.25 |
| Basin 5 | 10-year and ISWFV | 149 | 1 Sump | 165 |
| Basin 6 | 10-year and ISWFV | 502 | Structure C with 3 Check Dams & 2 Sumps | 536.25 |
| Basin 7 | 10-year and ISWFV | 145 | 1 Sump | 165 |
| Basin 8 | 10-year and ISWFV | 309 | Structure C with 2 Check Dams | 356.25 |
| Basin 9 | 100-year and ISWFV | 44 | 1 Sump | 165 |

**Retention Structure B**

- Swale Side slope: 3:1
- Swale Depth: 2 ft
- Check Dam Depth: 1.75 ft
- Minimum Space Between Check Dams: Varies per Basin
- Total Storage Per Check Dam: Varies per Basin

**Retention Structure C**

- Swale Side slope: 3:1
- Swale Depth: 1.5 ft
- Check Dam Depth: 1.25 ft
- Minimum Space Between Check Dams: Varies Per Basin
- Total Storage Per Check Dam: Varies per Basin

DRAINAGE BASIN 1

Drainage Basin 1 represents runoff from the area of development. This parcel generally slopes to the southwest. Runoff from this basin will be conveyed in conveyance swale A to a sump and is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event

DRAINAGE BASIN 2

Drainage Basin 2 represents runoff from the area of development including lots 24-35 and the roadway sloping from the normal crown. This parcel generally slopes to the northwest. Runoff from this basin will be stored in the proposed retention swale B utilizing 11 check dams and is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 3

Drainage Basin 3 represents runoff from the area of development including lots 36-38 and the roadway sloping from the normal crown. This basin slopes to the north and to the south where the stormwater will be conveyed to a low point. Runoff from this basin will be conveyed in conveyance swale A to two sumps and is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 4

Drainage Basin 4 represents runoff from the area of development including lots 15-23 and the roadway sloping from the normal crown. This basin slopes to the north where the stormwater will be conveyed to a low point. Runoff from this basin will be stored in the proposed retention swale C utilizing 12 check dams and 3 sumps, and is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 5

Drainage Basin 5 represents runoff from the area of development. This parcel generally slopes to the southwest. Runoff from this basin will be conveyed in conveyance swale A to a sump and is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 6

Drainage Basin 6 represents runoff from the area of development including the driveways from lots 1-3, lots 6-14 and the roadway sloping from the normal crown. This basin generally slopes to the north-west and south. Runoff from this basin will be stored in the proposed retention swale C utilizing 3 check dams and 2 sumps and is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 7

Drainage Basin 7 represents runoff from the area of development including the driveways from lot 4 and lot 5. This basin generally slopes to the southwest. Runoff from this basin will be stored in a sump and is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 8

Drainage Basin 8 represents runoff from the area of development including the roadway sloping from the normal crown. This basin generally slopes to the north and south. Runoff from this basin will be stored in the proposed retention swale C utilizing 2 check dams and is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

DRAINAGE BASIN 9-TYPICAL BASIN

Drainage Basin 9 represents runoff from the development of lot 3. This basin generally slopes to the southwest. This basin will be considered typical for each lot that slopes away from stormwater facilities. Runoff from a typical basin will sheet flow from a vegetative filter strip and will be stored in a sump that is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

INFILTRATION FACILITIES

Infiltration sumps are proposed to be installed throughout the development. These will capture any runoff not retained in check dams. Not taking into consideration infiltration, each sump is capable of storing 165 cubic feet of runoff volume. Lots 1-14 will require sumps to be installed after development. Pre-treatment facilities must be provided for infiltration facilities. Vegetative filter strips and vegetated swales will be used to satisfy the pre-treatment requirement. Refer to attachments for more detail on sump locations and storage calculations.

PRE-TREATMENT FACILITIES

The rural nature of the site will provide superb pretreatment of any storm water before leaving the site.

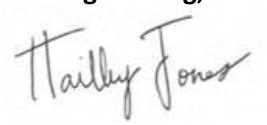
## 7.0 OPERATION AND MAINTENANCE

The operation and maintenance of the storm water management infrastructure are essential to the longevity of the storm water treatment. The lot layout includes an Operation and Maintenance Plan.

## 8.0 CONCLUSIONS

This report was prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The development of the 8.62-acre property will include a road extension, 38 single-family homes, landscaping, and undeveloped natural land, which will increase the impervious area and therefore increase both runoff rates and volume. The proposed retention structures have been sized to collect storm water and ensure that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owners. The plan was developed to ensure that storm water does not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

Prepared by:
**406 Engineering, Inc.**

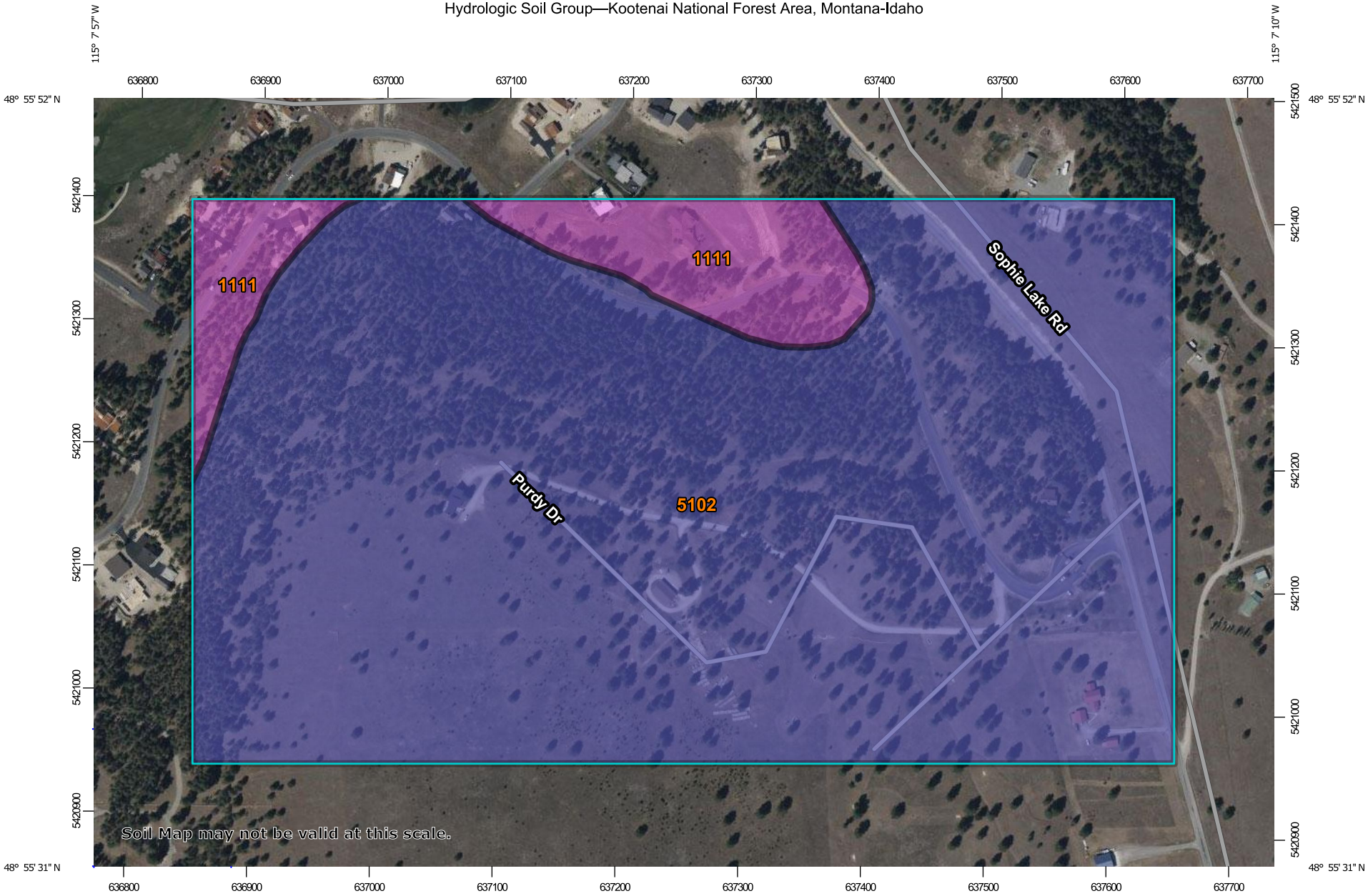


Hailley Jones, Staff Engineer

**ATTACHMENTS**

- ✓ *NRCS Hydrologic Soil Group (4 pages)*
- ✓ *NOAA Precipitation Data (4 pages)*
- ✓ *TR-55 Curve Number Values (2 pages)*
- ✓ *Composite Curve Number Calculations (1 page)*
- ✓ *Hydraflow Time of Concentration and Runoff Calculations (21 pages)*
- ✓ *Stormwater Facilities Sizing (7 pages)*

*https://406engineeringinc.sharepoint.com/Shared Documents/406 Work/1_Projects/2021 Projects/21-007K Escalante Wilderness Preserve/3_DESIGN&PERMITTING/5.Appendix E - Drainage Report/rpt.2025-09-02.CLIENT.DEQ 8.docx*
*Wednesday, January 7, 2026, 8:53 AM*




Map Scale: 1:4,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A
A/D
B
B/D
C
C/D
D
Not rated or not available

**Soil Rating Lines**

A
A/D
B
B/D
C
C/D
D
Not rated or not available

**Soil Rating Points**

A
A/D
B
B/D
C
C/D
D
Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Kootenai National Forest Area, Montana-Idaho
Survey Area Data: Version 24, Sep 16, 2024

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

Date(s) aerial images were photographed: Jul 14, 2023—Aug 13, 2023

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.

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1111 | Canusa-Felt family complex, 0 to 15 percent slopes | A | 8.8 | 9.7% |
| 5102 | Niarada-Niarada, greater slopes-Roosville complex, 2 to 30 percent slopes | B | 82.2 | 90.3% |
| **Totals for Area of Interest** | | | **91.0** | **100.0%** |

## Description

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.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

**NOAA Atlas 14, Volume 12, Version 2**
**Location name: Eureka, Montana, USA***
**Latitude: 48.9386°, Longitude: -115.1253°**
**Elevation: 2656 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Carl Trypaluk, Dale Unruh, Michael St.Laurent, Austin Jordan, Rama Sesha Sridhar Mantripragada, Sandra Pavlovic, Greg Fall, Fernando Salas

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.139** (0.122-0.157) | **0.182** (0.161-0.209) | **0.251** (0.219-0.292) | **0.307** (0.263-0.362) | **0.380** (0.314-0.458) | **0.435** (0.346-0.533) | **0.488** (0.370-0.613) | **0.539** (0.389-0.703) | **0.605** (0.409-0.837) | **0.652** (0.429-0.947) |
| 10-min | **0.192** (0.170-0.218) | **0.253** (0.224-0.289) | **0.348** (0.303-0.405) | **0.425** (0.364-0.502) | **0.527** (0.435-0.636) | **0.603** (0.480-0.739) | **0.677** (0.514-0.850) | **0.748** (0.540-0.976) | **0.839** (0.568-1.16) | **0.904** (0.596-1.31) |
| 15-min | **0.223** (0.197-0.253) | **0.294** (0.260-0.336) | **0.405** (0.353-0.471) | **0.494** (0.423-0.583) | **0.613** (0.506-0.739) | **0.701** (0.558-0.859) | **0.786** (0.597-0.987) | **0.869** (0.627-1.13) | **0.974** (0.660-1.35) | **1.05** (0.692-1.53) |
| 30-min | **0.272** (0.241-0.309) | **0.358** (0.317-0.410) | **0.494** (0.430-0.574) | **0.602** (0.516-0.711) | **0.747** (0.616-0.901) | **0.854** (0.680-1.05) | **0.958** (0.728-1.20) | **1.06** (0.764-1.38) | **1.19** (0.804-1.64) | **1.28** (0.843-1.86) |
| 60-min | **0.326** (0.288-0.369) | **0.427** (0.378-0.489) | **0.588** (0.512-0.684) | **0.717** (0.614-0.846) | **0.888** (0.733-1.07) | **1.02** (0.809-1.24) | **1.14** (0.865-1.43) | **1.26** (0.909-1.64) | **1.41** (0.956-1.96) | **1.52** (1.00-2.21) |
| 2-hr | **0.419** (0.377-0.469) | **0.527** (0.473-0.596) | **0.698** (0.617-0.802) | **0.837** (0.727-0.974) | **1.02** (0.860-1.22) | **1.16** (0.947-1.41) | **1.30** (1.02-1.61) | **1.43** (1.07-1.85) | **1.60** (1.13-2.20) | **1.73** (1.19-2.50) |
| 3-hr | **0.492** (0.448-0.546) | **0.600** (0.544-0.672) | **0.773** (0.690-0.879) | **0.914** (0.803-1.05) | **1.10** (0.942-1.30) | **1.25** (1.04-1.50) | **1.39** (1.11-1.71) | **1.54** (1.18-1.97) | **1.72** (1.25-2.34) | **1.85** (1.32-2.66) |
| 6-hr | **0.642** (0.589-0.704) | **0.753** (0.689-0.831) | **0.935** (0.843-1.04) | **1.08** (0.965-1.22) | **1.29** (1.12-1.48) | **1.45** (1.23-1.70) | **1.61** (1.33-1.94) | **1.77** (1.42-2.23) | **1.98** (1.52-2.65) | **2.14** (1.60-3.02) |
| 12-hr | **0.846** (0.776-0.925) | **0.978** (0.895-1.08) | **1.20** (1.08-1.32) | **1.38** (1.23-1.54) | **1.63** (1.43-1.84) | **1.82** (1.58-2.10) | **2.02** (1.71-2.39) | **2.22** (1.84-2.73) | **2.48** (2.00-3.24) | **2.69** (2.11-3.68) |
| 24-hr | **1.08** (0.990-1.19) | **1.24** (1.14-1.37) | **1.52** (1.37-1.68) | **1.74** (1.56-1.94) | **2.06** (1.82-2.31) | **2.30** (2.01-2.62) | **2.55** (2.19-2.97) | **2.80** (2.36-3.39) | **3.14** (2.58-4.02) | **3.39** (2.74-4.56) |
| 2-day | **1.30** (1.18-1.42) | **1.49** (1.36-1.64) | **1.82** (1.64-2.02) | **2.09** (1.87-2.33) | **2.47** (2.18-2.79) | **2.76** (2.40-3.16) | **3.05** (2.62-3.58) | **3.35** (2.83-4.07) | **3.75** (3.09-4.82) | **4.06** (3.28-5.46) |
| 3-day | **1.43** (1.31-1.57) | **1.65** (1.51-1.82) | **2.01** (1.82-2.24) | **2.31** (2.07-2.59) | **2.73** (2.40-3.10) | **3.05** (2.65-3.51) | **3.38** (2.88-3.97) | **3.71** (3.11-4.52) | **4.14** (3.41-5.35) | **4.48** (3.62-6.06) |
| 4-day | **1.55** (1.41-1.70) | **1.78** (1.62-1.97) | **2.17** (1.96-2.41) | **2.50** (2.23-2.79) | **2.94** (2.58-3.34) | **3.29** (2.85-3.79) | **3.63** (3.10-4.28) | **3.98** (3.34-4.87) | **4.45** (3.66-5.76) | **4.81** (3.89-6.51) |
| 7-day | **1.83** (1.67-2.02) | **2.10** (1.91-2.32) | **2.55** (2.29-2.83) | **2.92** (2.60-3.27) | **3.43** (3.00-3.90) | **3.82** (3.30-4.41) | **4.21** (3.59-4.98) | **4.62** (3.87-5.64) | **5.15** (4.23-6.65) | **5.55** (4.49-7.50) |
| 10-day | **2.07** (1.89-2.28) | **2.37** (2.16-2.62) | **2.86** (2.57-3.18) | **3.27** (2.91-3.66) | **3.83** (3.35-4.35) | **4.26** (3.68-4.91) | **4.69** (4.00-5.54) | **5.12** (4.30-6.26) | **5.70** (4.69-7.36) | **6.14** (4.97-8.27) |
| 20-day | **2.77** (2.53-3.06) | **3.16** (2.87-3.49) | **3.77** (3.39-4.21) | **4.28** (3.81-4.81) | **4.97** (4.36-5.67) | **5.49** (4.77-6.36) | **6.01** (5.15-7.12) | **6.52** (5.52-8.00) | **7.20** (5.98-9.32) | **7.70** (6.30-10.4) |
| 30-day | **3.34** (3.05-3.69) | **3.78** (3.43-4.19) | **4.50** (4.03-5.01) | **5.07** (4.51-5.69) | **5.84** (5.13-6.66) | **6.41** (5.58-7.43) | **6.97** (6.00-8.27) | **7.52** (6.40-9.23) | **8.23** (6.89-10.6) | **8.74** (7.24-11.8) |
| 45-day | **4.12** (3.75-4.55) | **4.63** (4.19-5.12) | **5.44** (4.87-6.04) | **6.08** (5.40-6.80) | **6.92** (6.08-7.86) | **7.53** (6.57-8.70) | **8.11** (7.01-9.58) | **8.66** (7.42-10.6) | **9.34** (7.92-12.0) | **9.82** (8.32-13.2) |
| 60-day | **4.79** (4.36-5.30) | **5.36** (4.85-5.93) | **6.24** (5.58-6.93) | **6.93** (6.15-7.74) | **7.81** (6.88-8.86) | **8.44** (7.38-9.73) | **9.02** (7.83-10.6) | **9.56** (8.24-11.6) | **10.2** (8.74-13.1) | **10.6** (9.17-14.2) |

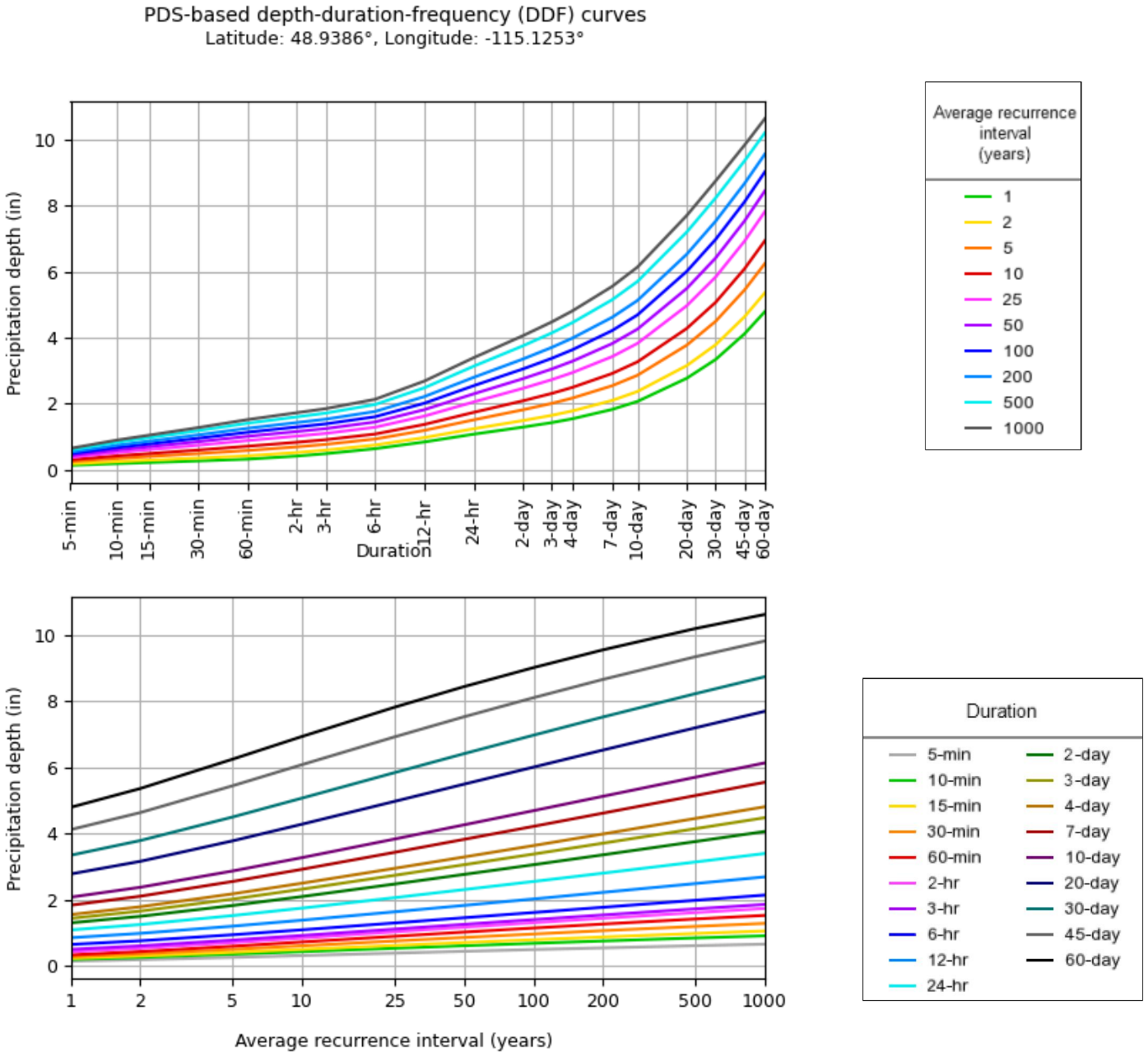
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical



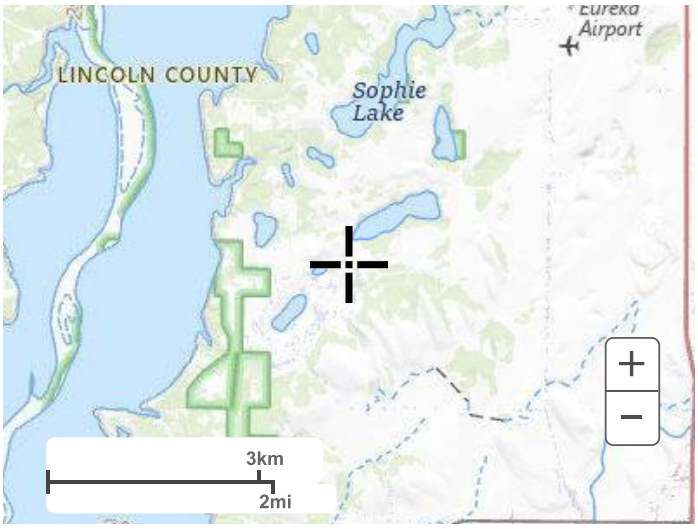

NOAA Atlas 14, Volume 12, Version 2

Created (GMT): Fri Aug 1 16:57:16 2025

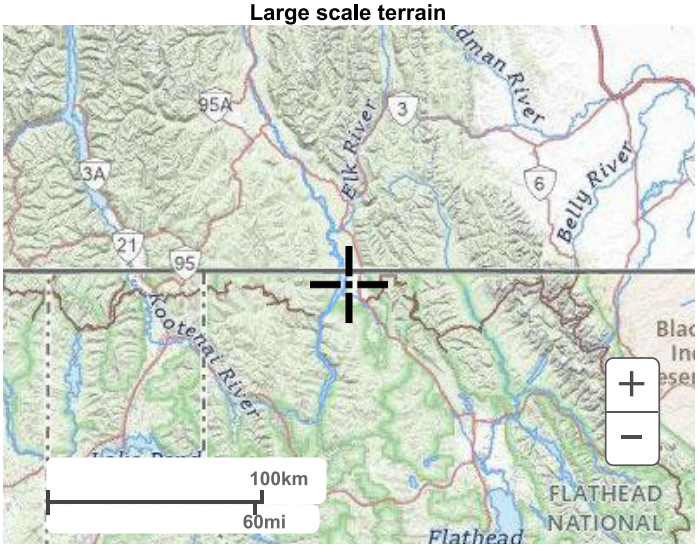
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## Maps & aerials

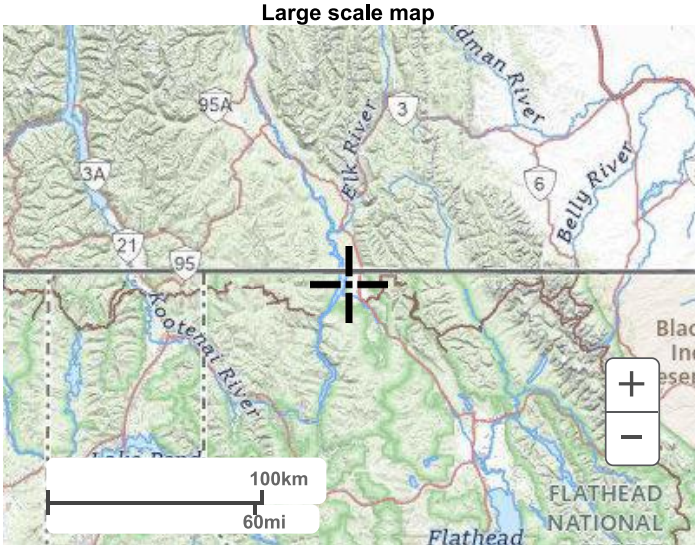
**Small scale terrain**



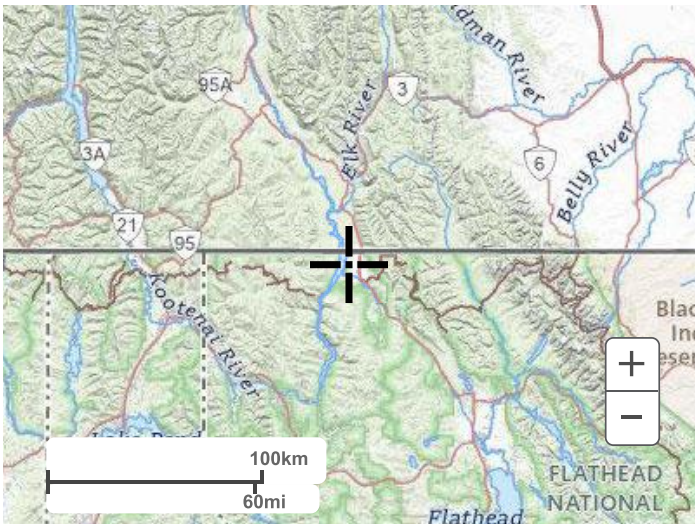

Large scale terrain




Large scale map




Large scale aerial




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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table 2-2a Runoff curve numbers for urban areas [1/]

| Cover description: Cover type and hydrologic condition | Average percent impervious area [2/] | Curve numbers for hydrologic soil group: A | B | C | D |
|---|---|---|---|---|---|
| ***Fully developed urban areas (vegetation established)*** | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only) [4/] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| ***Developing urban areas*** | | | | | |
| Newly graded areas (pervious areas only, no vegetation) [5/] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

| Cover description | | Curve numbers for hydrologic soil group | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic condition | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing. [2/] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element. [3/] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | 30 [4/] | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm). [5/] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods. [6/] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 30 [4/] | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

1 Average runoff condition, and $I_a = 0.2S$.

2 ***Poor:*** <50%) ground cover or heavily grazed with no mulch.
***Fair:*** 50 to 75% ground cover and not heavily grazed.
***Good:*** > 75% ground cover and lightly or only occasionally grazed.

3 ***Poor:*** <50% ground cover.
***Fair:*** 50 to 75% ground cover.
***Good:*** >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 ***Poor:*** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
***Fair:*** Woods are grazed but not burned, and some forest litter covers the soil.
***Good:*** Woods are protected from grazing, and litter and brush adequately cover the soil.

**Post-Developed Composite Curve Number & Initial Storm Water Facility Volume**
**PROJECT: ESCALANTE WILDERNESS PRESERVE-PHASE 12**
**PREPARED BY: 406 Engineering Inc**
September 24, 2025

| Basin ID | Total Area | | Open Space-Good Condition | | Asphalt | | Roof | | Composite CN | Total Impervious Area (SF) | Initial Storm Water Facility Volume (CF) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Acres) | (SF) | Area (SF) | CN | Area (SF) | CN | Area (SF) | CN | | | |
| Basin 1 | 0.14 | 6265 | 3652 | 39 | 2613 | 98 | 0 | 98 | **64** | 2613 | 109 |
| Basin 2 | 1.72 | 75054 | 50853 | 39 | 13989 | 98 | 10212 | 98 | **59** | 24201 | 1008 |
| Basin 3 | 0.64 | 27907 | 20021 | 39 | 5333 | 98 | 2553 | 98 | **56** | 7886 | 329 |
| Basin 4 | 2.25 | 97887 | 75524 | 39 | 14704 | 98 | 7659 | 98 | **53** | 22363 | 932 |
| Basin 5 | 0.19 | 8351 | 4780 | 39 | 3571 | 98 | 0 | 98 | **65** | 3571 | 149 |
| Basin 6 | 0.61 | 26500 | 14441 | 39 | 12059 | 98 | 0 | 98 | **66** | 12059 | 502 |
| Basin 7 | 0.16 | 6855 | 3369 | 39 | 3486 | 98 | 0 | 98 | **70** | 3486 | 145 |
| Basin 8 | 0.3601 | 15684 | 8280 | 39 | 7404 | 98 | 0 | 98 | **67** | 7404 | 309 |
| Basin 9 "Typical Basin" | 0.0958 | 4175 | 3123 | 39 | 201 | 98 | 851 | 98 | **54** | 1052 | 44 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 7 |
| 8 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 8 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 9-Typical Basin |
| 11 | SCS Runoff | 0.000 | 2 | 1440 | 1 | ------ | ------ | ------ | Developed Basin 1 |
| 12 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 2 |
| 13 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 3 |
| 14 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 4 |
| 15 | SCS Runoff | 0.000 | 2 | 1388 | 3 | ------ | ------ | ------ | Developed Basin 5 |
| 16 | SCS Runoff | 0.001 | 2 | 1332 | 18 | ------ | ------ | ------ | Developed Basin 6 |
| 17 | SCS Runoff | 0.000 | 2 | 1164 | 17 | ------ | ------ | ------ | Developed Basin 7 |
| 18 | SCS Runoff | 0.001 | 2 | 1290 | 17 | ------ | ------ | ------ | Developed Basin 8 |
| 19 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 9-Typical Basin |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 7 |
| 8 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 8 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 9-Typical Basin |
| 11 | SCS Runoff | 0.001 | 2 | 1136 | 31 | ------ | ------ | ------ | Developed Basin 1 |
| 12 | SCS Runoff | 0.004 | 2 | 1288 | 108 | ------ | ------ | ------ | Developed Basin 2 |
| 13 | SCS Runoff | 0.001 | 2 | 1426 | 10 | ------ | ------ | ------ | Developed Basin 3 |
| 14 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 4 |
| 15 | SCS Runoff | 0.001 | 2 | 1108 | 50 | ------ | ------ | ------ | Developed Basin 5 |
| 16 | SCS Runoff | 0.005 | 2 | 1074 | 190 | ------ | ------ | ------ | Developed Basin 6 |
| 17 | SCS Runoff | 0.002 | 2 | 748 | 82 | ------ | ------ | ------ | Developed Basin 7 |
| 18 | SCS Runoff | 0.003 | 2 | 1052 | 133 | ------ | ------ | ------ | Developed Basin 8 |
| 19 | SCS Runoff | 0.000 | 2 | 1440 | 0 | ------ | ------ | ------ | Developed Basin 9-Typical Basin |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 7 |
| 8 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 8 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 9-Typical Basin |
| 11 | SCS Runoff | 0.005 | 2 | 634 | 146 | ------ | ------ | ------ | Developed Basin 1 |
| 12 | SCS Runoff | 0.024 | 2 | 780 | 1,069 | ------ | ------ | ------ | Developed Basin 2 |
| 13 | SCS Runoff | 0.007 | 2 | 1094 | 292 | ------ | ------ | ------ | Developed Basin 3 |
| 14 | SCS Runoff | 0.015 | 2 | 1178 | 511 | ------ | ------ | ------ | Developed Basin 4 |
| 15 | SCS Runoff | 0.008 | 2 | 630 | 218 | ------ | ------ | ------ | Developed Basin 5 |
| 16 | SCS Runoff | 0.037 | 2 | 612 | 766 | ------ | ------ | ------ | Developed Basin 6 |
| 17 | SCS Runoff | 0.037 | 2 | 598 | 261 | ------ | ------ | ------ | Developed Basin 7 |
| 18 | SCS Runoff | 0.027 | 2 | 614 | 502 | ------ | ------ | ------ | Developed Basin 8 |
| 19 | SCS Runoff | 0.001 | 2 | 1140 | 26 | ------ | ------ | ------ | Developed Basin 9-Typical Basin |

# TR55 Tc Worksheet



## Hyd. No. 1

Pre-Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 217.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 29.25** | **+** | **0.00** | **+** | **0.00** | **=** | **29.25** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 29.30 min**

# TR55 Tc Worksheet



## Hyd. No. 2

Pre-Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 100.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.70 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 12.31** | **+** | **0.00** | **+** | **0.00** | **=** | **12.31** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 12.30 min**

# TR55 Tc Worksheet



## Hyd. No. 3

Pre-Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 176.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.05** | **+** | **0.00** | **+** | **0.00** | **=** | **11.05** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.10 min**

# TR55 Tc Worksheet



## Hyd. No. 4

Pre-Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 276.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.63** | **+** | **0.00** | **+** | **0.00** | **=** | **18.63** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 18.60 min**

# TR55 Tc Worksheet



## Hyd. No. 5

Pre-Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 218.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 29.36** | **+** | **0.00** | **+** | **0.00** | **=** | **29.36** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 29.40 min**

# TR55 Tc Worksheet



## Hyd. No. 6

Pre-Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 17.40** | **+** | **0.00** | **+** | **0.00** | **=** | **17.40** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 62.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =6.04 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.17** | **+** | **0.00** | **+** | **0.00** | **=** | **0.17** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 17.60 min**

# TR55 Tc Worksheet



## Hyd. No. 7

Pre-Developed Basin 7

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 56.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.68** | **+** | **0.00** | **+** | **0.00** | **=** | **4.68** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 4.70 min**

# TR55 Tc Worksheet



## Hyd. No. 8

Pre-Developed Basin 8

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 242.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 22.12** | **+** | **0.00** | **+** | **0.00** | **=** | **22.12** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 22.10 min**

# TR55 Tc Worksheet



## Hyd. No. 9

Pre-Developed Basin 9-Typical Basin

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 80.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 5.88** | **+** | **0.00** | **+** | **0.00** | **=** | **5.88** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 5.90 min**

# TR55 Tc Worksheet



## Hyd. No. 11

Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 217.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 29.25** | **+** | **0.00** | **+** | **0.00** | **=** | **29.25** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 29.30 min**

# TR55 Tc Worksheet



## Hyd. No. 12

Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 100.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.70 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 12.31** | **+** | **0.00** | **+** | **0.00** | **=** | **12.31** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 12.30 min**

# TR55 Tc Worksheet



## Hyd. No. 13

Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 176.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.05** | **+** | **0.00** | **+** | **0.00** | **=** | **11.05** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.10 min**

# TR55 Tc Worksheet



## Hyd. No. 14

Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 276.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 18.63** | **+** | **0.00** | **+** | **0.00** | **=** | **18.63** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 18.60 min**

# TR55 Tc Worksheet



## Hyd. No. 15

Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 218.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 29.36** | **+** | **0.00** | **+** | **0.00** | **=** | **29.36** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 29.40 min**

# TR55 Tc Worksheet



## Hyd. No. 16

Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 300.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 17.40** | **+** | **0.00** | **+** | **0.00** | **=** | **17.40** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 62.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 14.00 | | 0.00 | | 0.00 | | |
| Surface description | = Unpaved | | Paved | | Paved | | |
| Average velocity (ft/s) | =6.04 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.17** | **+** | **0.00** | **+** | **0.00** | **=** | **0.17** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 17.60 min**

# TR55 Tc Worksheet



## Hyd. No. 17

Developed Basin 7

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 56.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.68** | **+** | **0.00** | **+** | **0.00** | **=** | **4.68** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 4.70 min**

# TR55 Tc Worksheet



## Hyd. No. 18

Developed Basin 8

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 242.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 22.12** | **+** | **0.00** | **+** | **0.00** | **=** | **22.12** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 22.10 min**

# TR55 Tc Worksheet



## Hyd. No. 19

Developed Basin 9-Typical Basin

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 80.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 5.88** | **+** | **0.00** | **+** | **0.00** | **=** | **5.88** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 5.90 min**

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Sep 2 2025

## Swale A

**Triangular**

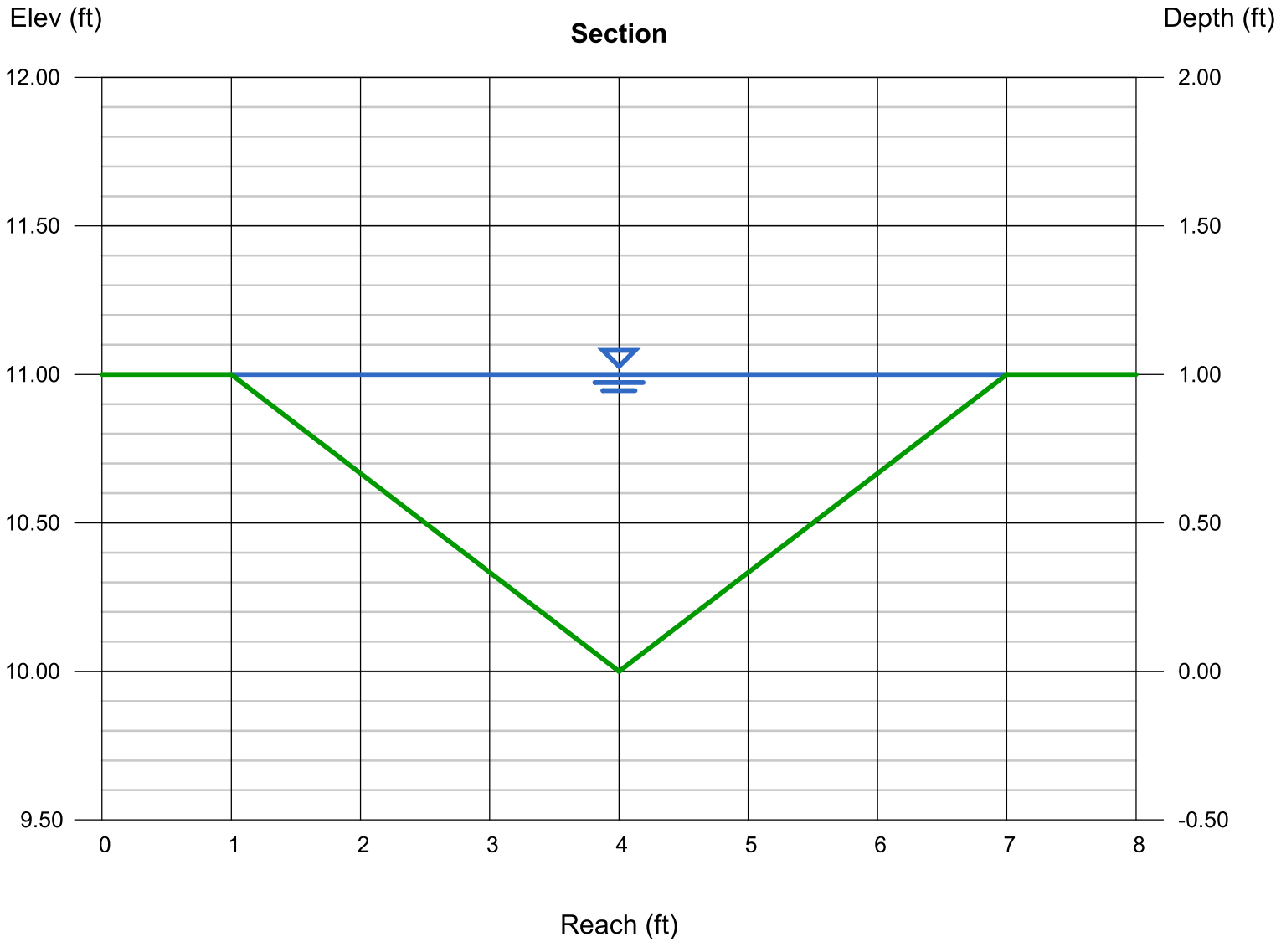
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.015 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.00 |
| Q (cfs) | = 12.78 |
| Area (sqft) | = 3.00 |
| Velocity (ft/s) | = 4.26 |
| Wetted Perim (ft) | = 6.32 |
| Crit Depth, Yc (ft) | = 1.00 |
| Top Width (ft) | = 6.00 |
| EGL (ft) | = 1.28 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 4 2025

## CHECK DAM- RETENTION STRUCTURE C

**Triangular**

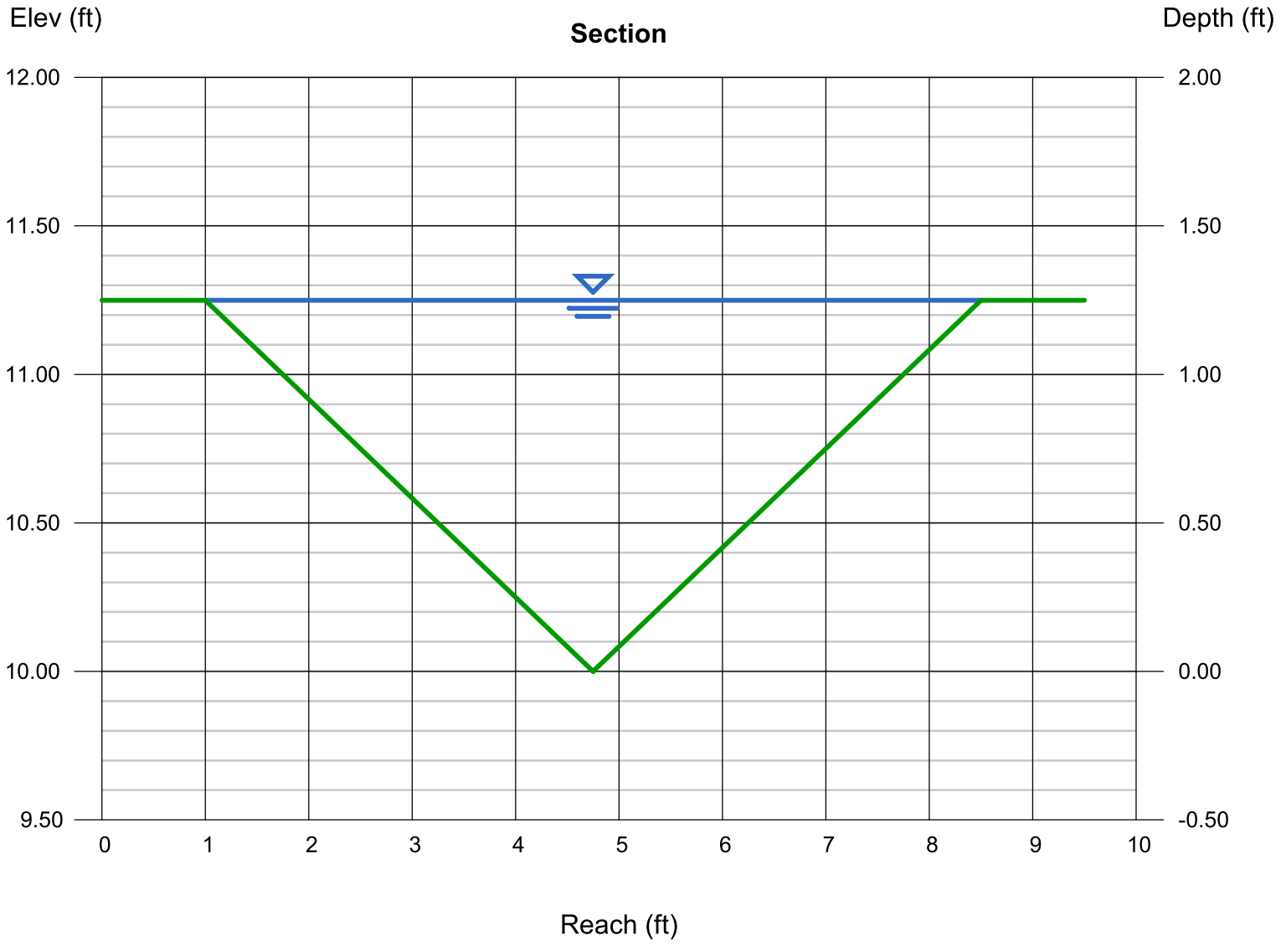
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.25 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.25 |
| Q (cfs) | = 2.317 |
| Area (sqft) | = 4.69 |
| Velocity (ft/s) | = 0.49 |
| Wetted Perim (ft) | = 7.91 |
| Crit Depth, Yc (ft) | = 0.52 |
| Top Width (ft) | = 7.50 |
| EGL (ft) | = 1.25 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 4 2025

## Swale C

**Triangular**

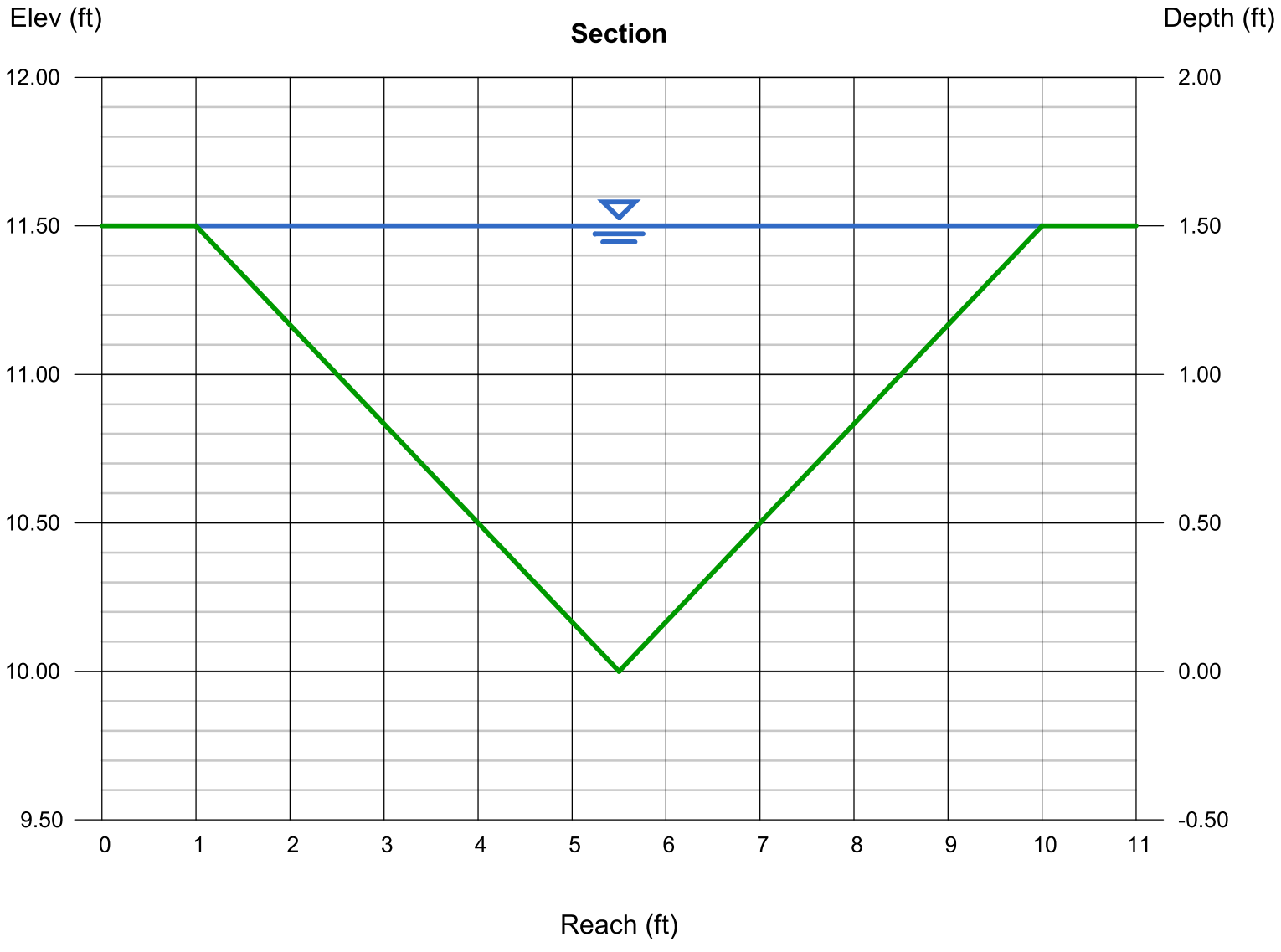
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.50 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.50 |
| Q (cfs) | = 3.768 |
| Area (sqft) | = 6.75 |
| Velocity (ft/s) | = 0.56 |
| Wetted Perim (ft) | = 9.49 |
| Crit Depth, Yc (ft) | = 0.63 |
| Top Width (ft) | = 9.00 |
| EGL (ft) | = 1.50 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 4 2025

## CHECK DAM- RETENTION STRUCTURE B

**Triangular**

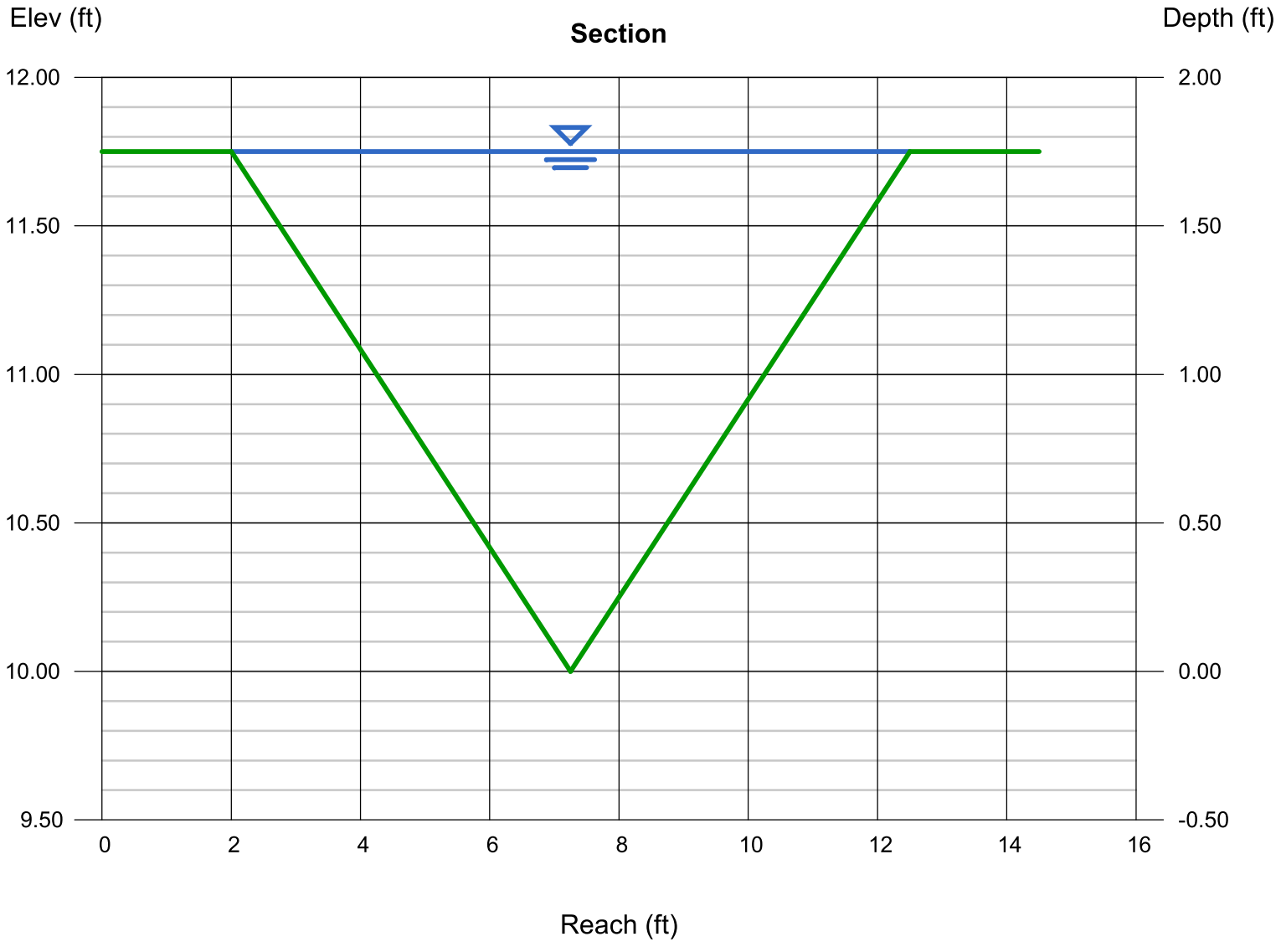
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.75 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.75 |
| Q (cfs) | = 5.684 |
| Area (sqft) | = 9.19 |
| Velocity (ft/s) | = 0.62 |
| Wetted Perim (ft) | = 11.07 |
| Crit Depth, Yc (ft) | = 0.75 |
| Top Width (ft) | = 10.50 |
| EGL (ft) | = 1.76 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Aug 28 2025

## Swable B

**Triangular**

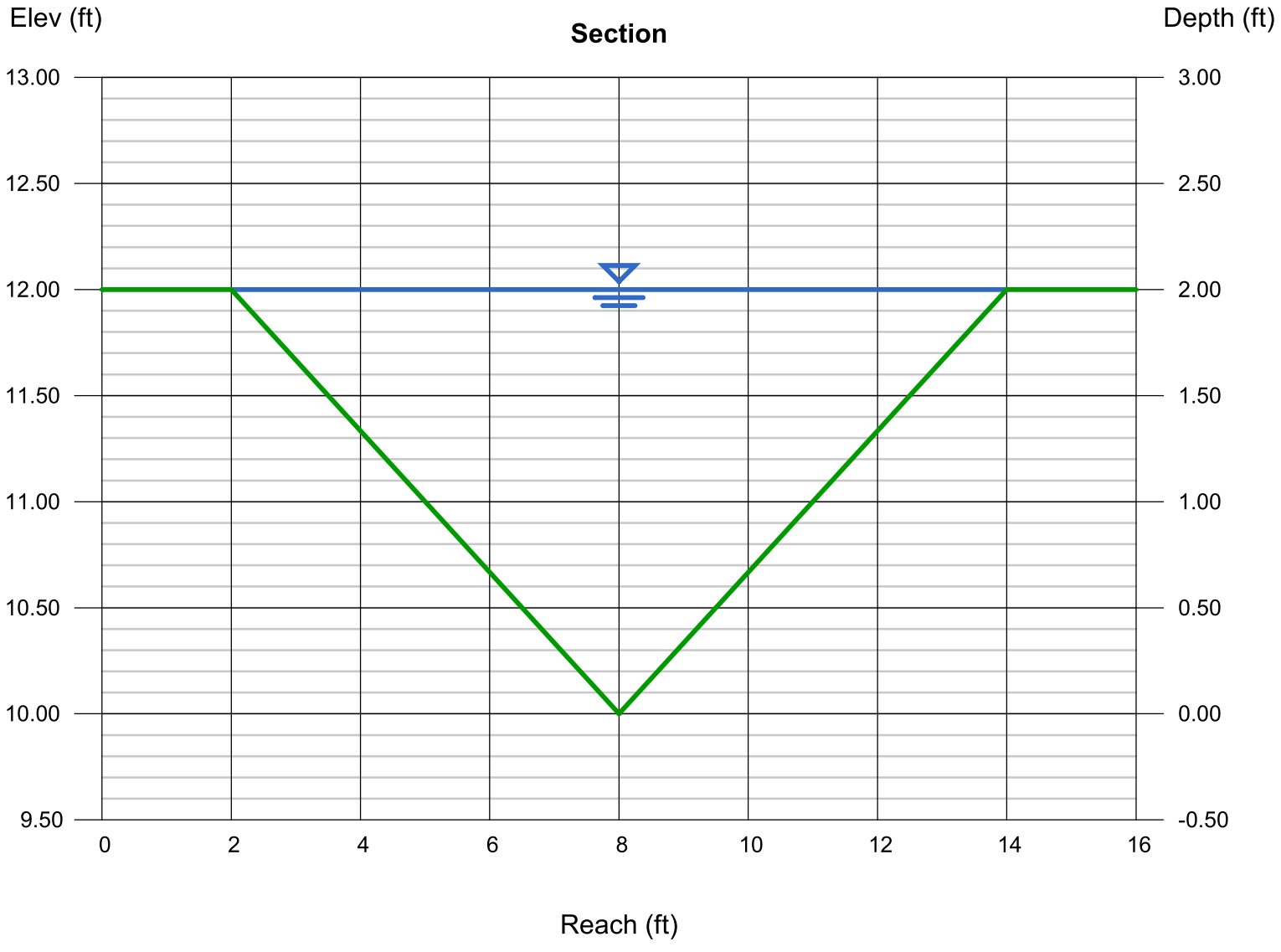
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 2.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 2.00 |
| Q (cfs) | = 8.116 |
| Area (sqft) | = 12.00 |
| Velocity (ft/s) | = 0.68 |
| Wetted Perim (ft) | = 12.65 |
| Crit Depth, Yc (ft) | = 0.86 |
| Top Width (ft) | = 12.00 |
| EGL (ft) | = 2.01 |



# Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 4 2025

## Typical Driveway Culvert

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 10.00 |
| Pipe Length (ft) | = | 14.00 |
| Slope (%) | = | 0.36 |
| Invert Elev Up (ft) | = | 10.05 |
| Rise (in) | = | 12.0 |
| Shape | = | Circular |
| Span (in) | = | 12.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.013 |
| Culvert Type | = | Circular Corrugate Metal Pipe |
| Culvert Entrance | = | Mitered to slope (C) |
| Coeff. K,M,c,Y,k | = | 0.021, 1.33, 0.0463, 0.75, 0.7 |

**Embankment**

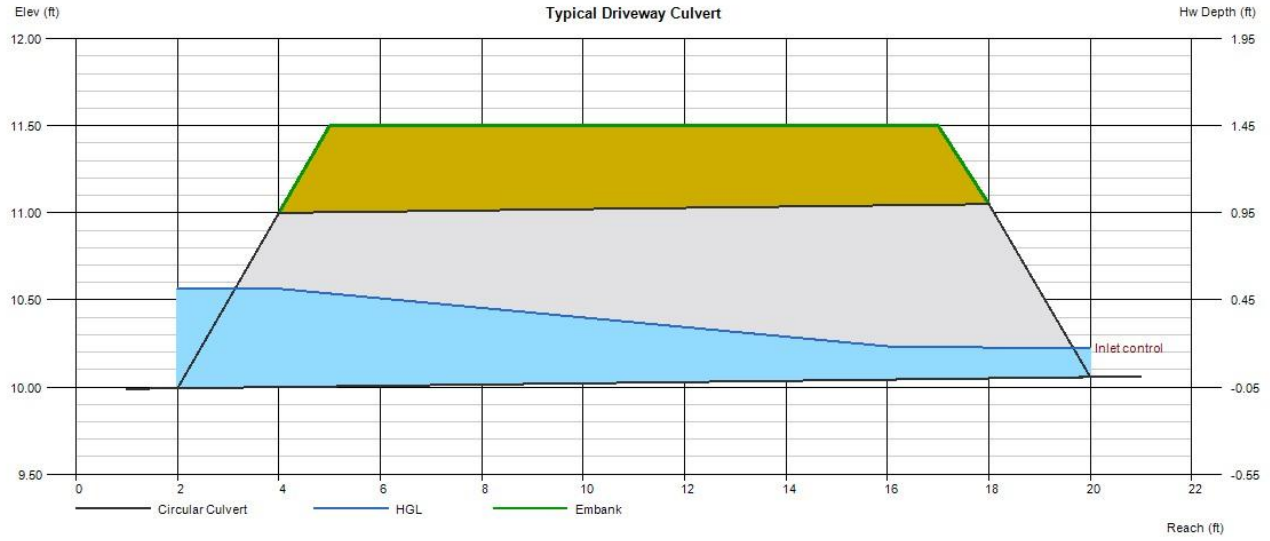
| | | |
|---|---|---|
| Top Elevation (ft) | = | 11.50 |
| Top Width (ft) | = | 12.00 |
| Crest Width (ft) | = | 6.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 0.00 |
| Qmax (cfs) | = | 2.00 |
| Tailwater Elev (ft) | = | (dc+D)/2 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 0.10 |
| Qpipe (cfs) | = | 0.10 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 0.22 |
| Veloc Up (ft/s) | = | 1.69 |
| HGL Dn (ft) | = | 10.56 |
| HGL Up (ft) | = | 10.18 |
| Hw Elev (ft) | = | 10.23 |
| Hw/D (ft) | = | 0.18 |
| Flow Regime | = | Inlet Control |



## Sump Calculations

| | |
|---|---|
| Cone | |
| Height | 4 |
| Top Diameter (ft) | 2 |
| Bottom Diameter (ft) | 4 |
| Barrel | |
| Height (ft) | 4 |
| Top Diameter (ft) | 4 |
| Bottom Diameter (ft) | 4 |
| Wall Thickness (in) | 4 |
| Sump Rock | |
| Depth Around Barrel (ft) | 2 |

| Inside Sump Volume | |
|---|---|
| Cone (CF) | 29.32 |
| Barrel (CF) | 50.24 |
| Total (CF) | 79.56 |

| Gravel Storage Volume | |
|---|---|
| Volume Around Barrel | 159.09 |
| Volume Under Barrel | 109.03 |
| Total (CF) | 268.12 |
| Storage in Gravel 30% (CF) | 80.44 |

| **Total Storage (CF)** | **160.00** |
|---|---|

| Infiltration per Sump @ 1.1 in/hr | |
|---|---|
| Infiltration Area (SF) | 54.51 |
| Total Infiltration (CF/HR) | 5.00 |
| **Infiltration - 1 hr Event (CF)** | **5.00** |

| **Total Storg and Infiltr in 1 Hr** | **164.99** |
|---|---|

# STORM DRAINAGE REPORT

PREPARED IN ACCORDANCE WITH
MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ) CIRCULAR 8

**Phase 13- Wilderness Escalante Preserve**

On property located at Sophie Lake Road
legally described as COS 4389
in S28, 29, 32 & 33, T37N, R27W, PMM, Lincoln County.
Published: January 7, 2026

**Prepared For:**
Escalante Wilderness
Preserve US LP
PO Box 2092
Eureka, MT 59917

**Prepared By:**
406 Engineering, Inc.
35 8th Street East
Kalispell, MT 59901

## 1.0 GENERAL

Escalante Wilderness Preserve US LP owns the 3-acre property referenced above. The owners intend to develop Phase 13 of the project which includes the development of 11 lots. The new development will include a road extension, 11 single-family homes, landscaping, and undeveloped natural land. The remaining portions of the property are to remain undeveloped.

This report aims to outline the current hydrological conditions of this site compared to the hydrological conditions that will exist after the proposed development. This report is prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The organization of the report follows the outlined requirements of DEQ-8. The report identifies storm water management with routing and storage requirements based on the analysis of the pre-development and post-development conditions.

This report and any attachments shall be submitted to the DEQ or to a delegated division of local government for review and approval. The report and attachments demonstrate that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owner. This report qualifies as a “Standard Plan” per DEQ-8.

## 2.0 SITE INFORMATION

GEOTECHNICAL INFORMATION:

Hydrologic soil groups are based on the estimates of runoff potential. The proposed development consists of hydrologic soil group A soils. Group A soils have high infiltration rates and low runoff potential, even when thoroughly wet. These deep, well-drained sands and gravels have high transmission rates. Refer to the appendices for the NRCS Hydrologic Soil Group map.

PRE-DEVELOPED CONDITIONS:

For this report, the predeveloped conditions of the site are assumed to be undeveloped. The existing project site is about 3 acres, with ground cover consisting of open space in good condition. The property slopes 0-25% to the north.

POST-DEVELOPED CONDITIONS:

The developed conditions of the 3-acre property will include the development of 11 single-family lots and a road extension. The remaining portions of the property will remain undeveloped. The development will result in a minor increase in impervious surfaces but will not change the overall drainage pattern or discharge point. Infiltration sumps and a Retention structure is proposed to manage the increased runoff from the development.

## 3.0 DRAINAGE DESIGN CRITERIA AND METHODS USED

The SCS method was used to estimate the storm runoff and volume for the property. Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2023 was used to analyze basin runoff. The runoff volume and peak flows for the 2, 10, and 100-year 24-hour storm events were analyzed for pre-developed and post-developed basins.

Primary inputs for the SCS methods are as follows:

- Basin Area: A basin is generally defined as an area that drains to a single point.
- Curve Number: A composite curve number (CN) for a basin is determined based on the hydrologic soil group, ground cover type, treatment, and hydraulic conditions. NRCS TR-55 Runoff CN tables are used to select the appropriate number.
- Time of Concentration: The time of concentration is the theoretical time it takes for runoff to travel to a point of interest from the hydraulically most distant point. Calculating a time of concentration involves summing flow times for runoff as sheet flow, shallow concentrated flow, and channel flow if applicable.
- Manning's Number: A n-value is designated for each surface type, providing an effective roughness coefficient for the water path selected to calculate the time of concentration. Standard tables and figures provided by *Technical Release 55 – Urban Hydrology for Small Watersheds* (TR-55) were used to select the appropriate number.
- Design Storm Depth: The SCS Method uses 24-hour storm depths developed by the National Oceanic and Atmospheric Administration (NOAA), with a selected design recurrence interval, such as 2, 10, or 100 years.
- Storm Distribution: To evaluate the peak flows, selecting a design storm hydrograph or rainfall time distribution pattern is necessary. A Type I storm distribution was utilized for sizing control facilities.

The selection of the curve number enables the SCS method to model the soil capacity and land cover to capture and infiltrate rainfall. The model is highly non-linear, meaning a relatively small percent increase in rainfall can lead to larger increases in runoff. This occurs because as the infiltrative capacity of the soil is used up, a higher percentage of precipitation will run off.

Both the TR-55 Manual and DEQ-8 have been used as reference for the SCS method in this report. The SCS method uses 24-hour storm depths developed by the NOAA with a selected design recurrence interval, such as 2, 10, 50, or 100-year storms. The precipitation data used in this report were obtained from NOAA Atlas 14, Volume 12, Version 2 and can be seen below in Table 1.

Table 1: NOAA Precipitation Depths

| Recurrence Interval | 2-year | 10-year | 100-year |
|---|---|---|---|
| 24-hour Precipitation Depth (in) | 1.24 | 1.74 | 2.55 |

This report is proposed as a Standard Plan per DEQ 8 and therefore must address storm water drainage peak flow and volume. Standard Plans must also demonstrate that the proposed development will not allow storm water to do any of the following:

- Exceed the pre-development runoff to an adjoining property during the 2-year storm event;
- Overtop roadways or driveways during a 10-year storm event; or
- Inundate any buildings or drainfields during a 100-year storm event. This may be demonstrated through either narrative descriptions or calculations.

**4.0 DELINEATION OF DRAINAGE BASINS**

For this report section, the property is evaluated as having five drainage basins. Two basins represent flow from the proposed home, road extension, and driveway development. Two additional basins represent from the road extensions. The fifth basin represents flow from the proposed home and driveway development on lots that slope away from the roadside stormwater facilities. The proposed property boundaries, the proposed development, and the topography across the site defined the drainage study extent. Although the proposed development will alter the localized drainage pattern, the overall drainage pattern will remain the same. Therefore, the pre-development and post-development drainage basins will remain the same size and shape.

PRE-DEVELOPED ON-SITE DRAINAGE BASINS:

For the pre-developed drainage basins, storm water moves as sheet flow with slopes ranging between 2%-18%. The basins are considered vacant, undeveloped land with no existing structures or impervious areas. No significant storm water runoff concerns are known to exist on the property. The curve number (CN) for the pre-developed site is based on the ground cover conditions of the existing open space in good condition for the soil group A (CN 39). Refer to the appendices for the TR-55 Runoff curve number tables and the TR-55 time of concentration calculations. Table 2 provides a summary of the pre-developed time of concentrations and curve numbers.

Table 2: Pre-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 0.16 | 39 | 9.9 |
| Basin 2 | 0.10 | 39 | 5 |
| Basin 3 | 0.37 | 39 | 8.2 |
| Basin 4 | 0.45 | 39 | 16 |
| Basin 5 | 0.16 | 39 | 8 |

POST-DEVELOPED ON-SITE DRAINAGE BASINS:

As mentioned above, the post-development drainage basins will remain the same size and shape as the pre-development drainage basins. The post-development conditions for the basins include the proposed development of the land including the homes, proposed asphalt driveways, and undeveloped open space in good condition. The composite CN is calculated land cover of open space in good condition for soil group A (CN 39), rooftops (98), and asphalt for soil group A (98). Table 3 provides a summary of the post-developed time of concentrations and curve numbers.

Table 3: Post-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 0.16 | 65 | 9.9 |
| Basin 2 | 0.10 | 82 | 5 |
| Basin 3 | 0.37 | 53 | 8.2 |
| Basin 4 | 0.45 | 54 | 16 |
| Basin 5 | 0.16 | 61 | 8 |

OFF-SITE BASINS:

The property is surrounded by land with similar ground cover. No off-site flows contribute to flows onto the property. All off-site flows are negligible and have not been considered in this drainage analysis.

## 5.0 RUNOFF VOLUMES AND FLOWS

Utilizing the procedures outlined in DEQ 8, runoff volumes and peak flows for the 2-year, 10-year, and 100-year 24-hour storm events were evaluated for the pre- and post-developed drainage basins. Refer to the attached calculations for the pre-developed and post-developed peak flows and runoff volumes.

Table 4: Post-Developed Peak Flows

| Basin ID | 2-year | | 10-year | | 100-year | |
|---|---|---|---|---|---|---|
| | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) |
| Basin 1 | 0 | 2.87 | 0.001 | 43.5 | 0.009 | 189 |
| Basin 2 | 0.009 | 72.9 | 0.031 | 165 | 0.075 | 352 |
| Basin 3 | 0 | 0 | 0 | 0 | 0.002 | 78.7 |
| Basin 4 | 0 | 0 | 0 | 0.245 | 0.003 | 122 |
| Basin 5 | 0 | 0 | 0.001 | 18 | 0.003 | 122 |

## 6.0 PROVISIONS TO MITIGATE ON-SITE STORM WATER FLOWS

INITIAL STORM WATER FACILITY

Utilizing the procedures identified in DEQ-8, the initial storm water facilities have been sized to infiltrate, evapotranspire, and/or capture the post-development runoff generated from the first 0.5 inches of rainfall on the impervious areas. The required volume of the initial storm water facilities have been included in the design of the proposed retention facility. Refer to Table 5 for the initial storm water facility volume for the drainage basins.

CONVEYANCE FACILITIES

Utilizing the procedures outlined within DEQ-8, conveyance facilities have been provided for numerous basins. Conveyance swales, check dams, and culverts have been proposed throughout the site and have been sized to convey the 10-year and 100-year post developed peak flows ensuring storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event. Refer to Table 5 and the attached calculations for more detail.

Table 5: Drainage Basin Conveyance

| | | Swales | | Swales and Check Dams | | | Culverts | |
|---|---|---|---|---|---|---|---|---|
| Basin ID | 10-year peak flow (cfs) | Swale ID | Maximum Conveyance (cfs) | Retention Structure ID | Maximum Conveyance Through Swale (cfs) | Maximum Conveyance Over Check Dam (cfs) | Culvert ID | Max Conveyance (cfs) |
| Basin 1 | 0.00 | A | 12.78 | N/A | N/A | N/A | 1 | 2 |
| Basin 2 | 0.03 | A | 12.78 | B | 2.317 | 1.278 | 1 | 2 |
| Basin 3 | 0.00 | A | 12.78 | N/A | N/A | N/A | 1 | 2 |
| Basin 4 | 0.00 | A | 12.78 | N/A | N/A | N/A | 1 | 2 |
| Basin 5 | 0.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

**Swale A**

- Side slope: 3:1
- Depth: 1 ft
- Cross-Sectional Area: 3 sf
- Capacity: 12.78 cfs

**Driveway Culvert**

- Diameter: 12”
- Length: 14’
- Capacity: 2.0 cfs
- Material: CMP

RETENTION AND INFILTRATION FACILITIES

Utilizing the procedures outlined in DEQ-8, the required and provided retention and infiltration facilities size for each basin can be seen in Table 6. With the existing topography on the property where storm water naturally sheets, the storm water will collect in the proposed retention and infiltration facilities. The proposed retention and infiltration facilities have been sized to retain at least, the post-developed 10-year and 100-year runoff volume. Refer to Table 6 and to the attached calculations for more detail.

INFILTRATION FACILITIES

Infiltration sumps are proposed to be installed throughout the development. These will capture any runoff not retained in check dams. Not taking into consideration infiltration, each sump is capable of storing 165 cubic feet of runoff volume. Lots 1-9 will require sumps to be installed after development. Pre-treatment facilities must be provided for infiltration facilities. Vegetative filter strips and vegetated swales will be used to satisfy the pre-treatment requirement. Refer to Table 6 and the attachments for more detail on sump locations and storage calculations.

Table 6: Drainage Basin Storage Volumes

| Basin ID | Design Storm Event | Design Volume (cf) | Proposed Retention/Infiltration Structure | Proposed Retention/Infiltration Structure Volume (cf) |
|---|---|---|---|---|
| Basin 1 | 10-year and ISWFV | 127 | Sump | 165 |
| Basin 2 | 10-year and ISWFV | 165.00 | Sump | 165 |
| Basin 3 | 100-year and ISWFV | 155 | Sump | 165 |
| Basin 4 | 100-year and ISWFV | 201 | Structure A with 1 Check Dam and a Sump | 255 |
| Basin 5 | 100-year and ISWFV | 122.00 | Sump | 165 |

**Retention Structure A**

- Side slope: 3:1
- Depth: 1.25’
- Check Dam Depth: 1.0’
- Minimum Space Between Check Dams: 60’
- Total Storage Per Check Dam: 90 cf

DRAINAGE BASIN 1

Drainage Basin 1 represents runoff from the area of development. This parcel generally slopes to the north. Runoff from this basin will be conveyed in conveyance swale A and stored in the proposed infiltration sump and is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 2

Drainage Basin 2 represents runoff from the area of development. This parcel generally slopes to the northeast. Runoff from this basin will be conveyed in swale A and stored in the proposed infiltration sump and is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 3

Drainage Basin 3 represents runoff from the area of development. This parcel generally slopes to the northeast. Runoff from this basin will be conveyed in swale A and stored in the proposed infiltration sump and is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 4

Drainage Basin 4 represents runoff from the area of development. This parcel generally slopes to the north. Runoff from this basin will be conveyed in swale A and stored in the proposed infiltration sump and retention structure A with 1 check dam. The facilities are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 5-Typical Basin

Drainage Basin 5 represents runoff from the development of lot 6. This basin generally slopes to the northeast. This basin will be considered typical for each lot that slopes away from stormwater facilities, including lots 1-9. Runoff from a typical basin will sheet flow from a vegetative filter strip and will be stored in a sump that is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event.

PRE-TREATMENT FACILITIES

The rural nature of the site will provide superb pretreatment of any storm water before leaving the site.

## 7.0 OPERATION AND MAINTENANCE

The operation and maintenance of the storm water management infrastructure are essential to the longevity of the storm water treatment. The lot layout includes an Operation and Maintenance Plan.

## 8.0 CONCLUSIONS

This report was prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The development of the 3-acre property will include the development of 11 lots with single-family homes, a road extension, landscaping, and undeveloped natural space which will increase the impervious area and therefore increase both runoff rates and volume. The proposed retention and infiltration structures have been sized to collect storm water and ensure that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owners. The plan was developed to ensure that storm water does not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

Prepared by:
**406 Engineering, Inc.**



Hailley Jones, Staff Engineer

**ATTACHMENTS**

- ✓ *NRCS Hydrologic Soil Group (3 pages)*
- ✓ *NOAA Precipitation Data (4 pages)*
- ✓ *TR-55 Curve Number Values (2 pages)*
- ✓ *Composite Curve Number Calculations (1 page)*
- ✓ *Hydraflow Time of Concentration and Runoff Calculations (13 pages)*
- ✓ *Stormwater Facilities Sizing (4 pages)*

*https://406engineeringinc.sharepoint.com/Shared Documents/406 Work/1_Projects/2021 Projects/21-007k Escalante Wilderness Preserve/3_DESIGN&PERMITTING/1_DEQ JOINT APP/5.Appendix E - Drainage Report/rpt.2025-09-24.CLIENT.DEQ 8.docx*
*Wednesday, January 7, 2026, 9:04 AM*


115° 8' 29" W
115° 8' 17" W
48° 55' 45" N
48° 55' 40" N
636140
636160
636180
636200
636220
636240
636260
636280
636300
636320
636340
636360
5421260
5421240
5421220
5421200
5421180
5421160
5421140
5421120
1075
1111
Soil Map may not be valid at this scale.
Map Scale: 1:1,100 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 15 30 60 90
Feet
0 50 100 200 300
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Lines**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Points**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Kootenai National Forest Area, Montana-Idaho
Survey Area Data: Version 24, Sep 16, 2024

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

Date(s) aerial images were photographed: Jul 14, 2023—Aug 13, 2023

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.

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1075 | Tetrault-Canusa-Jocko complex, 1 to 20 percent slopes | A | 2.4 | 77.5% |
| 1111 | Canusa-Felt family complex, 0 to 15 percent slopes | A | 0.7 | 22.5% |
| **Totals for Area of Interest** | | | **3.2** | **100.0%** |

## Description

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.

**NOAA Atlas 14, Volume 12, Version 2**
**Location name: Eureka, Montana, USA***
**Latitude: 48.9386°, Longitude: -115.1253°**
**Elevation: 2656 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Carl Trypaluk, Dale Unruh, Michael St.Laurent, Austin Jordan, Rama Sesha Sridhar Mantripragada, Sandra Pavlovic, Greg Fall, Fernando Salas

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.139** (0.122-0.157) | **0.182** (0.161-0.209) | **0.251** (0.219-0.292) | **0.307** (0.263-0.362) | **0.380** (0.314-0.458) | **0.435** (0.346-0.533) | **0.488** (0.370-0.613) | **0.539** (0.389-0.703) | **0.605** (0.409-0.837) | **0.652** (0.429-0.947) |
| 10-min | **0.192** (0.170-0.218) | **0.253** (0.224-0.289) | **0.348** (0.303-0.405) | **0.425** (0.364-0.502) | **0.527** (0.435-0.636) | **0.603** (0.480-0.739) | **0.677** (0.514-0.850) | **0.748** (0.540-0.976) | **0.839** (0.568-1.16) | **0.904** (0.596-1.31) |
| 15-min | **0.223** (0.197-0.253) | **0.294** (0.260-0.336) | **0.405** (0.353-0.471) | **0.494** (0.423-0.583) | **0.613** (0.506-0.739) | **0.701** (0.558-0.859) | **0.786** (0.597-0.987) | **0.869** (0.627-1.13) | **0.974** (0.660-1.35) | **1.05** (0.692-1.53) |
| 30-min | **0.272** (0.241-0.309) | **0.358** (0.317-0.410) | **0.494** (0.430-0.574) | **0.602** (0.516-0.711) | **0.747** (0.616-0.901) | **0.854** (0.680-1.05) | **0.958** (0.728-1.20) | **1.06** (0.764-1.38) | **1.19** (0.804-1.64) | **1.28** (0.843-1.86) |
| 60-min | **0.326** (0.288-0.369) | **0.427** (0.378-0.489) | **0.588** (0.512-0.684) | **0.717** (0.614-0.846) | **0.888** (0.733-1.07) | **1.02** (0.809-1.24) | **1.14** (0.865-1.43) | **1.26** (0.909-1.64) | **1.41** (0.956-1.96) | **1.52** (1.00-2.21) |
| 2-hr | **0.419** (0.377-0.469) | **0.527** (0.473-0.596) | **0.698** (0.617-0.802) | **0.837** (0.727-0.974) | **1.02** (0.860-1.22) | **1.16** (0.947-1.41) | **1.30** (1.02-1.61) | **1.43** (1.07-1.85) | **1.60** (1.13-2.20) | **1.73** (1.19-2.50) |
| 3-hr | **0.492** (0.448-0.546) | **0.600** (0.544-0.672) | **0.773** (0.690-0.879) | **0.914** (0.803-1.05) | **1.10** (0.942-1.30) | **1.25** (1.04-1.50) | **1.39** (1.11-1.71) | **1.54** (1.18-1.97) | **1.72** (1.25-2.34) | **1.85** (1.32-2.66) |
| 6-hr | **0.642** (0.589-0.704) | **0.753** (0.689-0.831) | **0.935** (0.843-1.04) | **1.08** (0.965-1.22) | **1.29** (1.12-1.48) | **1.45** (1.23-1.70) | **1.61** (1.33-1.94) | **1.77** (1.42-2.23) | **1.98** (1.52-2.65) | **2.14** (1.60-3.02) |
| 12-hr | **0.846** (0.776-0.925) | **0.978** (0.895-1.08) | **1.20** (1.08-1.32) | **1.38** (1.23-1.54) | **1.63** (1.43-1.84) | **1.82** (1.58-2.10) | **2.02** (1.71-2.39) | **2.22** (1.84-2.73) | **2.48** (2.00-3.24) | **2.69** (2.11-3.68) |
| 24-hr | **1.08** (0.990-1.19) | **1.24** (1.14-1.37) | **1.52** (1.37-1.68) | **1.74** (1.56-1.94) | **2.06** (1.82-2.31) | **2.30** (2.01-2.62) | **2.55** (2.19-2.97) | **2.80** (2.36-3.39) | **3.14** (2.58-4.02) | **3.39** (2.74-4.56) |
| 2-day | **1.30** (1.18-1.42) | **1.49** (1.36-1.64) | **1.82** (1.64-2.02) | **2.09** (1.87-2.33) | **2.47** (2.18-2.79) | **2.76** (2.40-3.16) | **3.05** (2.62-3.58) | **3.35** (2.83-4.07) | **3.75** (3.09-4.82) | **4.06** (3.28-5.46) |
| 3-day | **1.43** (1.31-1.57) | **1.65** (1.51-1.82) | **2.01** (1.82-2.24) | **2.31** (2.07-2.59) | **2.73** (2.40-3.10) | **3.05** (2.65-3.51) | **3.38** (2.88-3.97) | **3.71** (3.11-4.52) | **4.14** (3.41-5.35) | **4.48** (3.62-6.06) |
| 4-day | **1.55** (1.41-1.70) | **1.78** (1.62-1.97) | **2.17** (1.96-2.41) | **2.50** (2.23-2.79) | **2.94** (2.58-3.34) | **3.29** (2.85-3.79) | **3.63** (3.10-4.28) | **3.98** (3.34-4.87) | **4.45** (3.66-5.76) | **4.81** (3.89-6.51) |
| 7-day | **1.83** (1.67-2.02) | **2.10** (1.91-2.32) | **2.55** (2.29-2.83) | **2.92** (2.60-3.27) | **3.43** (3.00-3.90) | **3.82** (3.30-4.41) | **4.21** (3.59-4.98) | **4.62** (3.87-5.64) | **5.15** (4.23-6.65) | **5.55** (4.49-7.50) |
| 10-day | **2.07** (1.89-2.28) | **2.37** (2.16-2.62) | **2.86** (2.57-3.18) | **3.27** (2.91-3.66) | **3.83** (3.35-4.35) | **4.26** (3.68-4.91) | **4.69** (4.00-5.54) | **5.12** (4.30-6.26) | **5.70** (4.69-7.36) | **6.14** (4.97-8.27) |
| 20-day | **2.77** (2.53-3.06) | **3.16** (2.87-3.49) | **3.77** (3.39-4.21) | **4.28** (3.81-4.81) | **4.97** (4.36-5.67) | **5.49** (4.77-6.36) | **6.01** (5.15-7.12) | **6.52** (5.52-8.00) | **7.20** (5.98-9.32) | **7.70** (6.30-10.4) |
| 30-day | **3.34** (3.05-3.69) | **3.78** (3.43-4.19) | **4.50** (4.03-5.01) | **5.07** (4.51-5.69) | **5.84** (5.13-6.66) | **6.41** (5.58-7.43) | **6.97** (6.00-8.27) | **7.52** (6.40-9.23) | **8.23** (6.89-10.6) | **8.74** (7.24-11.8) |
| 45-day | **4.12** (3.75-4.55) | **4.63** (4.19-5.12) | **5.44** (4.87-6.04) | **6.08** (5.40-6.80) | **6.92** (6.08-7.86) | **7.53** (6.57-8.70) | **8.11** (7.01-9.58) | **8.66** (7.42-10.6) | **9.34** (7.92-12.0) | **9.82** (8.32-13.2) |
| 60-day | **4.79** (4.36-5.30) | **5.36** (4.85-5.93) | **6.24** (5.58-6.93) | **6.93** (6.15-7.74) | **7.81** (6.88-8.86) | **8.44** (7.38-9.73) | **9.02** (7.83-10.6) | **9.56** (8.24-11.6) | **10.2** (8.74-13.1) | **10.6** (9.17-14.2) |

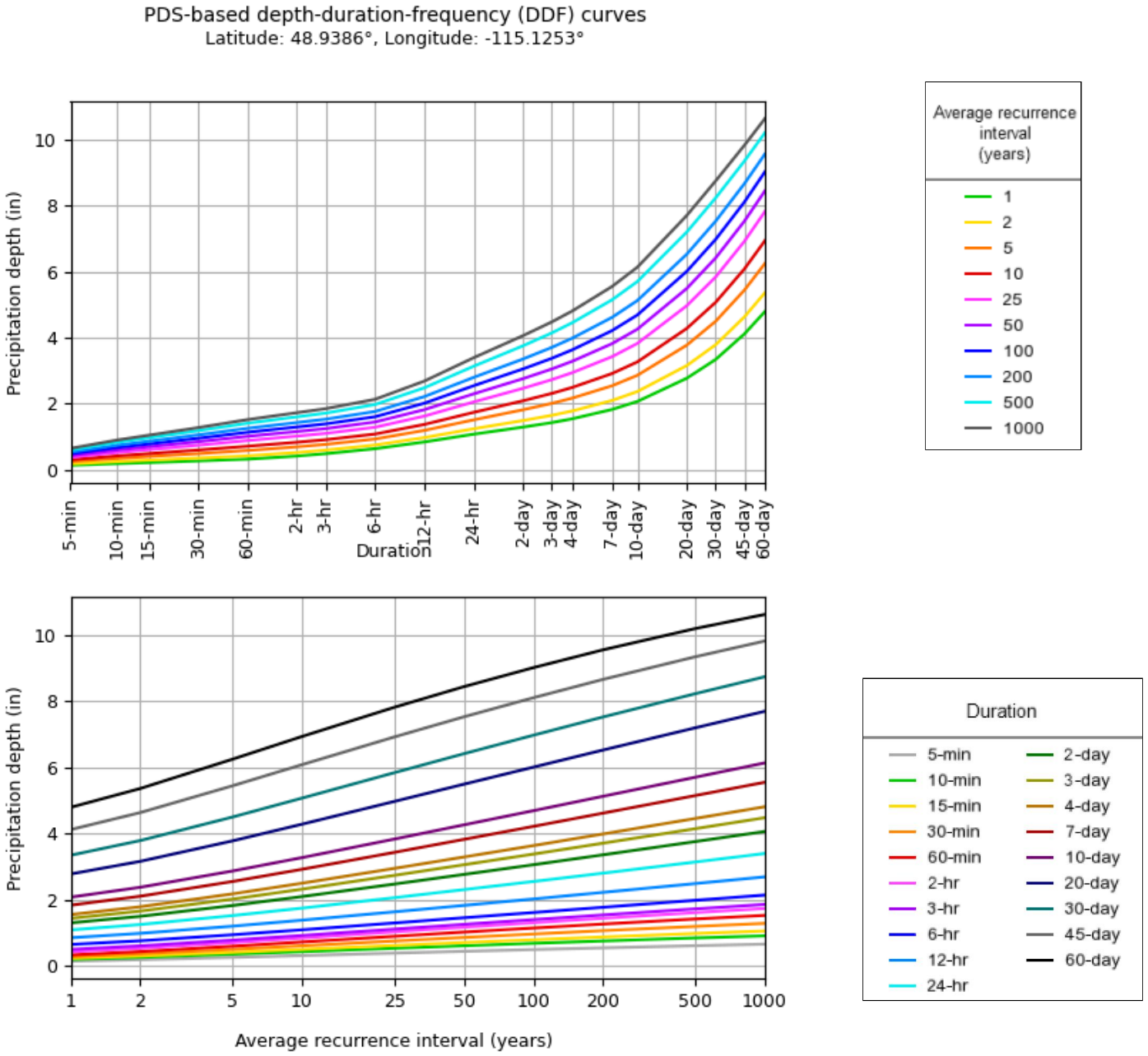
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical



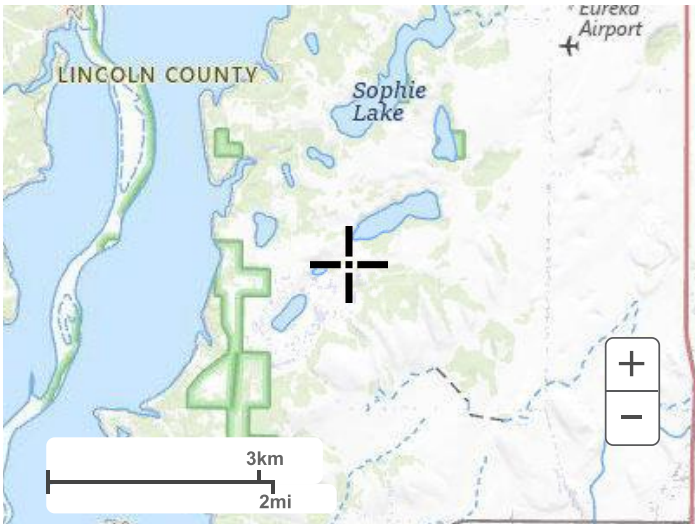

NOAA Atlas 14, Volume 12, Version 2

Created (GMT): Fri Aug 1 16:57:16 2025

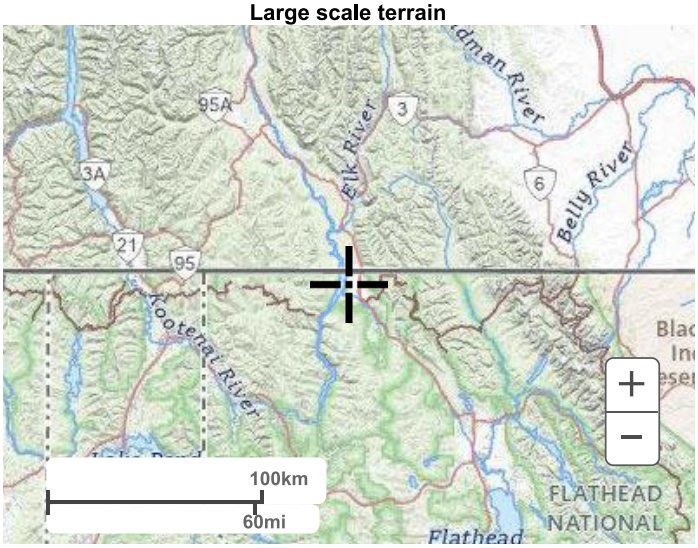
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## Maps & aerials

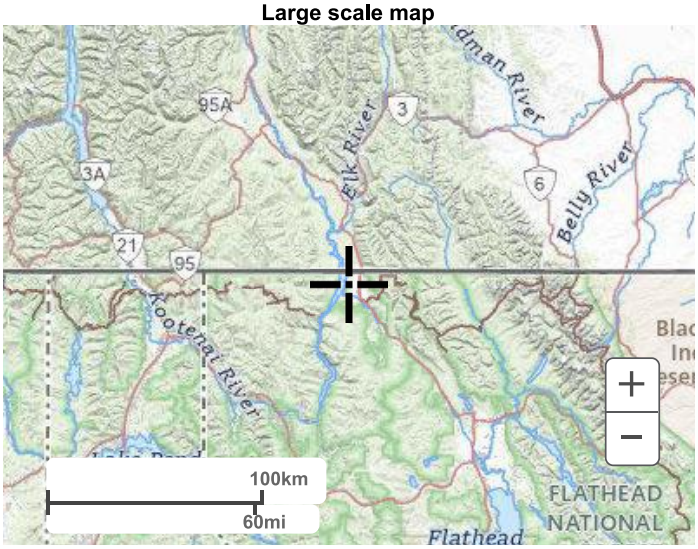
**Small scale terrain**



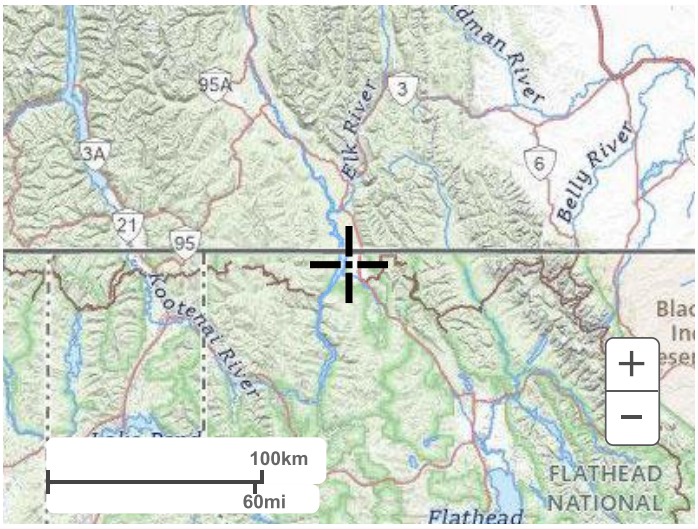

Large scale terrain




Large scale map




Large scale aerial




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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table 2-2a Runoff curve numbers for urban areas [1/]

| Cover description: Cover type and hydrologic condition | Average percent impervious area [2/] | Curve numbers for hydrologic soil group: A | B | C | D |
|---|---|---|---|---|---|
| ***Fully developed urban areas (vegetation established)*** | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only) [4/] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| ***Developing urban areas*** | | | | | |
| Newly graded areas (pervious areas only, no vegetation) [5/] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

| Cover description | | Curve numbers for hydrologic soil group | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic condition | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing. [2/] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element. [3/] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | 30 [4/] | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm). [5/] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods. [6/] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 30 [4/] | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

1 Average runoff condition, and $I_a = 0.2S$.

2 ***Poor:*** <50%) ground cover or heavily grazed with no mulch.
***Fair:*** 50 to 75% ground cover and not heavily grazed.
***Good:*** > 75% ground cover and lightly or only occasionally grazed.

3 ***Poor:*** <50% ground cover.
***Fair:*** 50 to 75% ground cover.
***Good:*** >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 ***Poor:*** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
***Fair:*** Woods are grazed but not burned, and some forest litter covers the soil.
***Good:*** Woods are protected from grazing, and litter and brush adequately cover the soil.

**Post-Developed Composite Curve Number & Initial Storm Water Facility Volume**

**PROJECT: ESCALANTE WILDERNESS PRESERVE PHASE 13**

**PREPARED BY: 406 Engineering Inc**

October 2, 2025

| Basin ID | Total Area | | Open Space (G.C.) | | Roof | | Asphalt | | Composite CN | Total Impervious Area (SF) | Initial Storm Water Facility Volume (CF) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Acres) | (SF) | Area (SF) | CN | Area (SF) | CN | Area (SF) | CN | | | |
| Basin 1 | 0.16 | 6953 | 3912 | 39 | 0 | 98 | 3041 | 98 | **65** | 3041 | 127 |
| Basin 2 | 0.10 | 4431 | 1273 | 39 | 0 | 98 | 3158 | 98 | **82** | 3158 | 132 |
| Basin 3 | 0.37 | 16046 | 12326 | 39 | 1750 | 98 | 1970 | 98 | **53** | 3720 | 155 |
| Basin 4 | 0.45 | 19492 | 14671 | 39 | 1750 | 98 | 3071 | 98 | **54** | 4821 | 201 |
| Basin 5 | 0.16 | 7141 | 4536 | 39 | 1750 | 98 | 855 | 98 | **61** | 2605 | 109 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 5 |
| 7 | SCS Runoff | 0.000 | 2 | 1376 | 3 | ------ | ------ | ------ | Developed Basin 1 |
| 8 | SCS Runoff | 0.009 | 2 | 598 | 73 | ------ | ------ | ------ | Developed Basin 2 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 3 |
| 10 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 4 |
| 11 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 5 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 5 |
| 7 | SCS Runoff | 0.001 | 2 | 1096 | 44 | ------ | ------ | ------ | Developed Basin 1 |
| 8 | SCS Runoff | 0.031 | 2 | 598 | 165 | ------ | ------ | ------ | Developed Basin 2 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 3 |
| 10 | SCS Runoff | 0.000 | 2 | 1440 | 0 | ------ | ------ | ------ | Developed Basin 4 |
| 11 | SCS Runoff | 0.001 | 2 | 1214 | 18 | ------ | ------ | ------ | Developed Basin 5 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Undeveloped Basin 5 |
| 7 | SCS Runoff | 0.009 | 2 | 608 | 189 | ------ | ------ | ------ | Developed Basin 1 |
| 8 | SCS Runoff | 0.075 | 2 | 596 | 352 | ------ | ------ | ------ | Developed Basin 2 |
| 9 | SCS Runoff | 0.002 | 2 | 1166 | 79 | ------ | ------ | ------ | Developed Basin 3 |
| 10 | SCS Runoff | 0.003 | 2 | 1148 | 122 | ------ | ------ | ------ | Developed Basin 4 |
| 11 | SCS Runoff | 0.003 | 2 | 754 | 122 | ------ | ------ | ------ | Developed Basin 5 |

# TR55 Tc Worksheet



## Hyd. No. 1

Undeveloped Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 97.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 6.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.90** | **+** | **0.00** | **+** | **0.00** | **=** | **9.90** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.90 min**

# TR55 Tc Worksheet



## Hyd. No. 2

Undeveloped Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 23.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.86** | **+** | **0.00** | **+** | **0.00** | **=** | **4.86** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 4.90 min**

# TR55 Tc Worksheet



## Hyd. No. 3

Undeveloped Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 44.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 3.65** | **+** | **0.00** | **+** | **0.00** | **=** | **3.65** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 3.60 min**

# TR55 Tc Worksheet



## Hyd. No. 4

Undeveloped Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 260.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 15.99** | **+** | **0.00** | **+** | **0.00** | **=** | **15.99** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 16.00 min**

# TR55 Tc Worksheet



## Hyd. No. 5

Undeveloped Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 131.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 18.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.11** | **+** | **0.00** | **+** | **0.00** | **=** | **8.11** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.10 min**

# TR55 Tc Worksheet



## Hyd. No. 7

Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 97.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 6.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.90** | **+** | **0.00** | **+** | **0.00** | **=** | **9.90** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.90 min**

# TR55 Tc Worksheet



## Hyd. No. 8

Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 23.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 4.86** | **+** | **0.00** | **+** | **0.00** | **=** | **4.86** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 4.90 min**

# TR55 Tc Worksheet



## Hyd. No. 9

Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 44.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 3.65** | **+** | **0.00** | **+** | **0.00** | **=** | **3.65** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 3.60 min**

# TR55 Tc Worksheet



## Hyd. No. 10

Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 260.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 15.99** | **+** | **0.00** | **+** | **0.00** | **=** | **15.99** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 16.00 min**

# TR55 Tc Worksheet



## Hyd. No. 11

Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 131.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 18.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.11** | **+** | **0.00** | **+** | **0.00** | **=** | **8.11** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.10 min**

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Sep 2 2025

## Swale A

**Triangular**

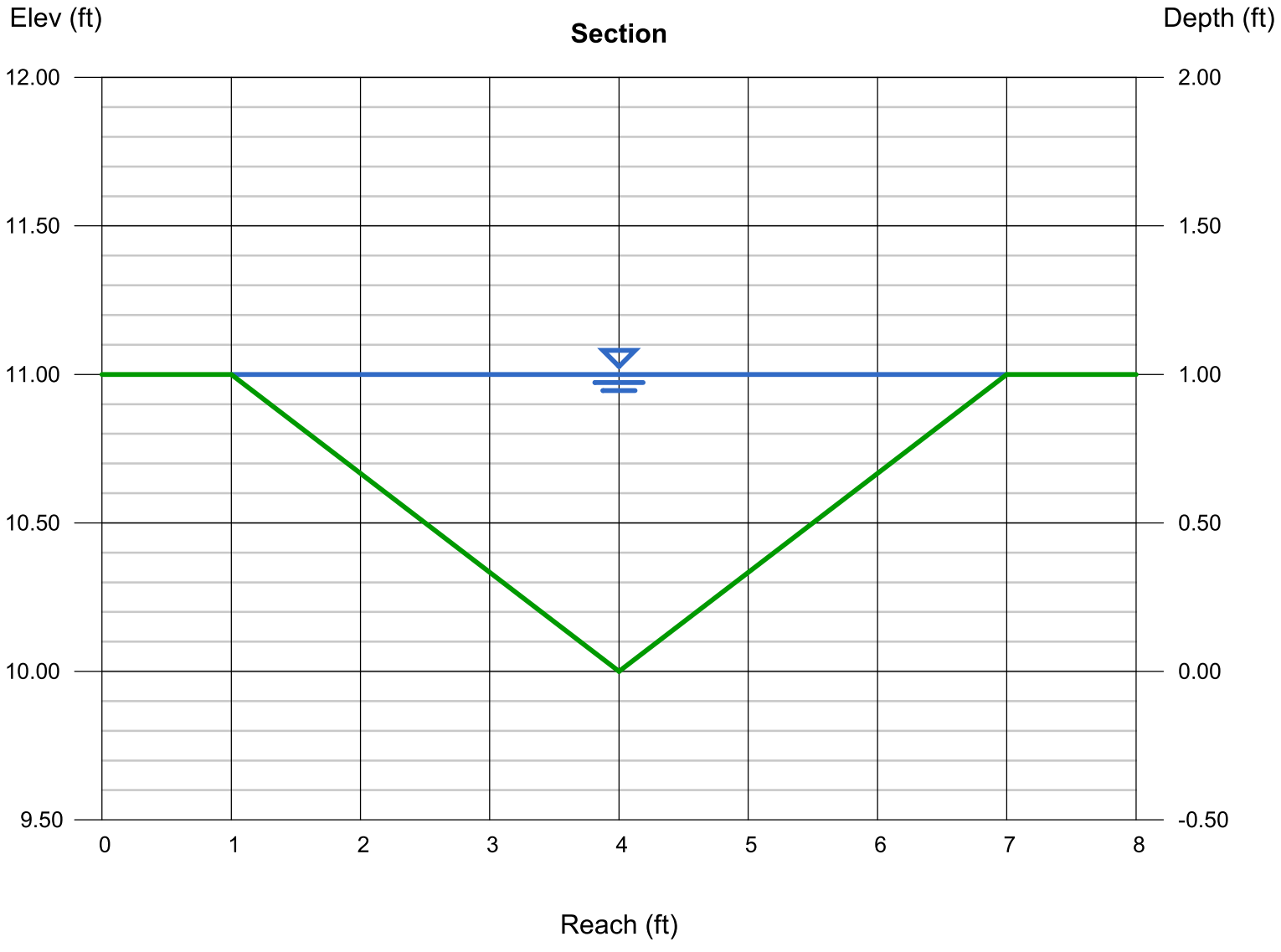
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.015 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.00 |
| Q (cfs) | = 12.78 |
| Area (sqft) | = 3.00 |
| Velocity (ft/s) | = 4.26 |
| Wetted Perim (ft) | = 6.32 |
| Crit Depth, Yc (ft) | = 1.00 |
| Top Width (ft) | = 6.00 |
| EGL (ft) | = 1.28 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Sep 30 2025

## Retention Structure A

**Triangular**

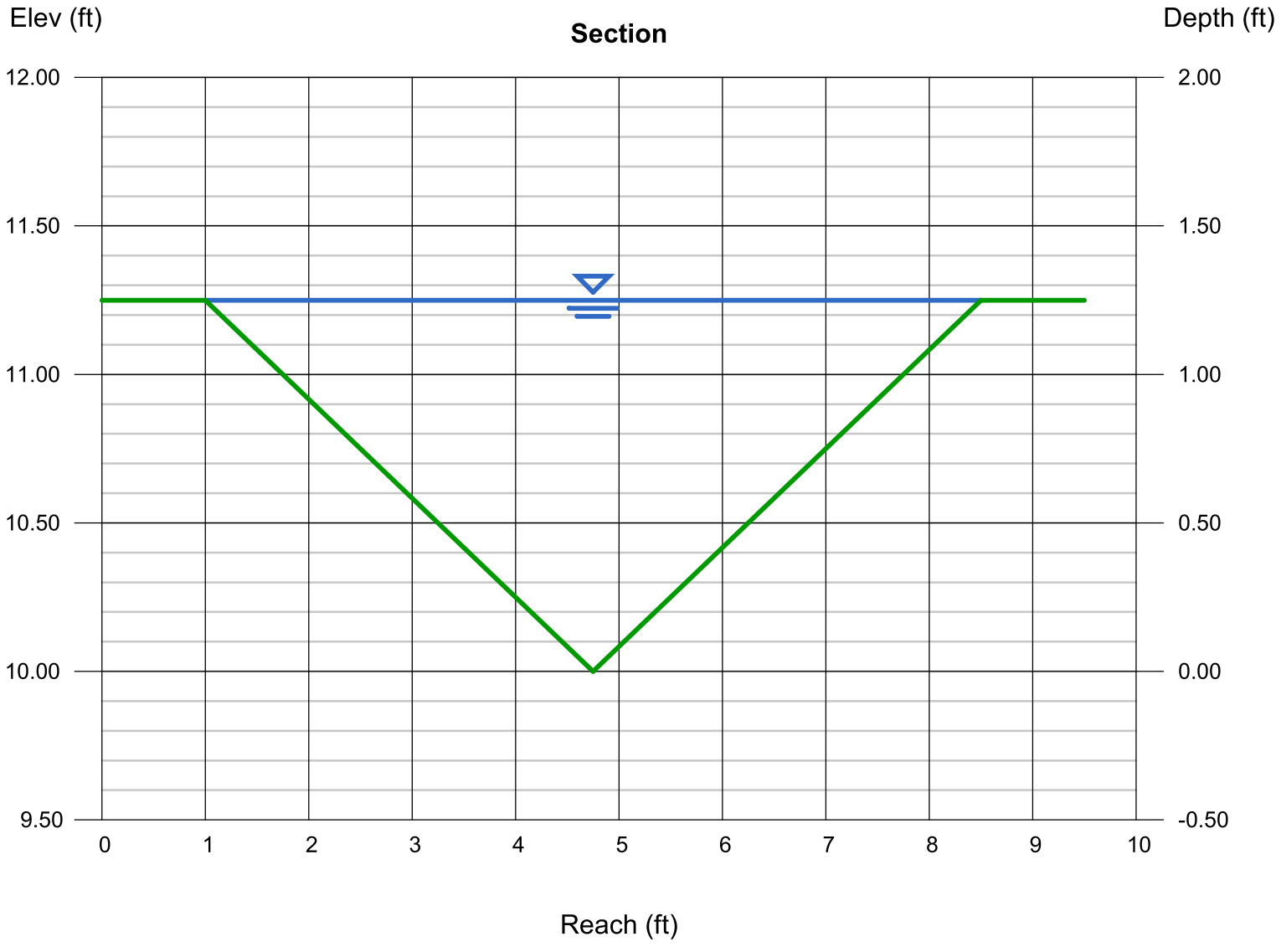
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.25 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.25 |
| Q (cfs) | = 2.317 |
| Area (sqft) | = 4.69 |
| Velocity (ft/s) | = 0.49 |
| Wetted Perim (ft) | = 7.91 |
| Crit Depth, Yc (ft) | = 0.52 |
| Top Width (ft) | = 7.50 |
| EGL (ft) | = 1.25 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Sep 30 2025

## Check Dam - Retention Structure A

**Triangular**

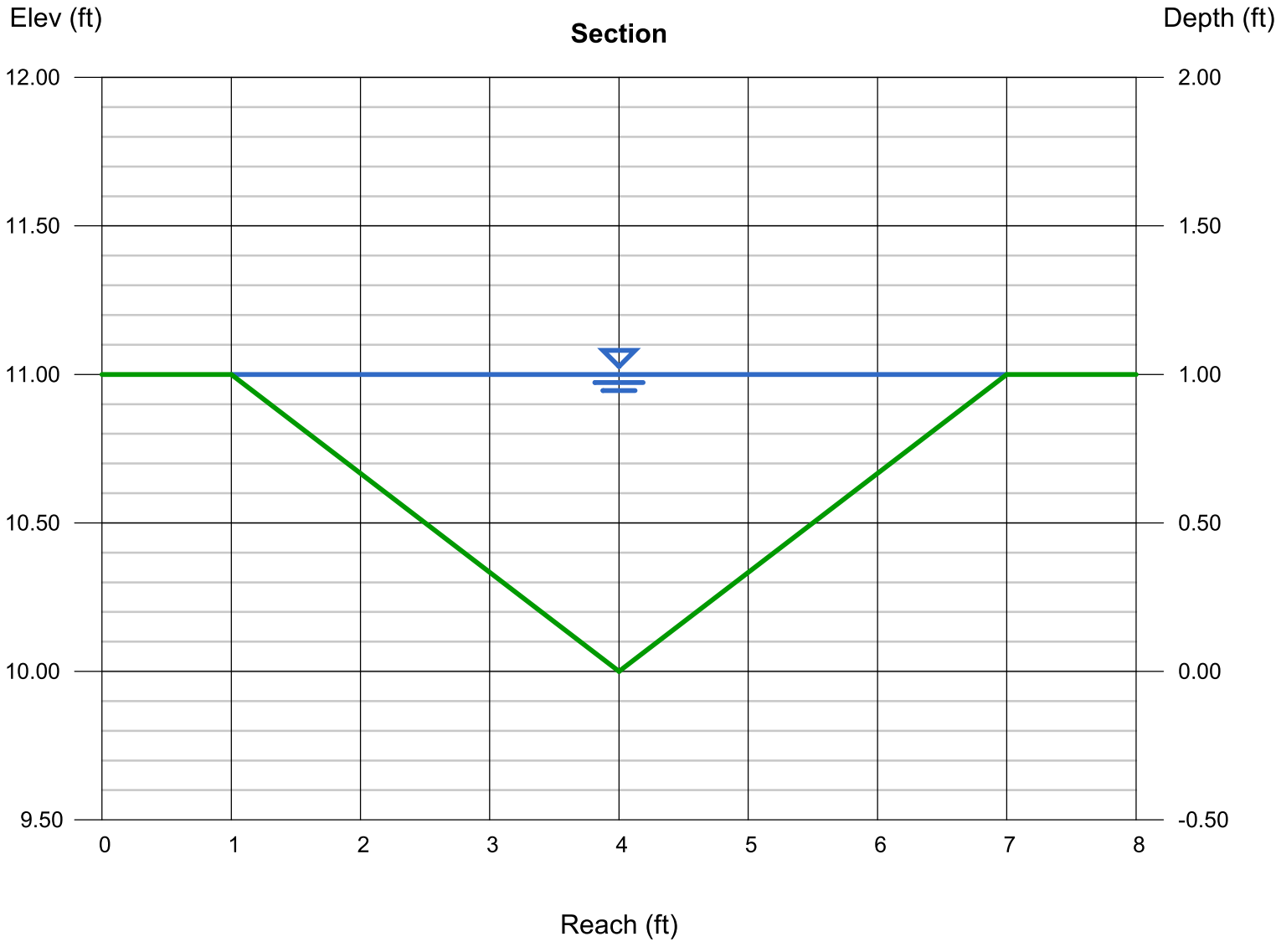
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.150 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.00 |
| Q (cfs) | = 1.278 |
| Area (sqft) | = 3.00 |
| Velocity (ft/s) | = 0.43 |
| Wetted Perim (ft) | = 6.32 |
| Crit Depth, Yc (ft) | = 0.41 |
| Top Width (ft) | = 6.00 |
| EGL (ft) | = 1.00 |



## Sump Calculations

| | |
|---|---|
| Cone | |
| Height | 4 |
| Top Diameter (ft) | 2 |
| Bottom Diameter (ft) | 4 |
| Barrel | |
| Height (ft) | 4 |
| Top Diameter (ft) | 4 |
| Bottom Diameter (ft) | 4 |
| Wall Thickness (in) | 4 |
| Sump Rock | |
| Depth Around Barrel (ft) | 2 |

| Inside Sump Volume | |
|---|---|
| Cone (CF) | 29.32 |
| Barrel (CF) | 50.24 |
| Total (CF) | 79.56 |

| Gravel Storage Volume | |
|---|---|
| Volume Around Barrel | 159.09 |
| Volume Under Barrel | 109.03 |
| Total (CF) | 268.12 |
| Storage in Gravel 30% (CF) | 80.44 |

| **Total Storage (CF)** | **160.00** |
|---|---|

| Infiltration per Sump @ 1.1 in/hr | |
|---|---|
| Infiltration Area (SF) | 54.51 |
| Total Infiltration (CF/HR) | 5.00 |
| **Infiltration - 1 hr Event (CF)** | **5.00** |

| **Total Storg and Infiltr in 1 Hr** | **164.99** |
|---|---|

# Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 4 2025

## Typical Driveway Culvert

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 10.00 |
| Pipe Length (ft) | = | 14.00 |
| Slope (%) | = | 0.36 |
| Invert Elev Up (ft) | = | 10.05 |
| Rise (in) | = | 12.0 |
| Shape | = | Circular |
| Span (in) | = | 12.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.013 |
| Culvert Type | = | Circular Corrugate Metal Pipe |
| Culvert Entrance | = | Mitered to slope (C) |
| Coeff. K,M,c,Y,k | = | 0.021, 1.33, 0.0463, 0.75, 0.7 |

**Embankment**

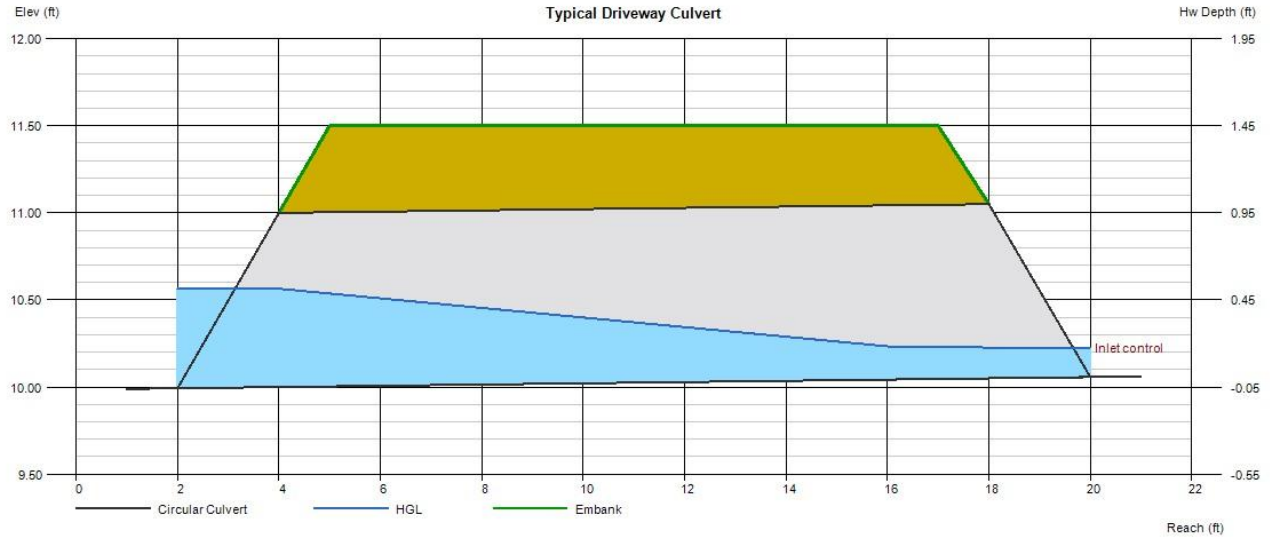
| | | |
|---|---|---|
| Top Elevation (ft) | = | 11.50 |
| Top Width (ft) | = | 12.00 |
| Crest Width (ft) | = | 6.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 0.00 |
| Qmax (cfs) | = | 2.00 |
| Tailwater Elev (ft) | = | (dc+D)/2 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 0.10 |
| Qpipe (cfs) | = | 0.10 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 0.22 |
| Veloc Up (ft/s) | = | 1.69 |
| HGL Dn (ft) | = | 10.56 |
| HGL Up (ft) | = | 10.18 |
| Hw Elev (ft) | = | 10.23 |
| Hw/D (ft) | = | 0.18 |
| Flow Regime | = | Inlet Control |



# STORM DRAINAGE REPORT

PREPARED IN ACCORDANCE WITH
MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ) CIRCULAR 8

**Phase 14- Wilderness Escalante Preserve**

On property located at Sophie Lake Road
legally described as COS 4389
in S28, 29, 32 & 33, T37N, R27W, PMM, Lincoln County.

Published: January 7, 2026

**Prepared For:**
Escalante Wilderness
Preserve US LP
PO Box 2092
Eureka, MT 59917

**Prepared By:**
406 Engineering, Inc.
35 8th Street East
Kalispell, MT 59901

## 1.0 GENERAL

Escalante Wilderness Preserve US LP owns the owns the 25.45-acre property referenced above. The owners intend to develop Phase 14 of the project which includes the development of 79 lots. The new development will include a road extension, 79 single-family homes, landscaping, and undeveloped natural land. The remaining portions of the property are to remain undeveloped.

This report aims to outline the current hydrological conditions of this site compared to the hydrological conditions that will exist after the proposed development. This report is prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The organization of the report follows the outlined requirements of DEQ-8. The report identifies storm water management with routing and storage requirements based on the analysis of the pre-development and post-development conditions.

This report and any attachments shall be submitted to the DEQ or to a delegated division of local government for review and approval. The report and attachments demonstrate that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owner. This report qualifies as a “Standard Plan” per DEQ-8.

## 2.0 SITE INFORMATION

GEOTECHNICAL INFORMATION:

Hydrologic soil groups are based on the estimates of runoff potential. The proposed development consists of hydrologic soil group A soils. Group A soils have high infiltration rates and low runoff potential, even when thoroughly wet. These deep, well-drained sands and gravels have high transmission rates. Refer to the appendices for the NRCS Hydrologic Soil Group map.

PRE-DEVELOPED CONDITIONS:

For this report, the predeveloped conditions of the site are assumed to be undeveloped. The existing project site is 25.45 acres, with ground cover consisting of open space in good condition. The western property slopes to the south while the easternmost property slopes to the southeast.

POST-DEVELOPED CONDITIONS:

The developed conditions of the 25.45-acre property will include the development of 79 single-family homes, a road extension, and landscaping. The remaining portions of the property will remain undeveloped. The development will result in a minor increase in impervious surfaces but will not change the overall drainage pattern or discharge point. Retention and conveyance structures are proposed to manage the increased runoff from the development.

## 3.0 DRAINAGE DESIGN CRITERIA AND METHODS USED

The SCS method was used to estimate the storm runoff and volume for the property. Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2023 was used to analyze basin runoff. The runoff volume and peak flows for the 2, 10, and 100-year 24-hour storm events were analyzed for pre-developed and post-developed basins.

Primary inputs for the SCS methods are as follows:

- Basin Area: A basin is generally defined as an area that drains to a single point.
- Curve Number: A composite curve number (CN) for a basin is determined based on the hydrologic soil group, ground cover type, treatment, and hydraulic conditions. NRCS TR-55 Runoff CN tables are used to select the appropriate number.
- Time of Concentration: The time of concentration is the theoretical time it takes for runoff to travel to a point of interest from the hydraulically most distant point. Calculating a time of concentration involves summing flow times for runoff as sheet flow, shallow concentrated flow, and channel flow if applicable.
- Manning's Number: A n-value is designated for each surface type, providing an effective roughness coefficient for the water path selected to calculate the time of concentration. Standard tables and figures provided by *Technical Release 55 – Urban Hydrology for Small Watersheds* (TR-55) were used to select the appropriate number.
- Design Storm Depth: The SCS Method uses 24-hour storm depths developed by the National Oceanic and Atmospheric Administration (NOAA), with a selected design recurrence interval, such as 2, 10, or 100 years.
- Storm Distribution: To evaluate the peak flows, selecting a design storm hydrograph or rainfall time distribution pattern is necessary. A Type I storm distribution was utilized for sizing control facilities.

The selection of the curve number enables the SCS method to model the soil capacity and land cover to capture and infiltrate rainfall. The model is highly non-linear, meaning a relatively small percent increase in rainfall can lead to larger increases in runoff. This occurs because as the infiltrative capacity of the soil is used up, a higher percentage of precipitation will run off.

Both the TR-55 Manual and DEQ-8 have been used as reference for the SCS method in this report. The SCS method uses 24-hour storm depths developed by the NOAA with a selected design recurrence interval, such as 2, 10, 50, or 100-year storms. The precipitation data used in this report were obtained from NOAA Atlas 14, Volume 12, Version 2 and can be seen below in Table 1.

Table 1: NOAA Precipitation Depths

| Recurrence Interval | 2-year | 10-year | 100-year |
|---|---|---|---|
| 24-hour Precipitation Depth (in) | 1.24 | 1.74 | 2.55 |

This report is proposed as a Standard Plan per DEQ 8 and therefore must address storm water drainage peak flow and volume. Standard Plans must also demonstrate that the proposed development will not allow storm water to do any of the following:

- Exceed the pre-development runoff to an adjoining property during the 2-year storm event;
- Overtop roadways or driveways during a 10-year storm event; or
- Inundate any buildings or drainfields during a 100-year storm event. This may be demonstrated through either narrative descriptions or calculations.

**4.0 DELINEATION OF DRAINAGE BASINS**

For this report section, the property is considered to have 19 drainage basins representing flow from the proposed home and driveway development as well as the road extensions. Drainage basin 20 is a "typical basin", representing flow from lots that slope away from the roadside stormwater facilities. The proposed property boundaries, the proposed development, and the topography across the site defined the drainage study extent. Although the proposed development will alter the localized drainage pattern, the overall drainage pattern will remain the same. Therefore, the pre-development and post-development drainage basins will remain the same size and shape.

PRE-DEVELOPED ON-SITE DRAINAGE BASINS:

For the pre-developed drainage basins, storm water moves as sheet flow with slopes ranging between 0%-13%. The basins are considered vacant, undeveloped land with no existing structures or impervious areas. No significant storm water runoff concerns are known to exist on the property. The curve number (CN) for the pre-developed site is based on the ground cover conditions of the existing open space in good condition for soil group A (CN 39). Refer to the appendices for the TR-55 Runoff curve number tables and the TR-55 time of concentration calculations. Table 2 provides a summary of the pre-developed time of concentrations and curve numbers.

Table 2: Pre-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 0.41 | 39 | 13.7 |
| Basin 2 | 0.53 | 39 | 9.1 |
| Basin 3 | 0.23 | 39 | 14 |
| Basin 4 | 0.86 | 39 | 12.1 |
| Basin 5 | 0.94 | 39 | 11.1 |
| Basin 6 | 0.27 | 39 | 1.8 |
| Basin 7 | 0.96 | 39 | 8 |
| Basin 8 | 0.38 | 39 | 10.1 |
| Basin 9 | 0.35 | 39 | 11.8 |
| Basin 10 | 0.51 | 39 | 13.1 |
| Basin 11 | 0.20 | 39 | 8.7 |
| Basin 12 | 0.66 | 39 | 10.1 |
| Basin 13 | 0.45 | 39 | 15.8 |
| Basin 14 | 0.16 | 39 | 15.6 |
| Basin 15 | 4.27 | 39 | 14.5 |
| Basin 16 | 2.30 | 39 | 16.6 |
| Basin 17 | 0.25 | 39 | 11.4 |
| Basin 18 | 2.82 | 39 | 11 |
| Basin 19 | 0.21 | 39 | 34.1 |
| Basin 20-TB Lot 21 | 0.23 | 39 | 13 |

POST-DEVELOPED ON-SITE DRAINAGE BASINS:

As mentioned above, the post-development drainage basins will remain the same size and shape as the pre-development drainage basins. The post-development conditions for the basins include the proposed development of the land including the homes, proposed asphalt drives, asphalt road extensions, and undeveloped natural land. The composite CN is calculated land cover of open space in good condition for soil group A (CN 39), rooftops (98), and asphalt (98). Table 3 provides a summary of the post-developed time of concentrations and curve numbers.

Table 3: Post-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 0.41 | 48 | 13.7 |
| Basin 2 | 0.53 | 68 | 9.1 |
| Basin 3 | 0.23 | 77 | 14 |
| Basin 4 | 0.86 | 55 | 12.1 |
| Basin 5 | 0.94 | 56 | 11.1 |
| Basin 6 | 0.27 | 68 | 1.8 |
| Basin 7 | 0.96 | 55 | 8 |
| Basin 8 | 0.38 | 68 | 10.1 |
| Basin 9 | 0.35 | 65 | 11.8 |
| Basin 10 | 0.51 | 65 | 13.1 |
| Basin 11 | 0.20 | 77 | 8.7 |
| Basin 12 | 0.66 | 59 | 10.1 |
| Basin 13 | 0.45 | 66 | 15.8 |
| Basin 14 | 0.16 | 80 | 15.6 |
| Basin 15 | 4.27 | 55 | 14.5 |
| Basin 16 | 2.30 | 53 | 16.6 |
| Basin 17 | 0.25 | 67 | 11.4 |
| Basin 18 | 2.82 | 55 | 11 |
| Basin 19 | 0.21 | 47 | 34.1 |
| Basin 20-TB Lot 21 | 0.23 | 50 | 13 |

OFF-SITE BASINS:

The property is surrounded by land with similar ground cover. No off-site flows contribute to flows onto the property. All off-site flows are negligible and have not been considered in this drainage analysis.

## 5.0 RUNOFF VOLUMES AND FLOWS

Utilizing the procedures outlined in DEQ 8, runoff volumes and peak flows for the 2-year, 10-year, and 100-year 24-hour storm events were evaluated for the pre- and post-developed drainage basins. Refer to the attached calculations for the pre-developed peak flows and runoff volumes, and Table 4 for the post-developed peak flows and runoff volumes.

Table 4: Post-Developed Peak Flows

| Basin ID | 2-year | | 10-year | | 100-year | |
|---|---|---|---|---|---|---|
| | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) |
| Basin 1 | 0 | 0 | 0 | 19 | 0.001 | 19 |
| Basin 2 | 0.001 | 34.3 | 0.005 | 223 | 0.077 | 789 |
| Basin 3 | 0.002 | 92.6 | 0.024 | 257 | 0.09 | 628 |
| Basin 4 | 0 | 0 | 0 | 4.17 | 0.008 | 295 |
| Basin 5 | 0 | 0 | 0.001 | 12.5 | 0.01 | 381 |
| Basin 6 | 0.001 | 16.4 | 0.002 | 107 | 0.049 | 377 |
| Basin 7 | 0 | 0 | 0.001 | 4.52 | 0.008 | 320 |
| Basin 8 | 0.001 | 25.4 | 0.004 | 165 | 0.048 | 583 |
| Basin 9 | 0 | 6.28 | 0.002 | 95.3 | 0.019 | 414 |
| Basin 10 | 0.001 | 9.15 | 0.004 | 139 | 0.028 | 604 |
| Basin 11 | 0.002 | 82.6 | 0.027 | 230 | 0.098 | 560 |
| Basin 12 | 0 | 0 | 0.002 | 41.5 | 0.009 | 410 |
| Basin 13 | 0.001 | 13.1 | 0.003 | 137 | 0.03 | 551 |
| Basin 14 | 0.005 | 95.7 | 0.028 | 233 | 0.081 | 523 |
| Basin 15 | 0 | 0 | 0.002 | 19.6 | 0.037 | 1387 |
| Basin 16 | 0 | 0 | 0 | 0 | 0.015 | 509 |
| Basin 17 | 0 | 11.7 | 0.002 | 93.9 | 0.025 | 353 |
| Basin 18 | 0 | 0 | 0.002 | 13.7 | 0.026 | 969 |
| Basin 19 | 0 | 0 | 0.001 | 23.4 | 0.004 | 159 |
| Basin 20-TB Lot 21 | 0 | 0 | 0 | 0 | 0.001 | 24.7 |

## 6.0 PROVISIONS TO MITIGATE ON-SITE STORM WATER FLOWS

INITIAL STORM WATER FACILITY

Utilizing the procedures identified in DEQ-8, the initial storm water facilities has been sized to infiltrate, evapotranspire, and/or capture the post-development runoff generated from the first 0.5 inches of rainfall on the impervious areas. The required volume of the initial storm water facilities have been included in the design of the proposed retention facility. Refer to attached calculations for the initial storm water facility volume for the drainage basins.

CONVEYANCE FACILITIES

Utilizing the procedures outlines within DEQ-8, conveyance facilities have been provided for numerous basins. Conveyance swales, check dams, and culverts have been proposed throughout the site and have been sized to convey the 100-year post developed peak flows ensuring storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event. Refer to Table 5 and the attached calculations for more detail.

Table 5: Drainage Basin Conveyance

| Basin ID | 100-year peak flow (cfs) | Swales | | Swales and Check Dams | | | Culverts | |
|---|---|---|---|---|---|---|---|---|
| | | Swale ID | Maximum Conveyance (cfs) | Retention Structure ID | Maximum Conveyance Through Swale (cfs) | Maximum Conveyance Over Check Dam (cfs) | Culvert ID | Max Conveyance (cfs) |
| Basin 1 | 0.001 | Swale A | 12.78 | A | 22.61 | 13.9 | N/A | N/A |
| Basin 2 | 0.077 | Swale A | 12.78 | A | 22.61 | 13.9 | 1 | 2.00 |
| Basin 3 | 0.090 | Swale A | 12.78 | A | 22.61 | 13.9 | 1 | 2.00 |
| Basin 4 | 0.008 | Swale A | 12.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 5 | 0.010 | Swale A | 13.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 6 | 0.049 | Swale A | 14.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 7 | 0.008 | Swale A | 15.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 8 | 0.048 | Swale A | 16.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 9 | 0.019 | Swale A | 17.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 10 | 0.028 | Swale A | 18.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 11 | 0.098 | Swale A | 19.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 12 | 0.009 | Swale A | 20.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 13 | 0.030 | Swale A | 21.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 14 | 0.081 | Swale A | 22.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 15 | 0.037 | Swale A | 23.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 16 | 0.015 | Swale A | 24.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 17 | 0.025 | Swale A | 25.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 18 | 0.026 | Swale A | 26.78 | B | 48.7 | 34.11 | 1 | 2.00 |
| Basin 19 | 0.004 | Swale A | 27.78 | A | 22.61 | 13.9 | 1 | 2.00 |
| Basin 20-TB Lot 21 | 0.001 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

**Swale A**

- Side slope: 3:1
- Depth: 1 ft
- Cross-Sectional Area: 3 sf
- Capacity: 12.78 cfs

**Driveway Culvert 1**

- Diameter: 12”
- Length: 14’
- Capacity: 2.0 cfs
- Material: CMP

RETENTION AND DETENTION FACILITIES

Utilizing the procedures outlined in DEQ-8, the required and provided retention and infiltration facilities size for each basin can be seen in Table 6. With the existing topography on the property where storm water naturally sheets, the storm water will collect in the proposed retention facilities. The proposed retention facilities have been sized to retain the post-developed 10-year and 100-year runoff volume. Refer to Table 6 and to the attached calculations for more detail.

Table 6: Drainage Basin Storage Volumes

| Basin ID | Design Storm Event | Design Volume (cf) | Proposed Retention/Infiltration Structure | Proposed Retention Facility Volume (cf) |
|---|---|---|---|---|
| Basin 1 | 100-year and ISWFV | 103 | Structure A with 1 Check Dam | 187.5 |
| Basin 2 | 10-year and ISWFV | 461 | Structure A with 1 check dam and 2 sumps | 519.38 |
| Basin 3 | 10-year and ISWFV | 264 | Structure A with 1 check dam and 1 sump | 354.38 |
| Basin 4 | 100-year and ISWFV | 413 | Structure B with 4 check dams | 427.50 |
| Basin 5 | 100-year and ISWFV | 471 | Structure B with 3 check dams and 1 sump | 537.75 |
| Basin 6 | 10-year and ISWFV | 233 | Structure B with 2 check dams | 330.75 |
| Basin 7 | 100-year and ISWFV | 463 | Structure B with 8 check dams | 525.00 |
| Basin 8 | 10-year and ISWFV | 333 | Structure B with 6 check dams | 393.75 |
| Basin 9 | 10-year and ISWFV | 271 | Structure B with 5 check dams | 315.00 |
| Basin 10 | 10-year and ISWFV | 400 | Structure B with 7 check dams | 441.00 |
| Basin 11 | 10-year and ISWFV | 233 | Structure B with 3 check dams | 283.50 |
| Basin 12 | 100-year and ISWFV | 410 | Structure B with 3 check dams and 1 sump | 456.38 |
| Basin 13 | 10-year and ISWFV | 360 | Structure B with 1 check dam and 2 sumps | 419.25 |
| Basin 14 | 10-year and ISWFV | 204 | 2 sumps | 330.00 |
| Basin 15 | 100-year and ISWFV | 2053 | Structure B with 9 Check Dams and 8 sumps | 2152.13 |
| Basin 16 | 100-year and ISWFV | 971 | Structure B with 9 dams and 1 sump | 991.88 |
| Basin 17 | 10-year and ISWFV | 214 | Structure B with 4 dams | 262.50 |
| Basin 18 | 100-year and ISWFV | 1378 | Structure B with 14 check dams and 1 sump | 1378.88 |
| Basin 19 | 100-year and ISWFV | 159 | Structure A with 1 check dam | 187.50 |
| Basin 20-TB Lot 21 | 100-year and ISWFV | 76 | 1 sump | 165.00 |

**Retention Swale A, Check Dam A**

- Side slope: 3:1
- Depth: 1.50 ft
- Cross-Sectional area: 6.75 sf
- Check Dam Depth: 1.25 ft
- Minimum space between check dams: varies per basin
- Total storage per check dam: varies per basin

**Retention Swale B, Check Dam B**

- Side slope: 3:1
- Depth: 2.0 ft
- Cross-Sectional Area: 12 sf
- Check Dam Depth: 1.75 ft
- Minimum space between check dams: varies per basin
- Total storage per check dam: varies per basin

DRAINAGE BASIN 1

Drainage Basin 1 represents runoff from lot 1 and the road extension development. This parcel generally slopes to the northwest. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with one check dam. Retention Structure A is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 2

Drainage Basin 2 represents runoff from lot 2 and 3 and the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with one check dam and two sumps. Retention Structure A and the infiltration sumps are designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 3

Drainage Basin 3 represents runoff from the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with one check and a sump. Retention Structure A and the infiltration sump are designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 4

Drainage Basin 4 represents runoff from lot 7 and 8, and the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with four check dams. Retention Structure B is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 5

Drainage Basin 5 represents runoff from lots 9-12, and the road extension development. This parcel generally slopes to the southeast, then follows the road grade south. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with three check dams and a sump. Retention Structure B and the infiltration sump are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 6

Drainage Basin 6 represents runoff from the road extension development. This parcel generally slopes to the south. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with two check dams and two sumps. Retention Structure B and the infiltration sump are designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 7

Drainage Basin 7 represents runoff from lot 16 and 17, and the road extension development. This parcel generally slopes to the northeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with eight check dams. Retention Structure B is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 8

Drainage Basin 8 represents runoff from the road extension development. This parcel generally slopes to the northeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with six check dams. Retention Structure B is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 9

Drainage Basin 9 represents runoff from the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with five check dams. Retention Structure B is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 10

Drainage Basin 10 represents runoff from the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with seven check dams. Retention Structure B is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 11

Drainage Basin 11 represents runoff from the road extension development. This parcel generally slopes to the south. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with three check dams. Retention Structure B is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 12

Drainage Basin 12 represents runoff from lot 12 and the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with three check dams and a sump. Retention Structure B and the infiltration sump are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 13

Drainage Basin 13 represents runoff from the road extension development. This parcel generally slopes to the southeast and southwest. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with one check dam and two sumps at the low point. Retention Structure B and the infiltration sumps are designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 14

Drainage Basin 14 represents runoff from the road extension development. This parcel generally slopes to the southwest. Runoff from this basin will be conveyed via conveyance swale A to two sumps. The infiltration sumps are designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event and that no roads, driveways, or other access points are overtopped during the 10-year storm event

DRAINAGE BASIN 15

Drainage Basin 15 represents runoff from lots 46-61 and the road extension development. This parcel generally slopes to the southwest. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with 9 check dams and multiple sumps throughout the basin. Retention Structure B and the infiltration sumps are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 16

Drainage Basin 16 represents runoff from lots 72-79 and the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with 9 check dams and a sump. Retention Structure B and the infiltration sump are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 17

Drainage Basin 17 represents runoff from the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with four check dams. Retention Structure B is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event and that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 18

Drainage Basin 18 represents runoff from lots 63, 67-70 and the road extension development. This parcel generally slopes to the southwest. Runoff from this basin will be conveyed via conveyance swale A to retention structure B with fourteen check dams and a sump. Retention Structure B and the infiltration sump are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event and that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 19

Drainage Basin 19 represents runoff from the road extension development. This parcel generally slopes to the northwest. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with one check dam. Retention Structure A is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event and that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 20-TYPICAL BASIN

Drainage Basin 20 represents runoff from the development of lot 21. This parcel generally slopes to the southeast. This basin will be considered typical for each lot that slopes away from stormwater facilities. On the drainage basin exhibit these lots are labeled as “TB” and include lots 4-6, 13-15, 19-31, 33-45, 62, 64, 66, and 71. Runoff from a typical basin will sheet flow from a vegetative filter strip and will be stored in an infiltration sump that is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event and that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

INFILTRATION FACILITIES

Infiltration sumps are proposed to be installed throughout the development. These will capture any runoff not retained in check dams. Not taking into consideration infiltration, each sump is capable of storing 165 cubic feet of runoff volume. Lots 4-6, 13-15, 19-31, 33-45, 62, 64, 66, and 71 will require sumps to be installed after development. Pre-treatment facilities must be provided for infiltration facilities. Vegetative filter strips and vegetated swales will be used to satisfy the pre-treatment requirement. Refer to attachments for more detail on sump locations and storage calculations.

PRE-TREATMENT FACILITIES

The rural nature of the site will provide superb pretreatment of any storm water before leaving the site.

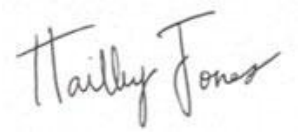
## 7.0 OPERATION AND MAINTENANCE

The operation and maintenance of the storm water management infrastructure are essential to the longevity of the storm water treatment. The lot layout includes an Operation and Maintenance Plan.

## 8.0 CONCLUSIONS

This report was prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The development of the 25.45-acre property will include the development of 79 lots with single family homes and road extensions, which will increase the impervious area and therefore increase both runoff rates and volume. The proposed retention and infiltration structures have been sized to collect storm water and ensure that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owners. The plan was developed to ensure that storm water does not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

Prepared by:
**406 Engineering, Inc.**

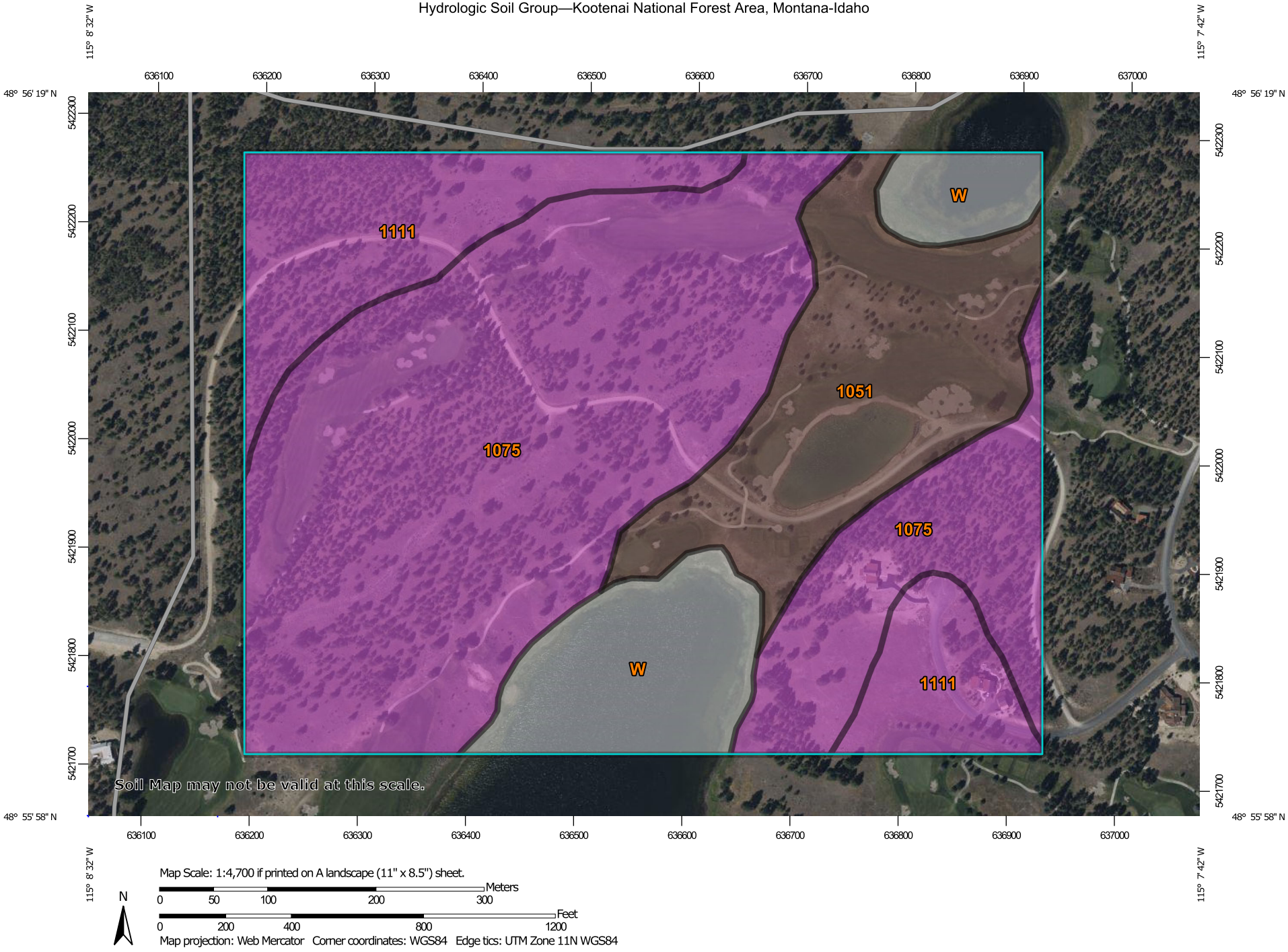


Hailley Jones, Staff Engineer

**ATTACHMENTS**

- ✓ *NRCS Hydrologic Soil Group (3 pages)*
- ✓ *NOAA Precipitation Data (4 pages)*
- ✓ *TR-55 Curve Number Values (2 pages)*
- ✓ *Composite Curve Number Calculations (1 page)*
- ✓ *Hydraflow Time of Concentration and Runoff Calculations (13 pages)*
- ✓ *Stormwater Facilities Sizing (4 pages)*

*https://406engineeringinc.sharepoint.com/Shared Documents/406 Work/1_Projects/21-007k Escalante Wilderness Preserve/3_DESIGN&PERMITTING/1_DEQ JOINT APP/5.Appendix E - Drainage Report/rpt.2025-10-16.CLIENT.DEQ 8.docx*
*Wednesday, January 7, 2026, 9:38 AM*




Map Scale: 1:4,700 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Lines**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Points**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Kootenai National Forest Area, Montana-Idaho
Survey Area Data: Version 24, Sep 16, 2024

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

Date(s) aerial images were photographed: Jul 14, 2023—Aug 13, 2023

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.

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1051 | Bohnly-Seelovers-Newbar family complex, 0 to 15 percent slopes | B/D | 17.9 | 17.6% |
| 1075 | Tetrault-Canusa-Jocko complex, 1 to 20 percent slopes | A | 56.1 | 55.2% |
| 1111 | Canusa-Felt family complex, 0 to 15 percent slopes | A | 16.1 | 15.8% |
| W | Water | | 11.6 | 11.4% |
| **Totals for Area of Interest** | | | **101.6** | **100.0%** |

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

**NOAA Atlas 14, Volume 12, Version 2**
**Location name: Eureka, Montana, USA***
**Latitude: 48.9386°, Longitude: -115.1253°**
**Elevation: 2656 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Carl Trypaluk, Dale Unruh, Michael St.Laurent, Austin Jordan, Rama Sesha Sridhar Mantripragada, Sandra Pavlovic, Greg Fall, Fernando Salas

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.139** (0.122-0.157) | **0.182** (0.161-0.209) | **0.251** (0.219-0.292) | **0.307** (0.263-0.362) | **0.380** (0.314-0.458) | **0.435** (0.346-0.533) | **0.488** (0.370-0.613) | **0.539** (0.389-0.703) | **0.605** (0.409-0.837) | **0.652** (0.429-0.947) |
| 10-min | **0.192** (0.170-0.218) | **0.253** (0.224-0.289) | **0.348** (0.303-0.405) | **0.425** (0.364-0.502) | **0.527** (0.435-0.636) | **0.603** (0.480-0.739) | **0.677** (0.514-0.850) | **0.748** (0.540-0.976) | **0.839** (0.568-1.16) | **0.904** (0.596-1.31) |
| 15-min | **0.223** (0.197-0.253) | **0.294** (0.260-0.336) | **0.405** (0.353-0.471) | **0.494** (0.423-0.583) | **0.613** (0.506-0.739) | **0.701** (0.558-0.859) | **0.786** (0.597-0.987) | **0.869** (0.627-1.13) | **0.974** (0.660-1.35) | **1.05** (0.692-1.53) |
| 30-min | **0.272** (0.241-0.309) | **0.358** (0.317-0.410) | **0.494** (0.430-0.574) | **0.602** (0.516-0.711) | **0.747** (0.616-0.901) | **0.854** (0.680-1.05) | **0.958** (0.728-1.20) | **1.06** (0.764-1.38) | **1.19** (0.804-1.64) | **1.28** (0.843-1.86) |
| 60-min | **0.326** (0.288-0.369) | **0.427** (0.378-0.489) | **0.588** (0.512-0.684) | **0.717** (0.614-0.846) | **0.888** (0.733-1.07) | **1.02** (0.809-1.24) | **1.14** (0.865-1.43) | **1.26** (0.909-1.64) | **1.41** (0.956-1.96) | **1.52** (1.00-2.21) |
| 2-hr | **0.419** (0.377-0.469) | **0.527** (0.473-0.596) | **0.698** (0.617-0.802) | **0.837** (0.727-0.974) | **1.02** (0.860-1.22) | **1.16** (0.947-1.41) | **1.30** (1.02-1.61) | **1.43** (1.07-1.85) | **1.60** (1.13-2.20) | **1.73** (1.19-2.50) |
| 3-hr | **0.492** (0.448-0.546) | **0.600** (0.544-0.672) | **0.773** (0.690-0.879) | **0.914** (0.803-1.05) | **1.10** (0.942-1.30) | **1.25** (1.04-1.50) | **1.39** (1.11-1.71) | **1.54** (1.18-1.97) | **1.72** (1.25-2.34) | **1.85** (1.32-2.66) |
| 6-hr | **0.642** (0.589-0.704) | **0.753** (0.689-0.831) | **0.935** (0.843-1.04) | **1.08** (0.965-1.22) | **1.29** (1.12-1.48) | **1.45** (1.23-1.70) | **1.61** (1.33-1.94) | **1.77** (1.42-2.23) | **1.98** (1.52-2.65) | **2.14** (1.60-3.02) |
| 12-hr | **0.846** (0.776-0.925) | **0.978** (0.895-1.08) | **1.20** (1.08-1.32) | **1.38** (1.23-1.54) | **1.63** (1.43-1.84) | **1.82** (1.58-2.10) | **2.02** (1.71-2.39) | **2.22** (1.84-2.73) | **2.48** (2.00-3.24) | **2.69** (2.11-3.68) |
| 24-hr | **1.08** (0.990-1.19) | **1.24** (1.14-1.37) | **1.52** (1.37-1.68) | **1.74** (1.56-1.94) | **2.06** (1.82-2.31) | **2.30** (2.01-2.62) | **2.55** (2.19-2.97) | **2.80** (2.36-3.39) | **3.14** (2.58-4.02) | **3.39** (2.74-4.56) |
| 2-day | **1.30** (1.18-1.42) | **1.49** (1.36-1.64) | **1.82** (1.64-2.02) | **2.09** (1.87-2.33) | **2.47** (2.18-2.79) | **2.76** (2.40-3.16) | **3.05** (2.62-3.58) | **3.35** (2.83-4.07) | **3.75** (3.09-4.82) | **4.06** (3.28-5.46) |
| 3-day | **1.43** (1.31-1.57) | **1.65** (1.51-1.82) | **2.01** (1.82-2.24) | **2.31** (2.07-2.59) | **2.73** (2.40-3.10) | **3.05** (2.65-3.51) | **3.38** (2.88-3.97) | **3.71** (3.11-4.52) | **4.14** (3.41-5.35) | **4.48** (3.62-6.06) |
| 4-day | **1.55** (1.41-1.70) | **1.78** (1.62-1.97) | **2.17** (1.96-2.41) | **2.50** (2.23-2.79) | **2.94** (2.58-3.34) | **3.29** (2.85-3.79) | **3.63** (3.10-4.28) | **3.98** (3.34-4.87) | **4.45** (3.66-5.76) | **4.81** (3.89-6.51) |
| 7-day | **1.83** (1.67-2.02) | **2.10** (1.91-2.32) | **2.55** (2.29-2.83) | **2.92** (2.60-3.27) | **3.43** (3.00-3.90) | **3.82** (3.30-4.41) | **4.21** (3.59-4.98) | **4.62** (3.87-5.64) | **5.15** (4.23-6.65) | **5.55** (4.49-7.50) |
| 10-day | **2.07** (1.89-2.28) | **2.37** (2.16-2.62) | **2.86** (2.57-3.18) | **3.27** (2.91-3.66) | **3.83** (3.35-4.35) | **4.26** (3.68-4.91) | **4.69** (4.00-5.54) | **5.12** (4.30-6.26) | **5.70** (4.69-7.36) | **6.14** (4.97-8.27) |
| 20-day | **2.77** (2.53-3.06) | **3.16** (2.87-3.49) | **3.77** (3.39-4.21) | **4.28** (3.81-4.81) | **4.97** (4.36-5.67) | **5.49** (4.77-6.36) | **6.01** (5.15-7.12) | **6.52** (5.52-8.00) | **7.20** (5.98-9.32) | **7.70** (6.30-10.4) |
| 30-day | **3.34** (3.05-3.69) | **3.78** (3.43-4.19) | **4.50** (4.03-5.01) | **5.07** (4.51-5.69) | **5.84** (5.13-6.66) | **6.41** (5.58-7.43) | **6.97** (6.00-8.27) | **7.52** (6.40-9.23) | **8.23** (6.89-10.6) | **8.74** (7.24-11.8) |
| 45-day | **4.12** (3.75-4.55) | **4.63** (4.19-5.12) | **5.44** (4.87-6.04) | **6.08** (5.40-6.80) | **6.92** (6.08-7.86) | **7.53** (6.57-8.70) | **8.11** (7.01-9.58) | **8.66** (7.42-10.6) | **9.34** (7.92-12.0) | **9.82** (8.32-13.2) |
| 60-day | **4.79** (4.36-5.30) | **5.36** (4.85-5.93) | **6.24** (5.58-6.93) | **6.93** (6.15-7.74) | **7.81** (6.88-8.86) | **8.44** (7.38-9.73) | **9.02** (7.83-10.6) | **9.56** (8.24-11.6) | **10.2** (8.74-13.1) | **10.6** (9.17-14.2) |

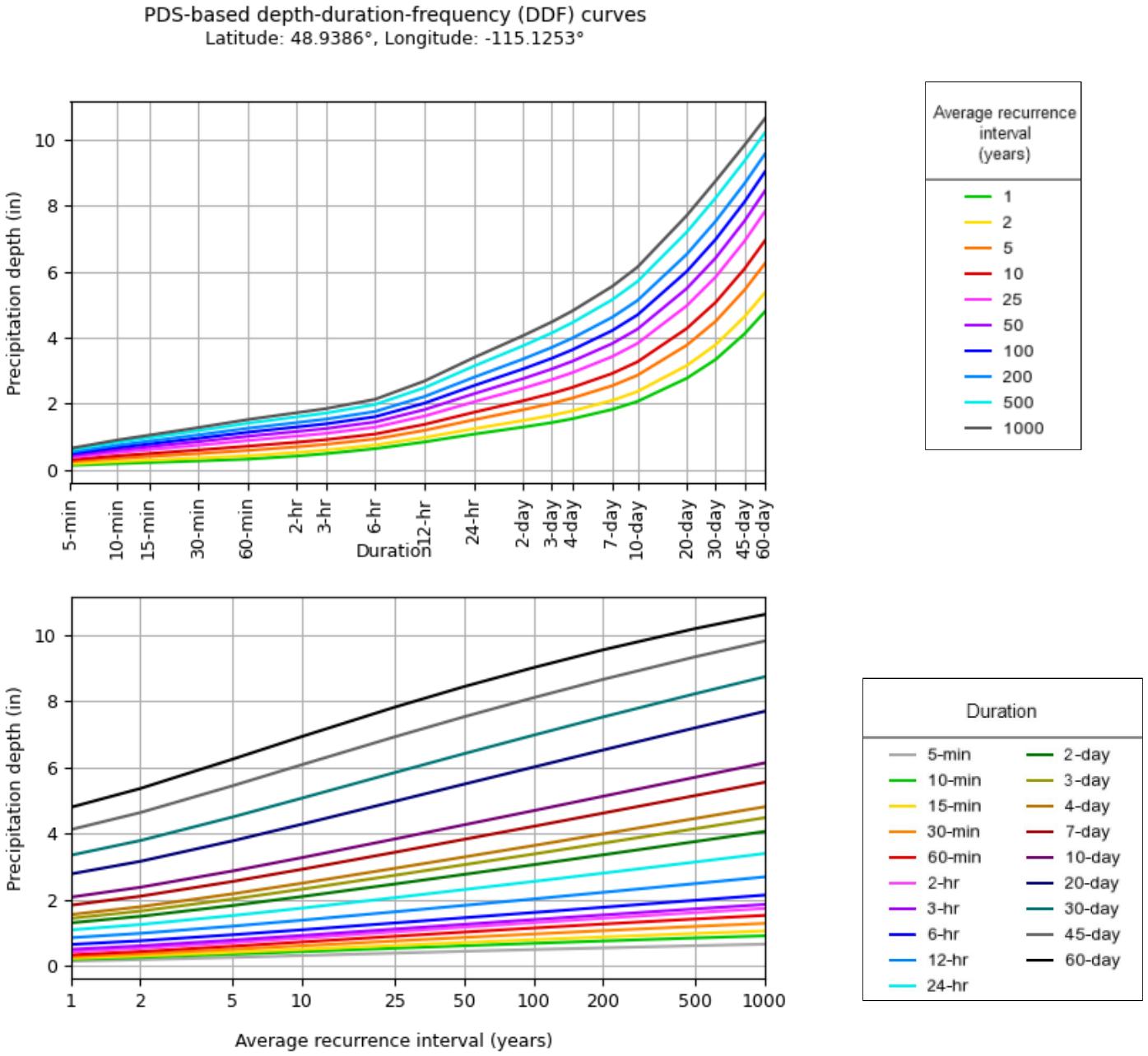
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical



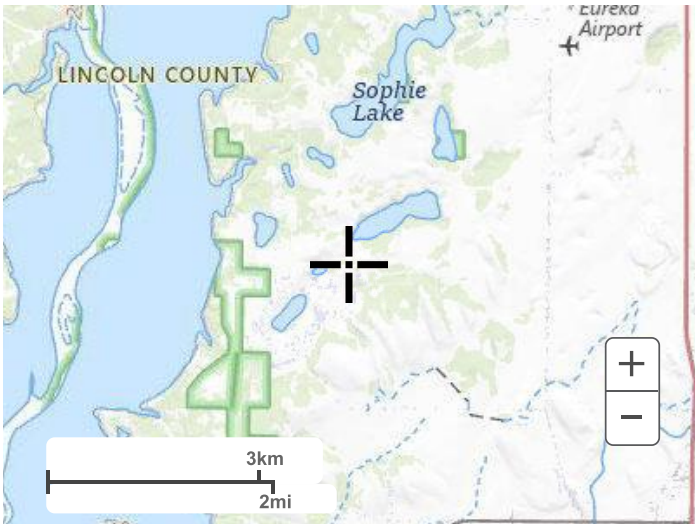

NOAA Atlas 14, Volume 12, Version 2

Created (GMT): Fri Aug 1 16:57:16 2025

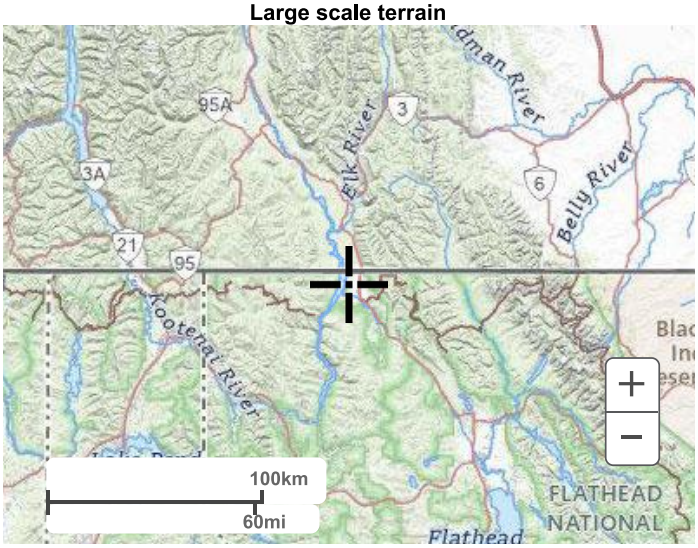
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## Maps & aerials

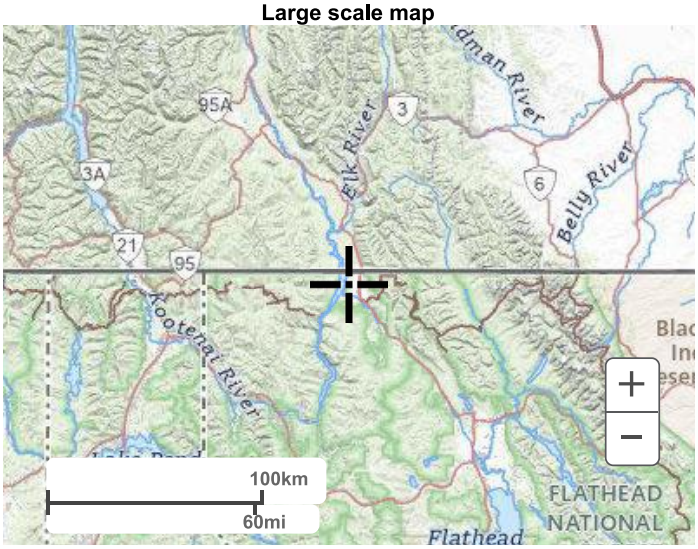
**Small scale terrain**



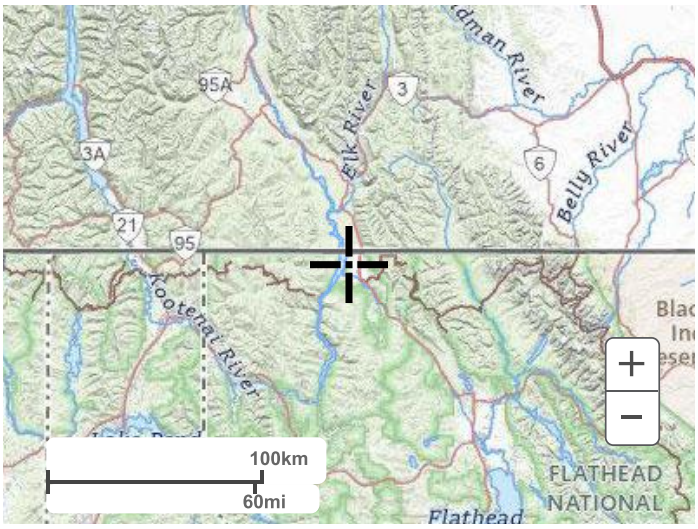

Large scale terrain




Large scale map




Large scale aerial




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National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table 2-2a Runoff curve numbers for urban areas [1]

| Cover description: Cover type and hydrologic condition | Average percent impervious area [2] | Curve numbers for hydrologic soil group: A | B | C | D |
|---|---|---|---|---|---|
| ***Fully developed urban areas (vegetation established)*** | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.) [3]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only) [4] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| ***Developing urban areas*** | | | | | |
| Newly graded areas (pervious areas only, no vegetation) [5] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

| Cover description | | Curve numbers for hydrologic soil group | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic condition | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing. [2/] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element. [3/] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | 30 [4/] | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm). [5/] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods. [6/] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 30 [4/] | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

1 Average runoff condition, and $I_a = 0.2S$.

2 ***Poor:*** <50%) ground cover or heavily grazed with no mulch.
***Fair:*** 50 to 75% ground cover and not heavily grazed.
***Good:*** > 75% ground cover and lightly or only occasionally grazed.

3 ***Poor:*** <50% ground cover.
***Fair:*** 50 to 75% ground cover.
***Good:*** >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 ***Poor:*** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
***Fair:*** Woods are grazed but not burned, and some forest litter covers the soil.
***Good:*** Woods are protected from grazing, and litter and brush adequately cover the soil.

**Post-Developed Composite Curve Number & Initial Storm Water Facility Volume**
**PROJECT: ESCALANTE WILDERNESS PRESERVE-PHASE 14**
**PREPARED BY: 406 Engineering Inc**
October 29, 2025

| Basin ID | Total Area | | Open Space Group A - Good Condition | | Roof | | Asphalt | | Composite CN | Total Impervious Area (SF) | Initial Storm Water Facility Volume (CF) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Acres) | (SF) | Area (SF) | CN | Area (SF) | CN | Area (SF) | CN | | | |
| Basin 1 | 0.41 | 17662 | 15188 | 39 | 1400 | 98 | 1074 | 98 | **48** | 2474 | 103 |
| Basin 2 | 0.53 | 23137 | 12072 | 39 | 4200 | 98 | 6865 | 98 | **68** | 11065 | 461 |
| Basin 3 | 0.23 | 9975 | 3640 | 39 | 0 | 98 | 6335 | 98 | **77** | 6335 | 264 |
| Basin 4 | 0.86 | 37470 | 27547 | 39 | 2800 | 98 | 7123 | 98 | **55** | 9923 | 413 |
| Basin 5 | 0.94 | 40928 | 29618 | 39 | 5600 | 98 | 5710 | 98 | **56** | 11310 | 471 |
| Basin 6 | 0.27 | 11578 | 5980 | 39 | 0 | 98 | 5598 | 98 | **68** | 5598 | 233 |
| Basin 7 | 0.96 | 41982 | 30875 | 39 | 4200 | 98 | 6907 | 98 | **55** | 11107 | 463 |
| Basin 8 | 0.38 | 16506 | 8514 | 39 | 0 | 98 | 7992 | 98 | **68** | 7992 | 333 |
| Basin 9 | 0.35 | 15284 | 8781 | 39 | 0 | 98 | 6503 | 98 | **65** | 6503 | 271 |
| Basin 10 | 0.51 | 22167 | 12575 | 39 | 0 | 98 | 9592 | 98 | **65** | 9592 | 400 |
| Basin 11 | 0.20 | 8826 | 3226 | 39 | 0 | 98 | 5600 | 98 | **77** | 5600 | 233 |
| Basin 12 | 0.66 | 28802 | 19225 | 39 | 0 | 98 | 9577 | 98 | **59** | 9577 | 399 |
| Basin 13 | 0.45 | 19518 | 10885 | 39 | 0 | 98 | 8633 | 98 | **66** | 8633 | 360 |
| Basin 14 | 0.16 | 7144 | 2237 | 39 | 0 | 98 | 4907 | 98 | **80** | 4907 | 204 |
| Basin 15 | 4.27 | 185960 | 136688 | 39 | 22400 | 98 | 26872 | 98 | **55** | 49272 | 2053 |
| Basin 16 | 2.30 | 100309 | 77009 | 39 | 11200 | 98 | 12100 | 98 | **53** | 23300 | 971 |
| Basin 17 | 0.25 | 11037 | 5910 | 39 | 0 | 98 | 5127 | 98 | **67** | 5127 | 214 |
| Basin 18 | 2.82 | 122739 | 89661 | 39 | 8400 | 98 | 24678 | 98 | **55** | 33078 | 1378 |
| Basin 19 | 0.21 | 8983 | 7909 | 39 | 0 | 98 | 1074 | 98 | **47** | 1074 | 45 |
| Basin 20-TB Lot 21 | 0.23 | 9828 | 8011 | 39 | 1400 | 98 | 417 | 98 | **50** | 1817 | 76 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 1 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 7 |
| 8 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 8 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 9 |
| 10 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 10 |
| 11 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 11 |
| 12 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 12 |
| 13 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 13 |
| 14 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed basin 14 |
| 15 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 15 |
| 16 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 16 |
| 17 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 17 |
| 18 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 18 |
| 19 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 19 |
| 20 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 20- Typical Basi |
| 24 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 1 |
| 25 | SCS Runoff | 0.001 | 2 | 1238 | 34 | ------ | ------ | ------ | Developed Basin 2 |
| 26 | SCS Runoff | 0.002 | 2 | 714 | 93 | ------ | ------ | ------ | Developed Basin 3 |
| 27 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 4 |
| 28 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 5 |
| 29 | SCS Runoff | 0.001 | 1 | 1235 | 16 | ------ | ------ | ------ | Developed Basin 6 |
| 30 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 7 |
| 31 | SCS Runoff | 0.001 | 2 | 1242 | 25 | ------ | ------ | ------ | Developed Basin 8 |
| 32 | SCS Runoff | 0.000 | 2 | 1376 | 6 | ------ | ------ | ------ | Developed Basin 9 |
| 33 | SCS Runoff | 0.001 | 2 | 1376 | 9 | ------ | ------ | ------ | Developed Basin 10 |
| 34 | SCS Runoff | 0.002 | 2 | 708 | 83 | ------ | ------ | ------ | Developed Basin 11 |
| 35 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 12 |
| 36 | SCS Runoff | 0.001 | 2 | 1330 | 13 | ------ | ------ | ------ | Developed Basin 13 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 37 | SCS Runoff | 0.005 | 2 | 608 | 96 | ------ | ------ | ------ | Developed Basin 14 |
| 38 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 15 |
| 39 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 16 |
| 40 | SCS Runoff | 0.000 | 2 | 1282 | 12 | ------ | ------ | ------ | Developed Basin 17 |
| 41 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 18 |
| 42 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 19 |
| 43 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 20- Typical Basin |

# TR55 Tc Worksheet



## Hyd. No. 1

Pre Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 133.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.71** | **+** | **0.00** | **+** | **0.00** | **=** | **13.71** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.70 min**

# TR55 Tc Worksheet



## Hyd. No. 2

Pre Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 71.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.07** | **+** | **0.00** | **+** | **0.00** | **=** | **9.07** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.10 min**

# TR55 Tc Worksheet



## Hyd. No. 3

Pre Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 122.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.99** | **+** | **0.00** | **+** | **0.00** | **=** | **13.99** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 14.00 min**

# TR55 Tc Worksheet



## Hyd. No. 4

Pre Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 144.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 12.10** | **+** | **0.00** | **+** | **0.00** | **=** | **12.10** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 12.10 min**

# TR55 Tc Worksheet



## Hyd. No. 5

Pre-Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 144.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.07** | **+** | **0.00** | **+** | **0.00** | **=** | **11.07** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.10 min**

# TR55 Tc Worksheet



## Hyd. No. 6

Pre Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.011 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 118.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.20 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.84** | **+** | **0.00** | **+** | **0.00** | **=** | **1.84** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 1.80 min**

# TR55 Tc Worksheet



## Hyd. No. 7

Pre Developed Basin 7

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 110.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.03** | **+** | **0.00** | **+** | **0.00** | **=** | **8.03** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.00 min**

# TR55 Tc Worksheet



## Hyd. No. 8

Pre Developed Basin 8

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 107.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.07** | **+** | **0.00** | **+** | **0.00** | **=** | **10.07** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 10.10 min**

# TR55 Tc Worksheet



## Hyd. No. 9

Pre Developed Basin 9

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 132.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.20 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.77** | **+** | **0.00** | **+** | **0.00** | **=** | **11.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.80 min**

# TR55 Tc Worksheet



## Hyd. No. 10

Pre Developed Basin 10

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 152.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.30 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.11** | **+** | **0.00** | **+** | **0.00** | **=** | **13.11** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.10 min**

# TR55 Tc Worksheet



## Hyd. No. 11

Pre Developed Basin 11

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 72.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.50 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.75** | **+** | **0.00** | **+** | **0.00** | **=** | **8.75** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.70 min**

# TR55 Tc Worksheet



## Hyd. No. 12

Pre Developed Basin 12

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 137.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 11.50 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.06** | **+** | **0.00** | **+** | **0.00** | **=** | **10.06** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 10.10 min**

# TR55 Tc Worksheet



## Hyd. No. 13

Pre Developed Basin 13

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 159.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 15.81** | **+** | **0.00** | **+** | **0.00** | **=** | **15.81** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 15.80 min**

# TR55 Tc Worksheet



## Hyd. No. 14

Pre Developed basin 14

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 70.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 1.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 15.61** | **+** | **0.00** | **+** | **0.00** | **=** | **15.61** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 15.60 min**

# TR55 Tc Worksheet



## Hyd. No. 15

Pre Developed Basin 15

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 150.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.50 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 14.53** | **+** | **0.00** | **+** | **0.00** | **=** | **14.53** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 14.50 min**

# TR55 Tc Worksheet



## Hyd. No. 16

Pre Developed Basin 16

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 262.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 16.61** | **+** | **0.00** | **+** | **0.00** | **=** | **16.61** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 16.60 min**

# TR55 Tc Worksheet



## Hyd. No. 17

Pre Developed Basin 17

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 126.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.10 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.41** | **+** | **0.00** | **+** | **0.00** | **=** | **11.41** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.40 min**

# TR55 Tc Worksheet



## Hyd. No. 18

Pre Developed Basin 18

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 156.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.97** | **+** | **0.00** | **+** | **0.00** | **=** | **10.97** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.00 min**

# TR55 Tc Worksheet



## Hyd. No. 19

Pre-Developed Basin 19

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 263.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 34.12** | **+** | **0.00** | **+** | **0.00** | **=** | **34.12** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 34.10 min**

# TR55 Tc Worksheet



## Hyd. No. 20

Pre Developed Basin 20- Typical Basin

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 158.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.03** | **+** | **0.00** | **+** | **0.00** | **=** | **13.03** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.00 min**

# TR55 Tc Worksheet



## Hyd. No. 24

Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 133.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.71** | **+** | **0.00** | **+** | **0.00** | **=** | **13.71** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.70 min**

# TR55 Tc Worksheet



## Hyd. No. 25

Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 71.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 9.07** | **+** | **0.00** | **+** | **0.00** | **=** | **9.07** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 9.10 min**

# TR55 Tc Worksheet



## Hyd. No. 26

Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 122.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.99** | **+** | **0.00** | **+** | **0.00** | **=** | **13.99** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 14.00 min**

# TR55 Tc Worksheet



## Hyd. No. 27

Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 144.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 12.10** | **+** | **0.00** | **+** | **0.00** | **=** | **12.10** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 12.10 min**

# TR55 Tc Worksheet



## Hyd. No. 28

Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 144.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.07** | **+** | **0.00** | **+** | **0.00** | **=** | **11.07** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.10 min**

# TR55 Tc Worksheet



## Hyd. No. 29

Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.011 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 118.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.20 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 1.84** | **+** | **0.00** | **+** | **0.00** | **=** | **1.84** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 1.80 min**

# TR55 Tc Worksheet



## Hyd. No. 30

Developed Basin 7

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 110.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 13.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.03** | **+** | **0.00** | **+** | **0.00** | **=** | **8.03** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.00 min**

# TR55 Tc Worksheet



## Hyd. No. 31

Developed Basin 8

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 107.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.07** | **+** | **0.00** | **+** | **0.00** | **=** | **10.07** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 10.10 min**

# TR55 Tc Worksheet



## Hyd. No. 32

Developed Basin 9

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 132.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.20 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.77** | **+** | **0.00** | **+** | **0.00** | **=** | **11.77** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.80 min**

# TR55 Tc Worksheet



## Hyd. No. 33

Developed Basin 10

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 152.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.30 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.11** | **+** | **0.00** | **+** | **0.00** | **=** | **13.11** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.10 min**

# TR55 Tc Worksheet



## Hyd. No. 34

Developed Basin 11

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 72.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.50 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.75** | **+** | **0.00** | **+** | **0.00** | **=** | **8.75** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.70 min**

# TR55 Tc Worksheet



## Hyd. No. 35

Developed Basin 12

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 137.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 11.50 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.06** | **+** | **0.00** | **+** | **0.00** | **=** | **10.06** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 10.10 min**

# TR55 Tc Worksheet



## Hyd. No. 36

Developed Basin 13

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 159.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 15.81** | **+** | **0.00** | **+** | **0.00** | **=** | **15.81** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 15.80 min**

# TR55 Tc Worksheet



## Hyd. No. 37

Developed Basin 14

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 70.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 1.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 15.61** | **+** | **0.00** | **+** | **0.00** | **=** | **15.61** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 15.60 min**

# TR55 Tc Worksheet



## Hyd. No. 38

Developed Basin 15

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 150.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 5.50 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 14.53** | **+** | **0.00** | **+** | **0.00** | **=** | **14.53** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 14.50 min**

# TR55 Tc Worksheet



## Hyd. No. 39

Developed Basin 16

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 262.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 16.61** | **+** | **0.00** | **+** | **0.00** | **=** | **16.61** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 16.60 min**

# TR55 Tc Worksheet



## Hyd. No. 40

Developed Basin 17

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 126.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 7.10 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 11.41** | **+** | **0.00** | **+** | **0.00** | **=** | **11.41** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.40 min**

# TR55 Tc Worksheet



## Hyd. No. 41

Developed Basin 18

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 156.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 12.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 10.97** | **+** | **0.00** | **+** | **0.00** | **=** | **10.97** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 11.00 min**

# TR55 Tc Worksheet



## Hyd. No. 42

Pre-Developed Basin 19

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 263.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 2.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 34.12** | **+** | **0.00** | **+** | **0.00** | **=** | **34.12** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 34.10 min**

# TR55 Tc Worksheet



## Hyd. No. 43

Developed Basin 20- Typical Basin

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 158.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 8.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.03** | **+** | **0.00** | **+** | **0.00** | **=** | **13.03** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.00 min**

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 1 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 7 |
| 8 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 8 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 9 |
| 10 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 10 |
| 11 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 11 |
| 12 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 12 |
| 13 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 13 |
| 14 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed basin 14 |
| 15 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 15 |
| 16 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 16 |
| 17 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 17 |
| 18 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 18 |
| 19 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 19 |
| 20 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 20- Typical Basi |
| 24 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 1 |
| 25 | SCS Runoff | 0.005 | 2 | 774 | 223 | ------ | ------ | ------ | Developed Basin 2 |
| 26 | SCS Runoff | 0.024 | 2 | 606 | 257 | ------ | ------ | ------ | Developed Basin 3 |
| 27 | SCS Runoff | 0.000 | 2 | 1440 | 4 | ------ | ------ | ------ | Developed Basin 4 |
| 28 | SCS Runoff | 0.001 | 2 | 1426 | 12 | ------ | ------ | ------ | Developed Basin 5 |
| 29 | SCS Runoff | 0.002 | 1 | 769 | 107 | ------ | ------ | ------ | Developed Basin 6 |
| 30 | SCS Runoff | 0.001 | 2 | 1440 | 5 | ------ | ------ | ------ | Developed Basin 7 |
| 31 | SCS Runoff | 0.004 | 2 | 778 | 165 | ------ | ------ | ------ | Developed Basin 8 |
| 32 | SCS Runoff | 0.002 | 2 | 1096 | 95 | ------ | ------ | ------ | Developed Basin 9 |
| 33 | SCS Runoff | 0.004 | 2 | 1096 | 139 | ------ | ------ | ------ | Developed Basin 10 |
| 34 | SCS Runoff | 0.027 | 2 | 600 | 230 | ------ | ------ | ------ | Developed Basin 11 |
| 35 | SCS Runoff | 0.002 | 2 | 1288 | 42 | ------ | ------ | ------ | Developed Basin 12 |
| 36 | SCS Runoff | 0.003 | 2 | 1072 | 137 | ------ | ------ | ------ | Developed Basin 13 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 37 | SCS Runoff | 0.028 | 2 | 604 | 233 | ------ | ------ | ------ | Developed Basin 14 |
| 38 | SCS Runoff | 0.002 | 2 | 1440 | 20 | ------ | ------ | ------ | Developed Basin 15 |
| 39 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 16 |
| 40 | SCS Runoff | 0.002 | 2 | 1044 | 94 | ------ | ------ | ------ | Developed Basin 17 |
| 41 | SCS Runoff | 0.002 | 2 | 1440 | 14 | ------ | ------ | ------ | Developed Basin 18 |
| 42 | SCS Runoff | 0.001 | 2 | 1232 | 23 | ------ | ------ | ------ | Pre-Developed Basin 19 |
| 43 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 20- Typical Basin |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 1 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 7 |
| 8 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 8 |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 9 |
| 10 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 10 |
| 11 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 11 |
| 12 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 12 |
| 13 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 13 |
| 14 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed basin 14 |
| 15 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 15 |
| 16 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 16 |
| 17 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 17 |
| 18 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 18 |
| 19 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 19 |
| 20 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre Developed Basin 20- Typical Basi |
| 24 | SCS Runoff | 0.001 | 2 | 1354 | 19 | ------ | ------ | ------ | Developed Basin 1 |
| 25 | SCS Runoff | 0.077 | 2 | 602 | 789 | ------ | ------ | ------ | Developed Basin 2 |
| 26 | SCS Runoff | 0.090 | 2 | 604 | 628 | ------ | ------ | ------ | Developed Basin 3 |
| 27 | SCS Runoff | 0.008 | 2 | 1118 | 295 | ------ | ------ | ------ | Developed Basin 4 |
| 28 | SCS Runoff | 0.010 | 2 | 1094 | 381 | ------ | ------ | ------ | Developed Basin 5 |
| 29 | SCS Runoff | 0.049 | 1 | 598 | 377 | ------ | ------ | ------ | Developed Basin 6 |
| 30 | SCS Runoff | 0.008 | 2 | 1116 | 320 | ------ | ------ | ------ | Developed Basin 7 |
| 31 | SCS Runoff | 0.048 | 2 | 604 | 583 | ------ | ------ | ------ | Developed Basin 8 |
| 32 | SCS Runoff | 0.019 | 2 | 608 | 414 | ------ | ------ | ------ | Developed Basin 9 |
| 33 | SCS Runoff | 0.028 | 2 | 608 | 604 | ------ | ------ | ------ | Developed Basin 10 |
| 34 | SCS Runoff | 0.098 | 2 | 600 | 560 | ------ | ------ | ------ | Developed Basin 11 |
| 35 | SCS Runoff | 0.009 | 2 | 780 | 410 | ------ | ------ | ------ | Developed Basin 12 |
| 36 | SCS Runoff | 0.030 | 2 | 608 | 551 | ------ | ------ | ------ | Developed Basin 13 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 37 | SCS Runoff | 0.081 | 2 | 604 | 523 | ------ | ------ | ------ | Developed Basin 14 |
| 38 | SCS Runoff | 0.037 | 2 | 1120 | 1,387 | ------ | ------ | ------ | Developed Basin 15 |
| 39 | SCS Runoff | 0.015 | 2 | 1176 | 509 | ------ | ------ | ------ | Developed Basin 16 |
| 40 | SCS Runoff | 0.025 | 2 | 604 | 353 | ------ | ------ | ------ | Developed Basin 17 |
| 41 | SCS Runoff | 0.026 | 2 | 1118 | 969 | ------ | ------ | ------ | Developed Basin 18 |
| 42 | SCS Runoff | 0.004 | 2 | 774 | 159 | ------ | ------ | ------ | Pre-Developed Basin 19 |
| 43 | SCS Runoff | 0.001 | 2 | 1272 | 25 | ------ | ------ | ------ | Developed Basin 20- Typical Basin |

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Sep 2 2025

## Swale A

**Triangular**

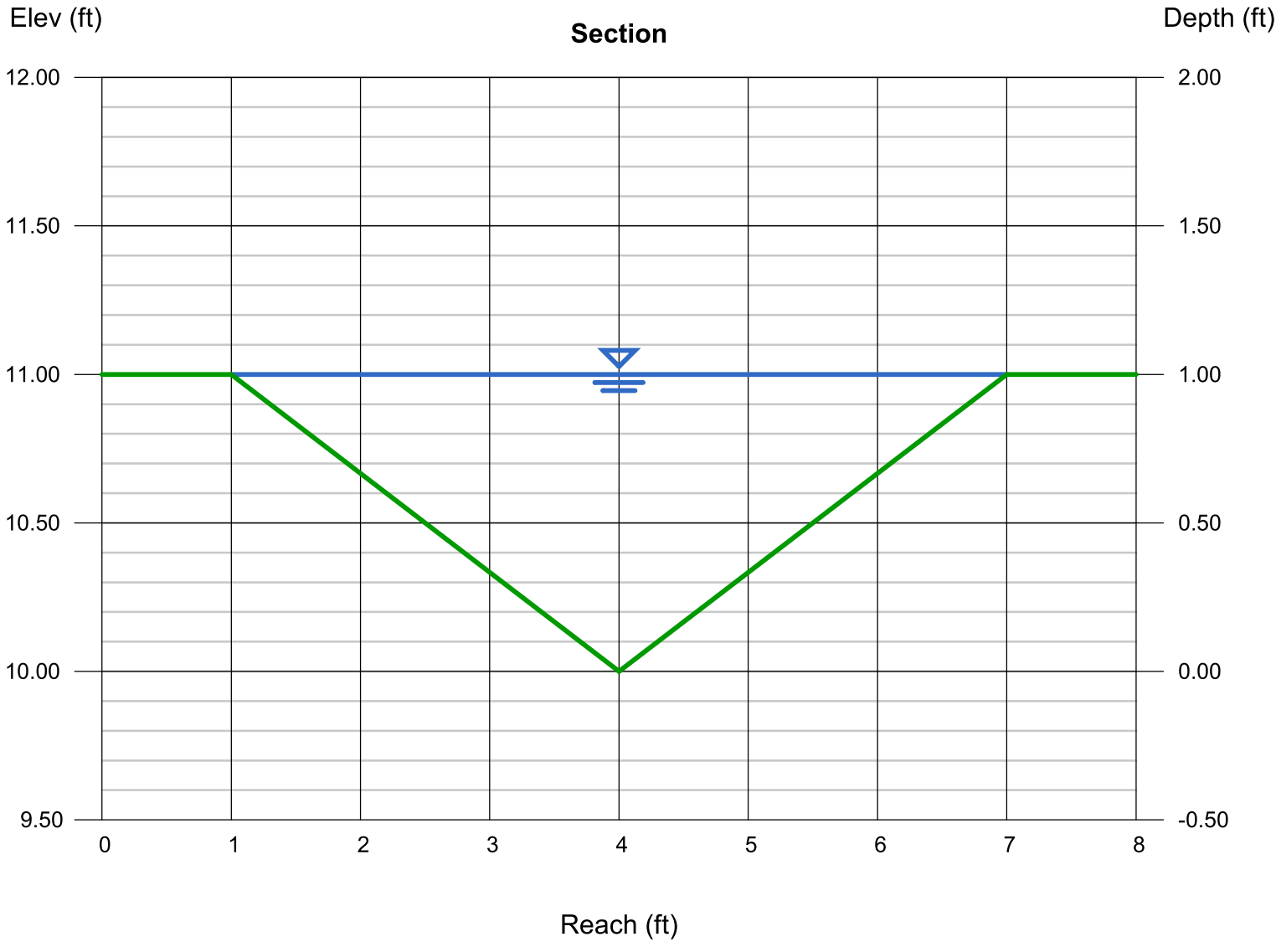
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.015 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.00 |
| Q (cfs) | = 12.78 |
| Area (sqft) | = 3.00 |
| Velocity (ft/s) | = 4.26 |
| Wetted Perim (ft) | = 6.32 |
| Crit Depth, Yc (ft) | = 1.00 |
| Top Width (ft) | = 6.00 |
| EGL (ft) | = 1.28 |



# Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 4 2025

## Typical Driveway Culvert

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 10.00 |
| Pipe Length (ft) | = | 14.00 |
| Slope (%) | = | 0.36 |
| Invert Elev Up (ft) | = | 10.05 |
| Rise (in) | = | 12.0 |
| Shape | = | Circular |
| Span (in) | = | 12.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.013 |
| Culvert Type | = | Circular Corrugate Metal Pipe |
| Culvert Entrance | = | Mitered to slope (C) |
| Coeff. K,M,c,Y,k | = | 0.021, 1.33, 0.0463, 0.75, 0.7 |

**Embankment**

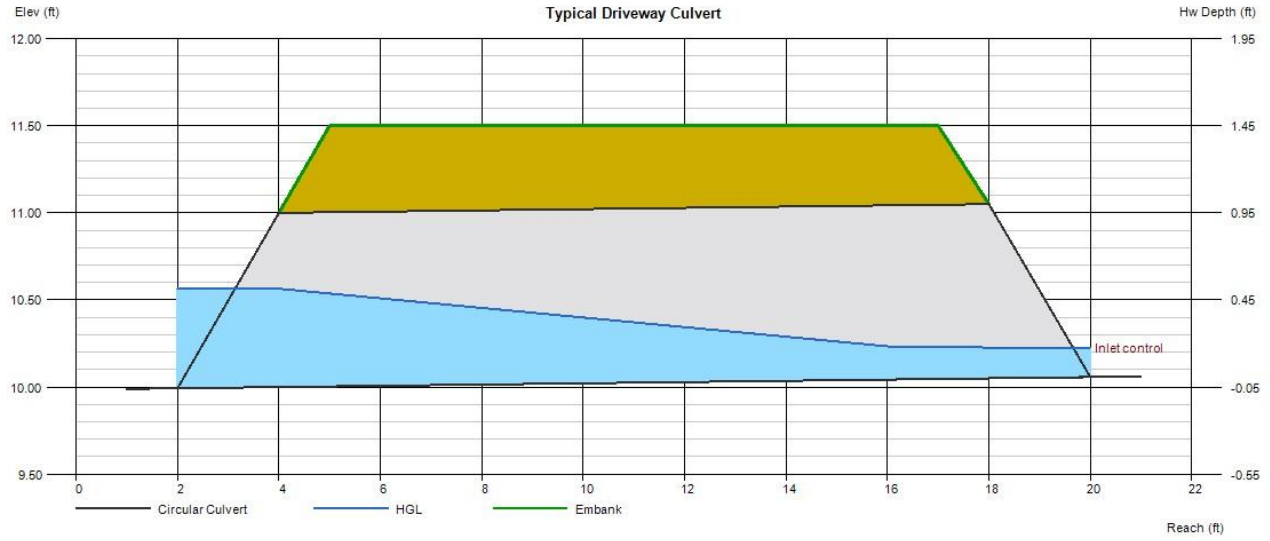
| | | |
|---|---|---|
| Top Elevation (ft) | = | 11.50 |
| Top Width (ft) | = | 12.00 |
| Crest Width (ft) | = | 6.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 0.00 |
| Qmax (cfs) | = | 2.00 |
| Tailwater Elev (ft) | = | (dc+D)/2 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 0.10 |
| Qpipe (cfs) | = | 0.10 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 0.22 |
| Veloc Up (ft/s) | = | 1.69 |
| HGL Dn (ft) | = | 10.56 |
| HGL Up (ft) | = | 10.18 |
| Hw Elev (ft) | = | 10.23 |
| Hw/D (ft) | = | 0.18 |
| Flow Regime | = | Inlet Control |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 24 2025

## Retention Swale A

**Triangular**

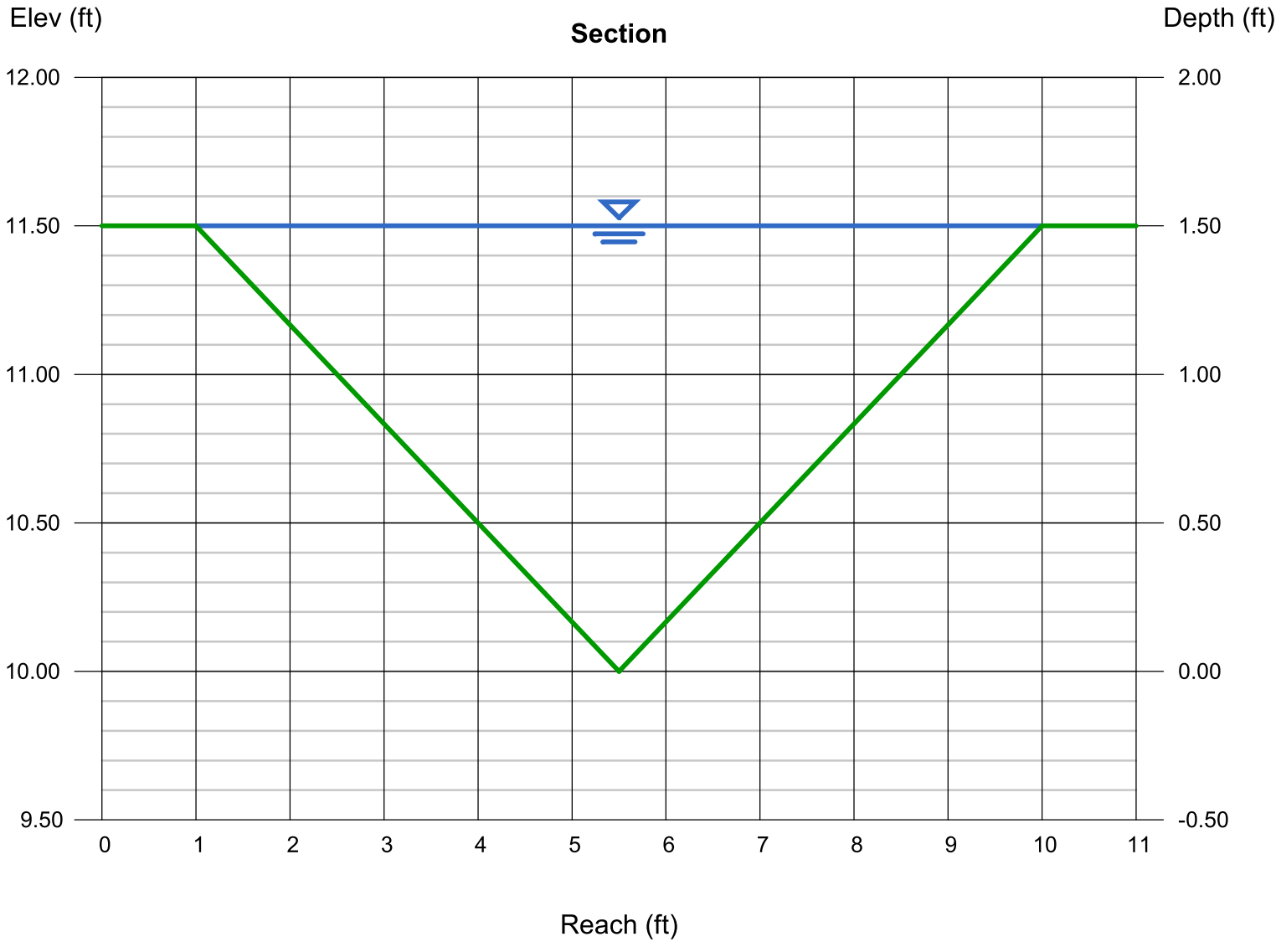
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.50 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.025 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.50 |
| Q (cfs) | = 22.61 |
| Area (sqft) | = 6.75 |
| Velocity (ft/s) | = 3.35 |
| Wetted Perim (ft) | = 9.49 |
| Crit Depth, Yc (ft) | = 1.29 |
| Top Width (ft) | = 9.00 |
| EGL (ft) | = 1.67 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 24 2025

## Check Dam A

**Triangular**

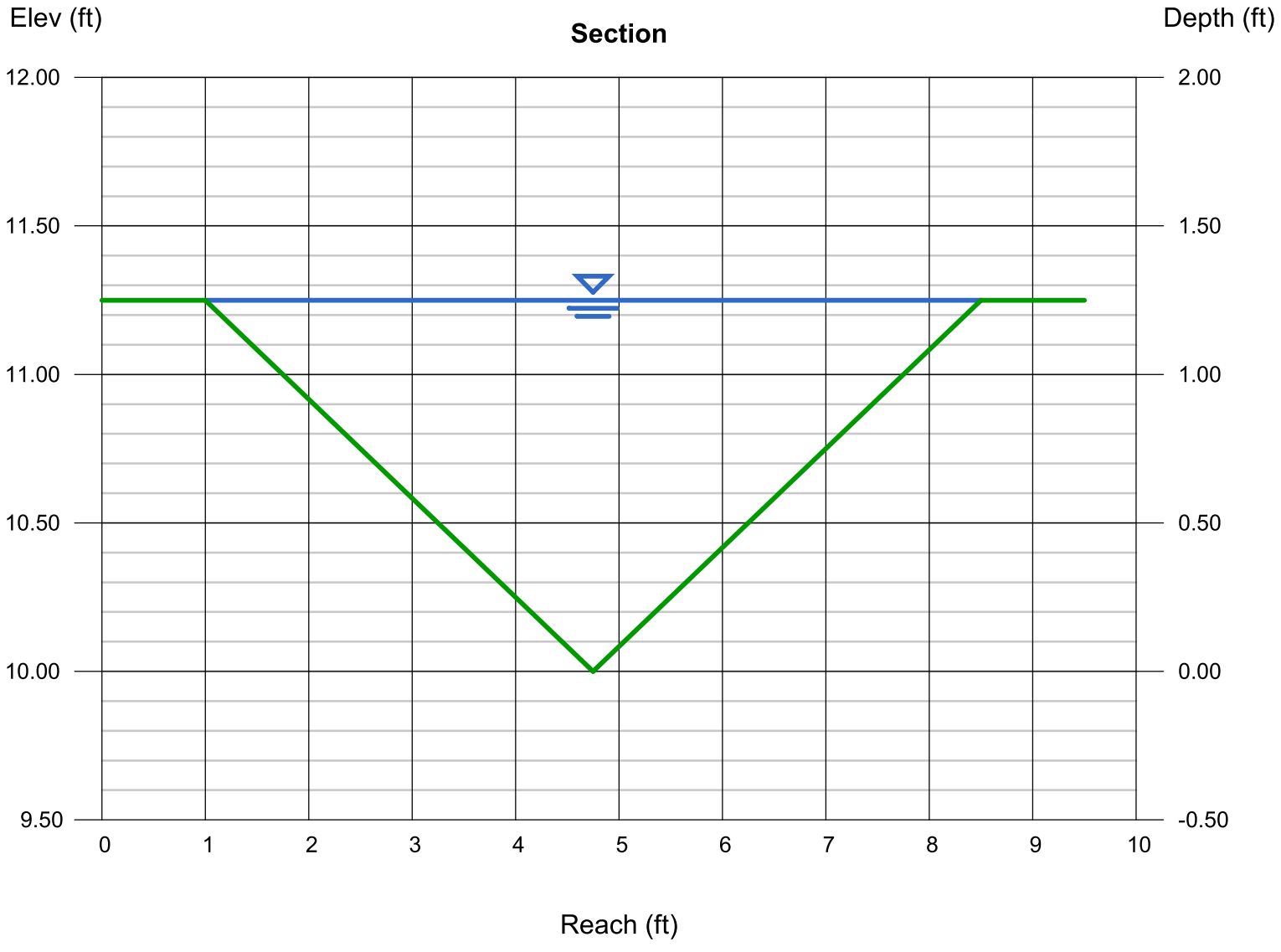
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.25 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.025 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.25 |
| Q (cfs) | = 13.90 |
| Area (sqft) | = 4.69 |
| Velocity (ft/s) | = 2.97 |
| Wetted Perim (ft) | = 7.91 |
| Crit Depth, Yc (ft) | = 1.06 |
| Top Width (ft) | = 7.50 |
| EGL (ft) | = 1.39 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 24 2025

## Retention Swale B

**Triangular**

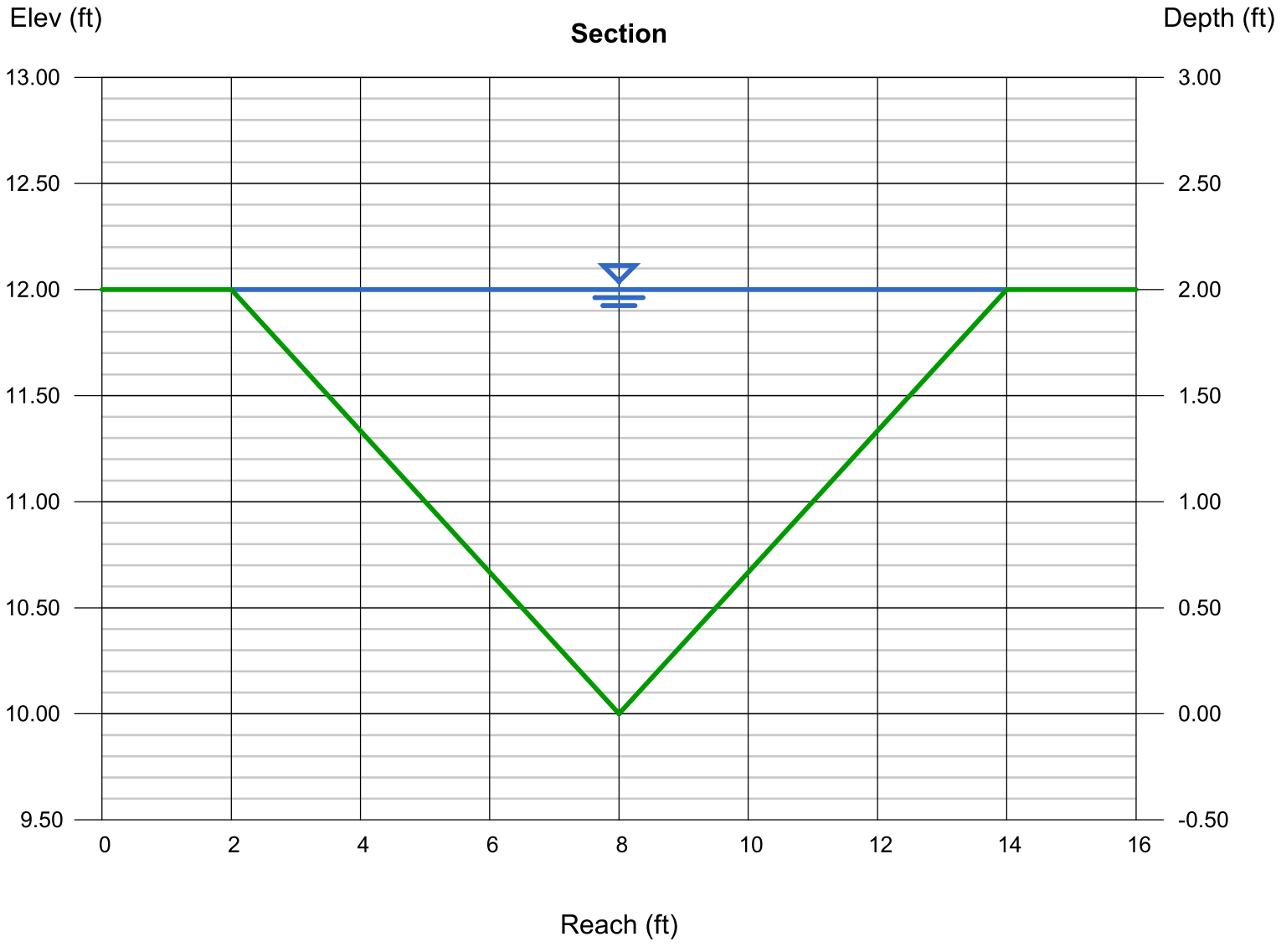
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 2.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.025 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 2.00 |
| Q (cfs) | = 48.70 |
| Area (sqft) | = 12.00 |
| Velocity (ft/s) | = 4.06 |
| Wetted Perim (ft) | = 12.65 |
| Crit Depth, Yc (ft) | = 1.75 |
| Top Width (ft) | = 12.00 |
| EGL (ft) | = 2.26 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 24 2025

## Check Dam B

**Triangular**

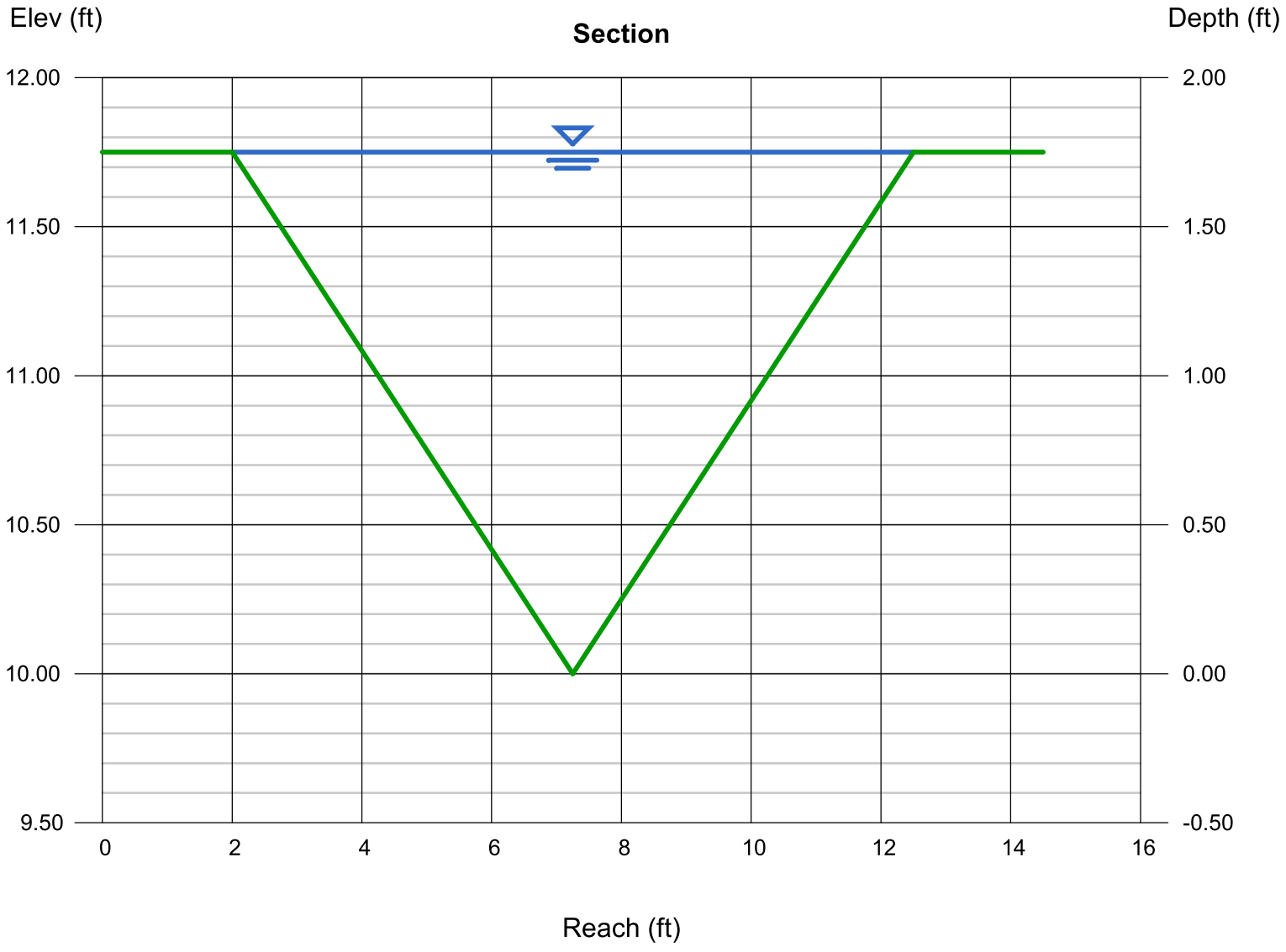
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.75 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.025 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.75 |
| Q (cfs) | = 34.11 |
| Area (sqft) | = 9.19 |
| Velocity (ft/s) | = 3.71 |
| Wetted Perim (ft) | = 11.07 |
| Crit Depth, Yc (ft) | = 1.52 |
| Top Width (ft) | = 10.50 |
| EGL (ft) | = 1.96 |



## Sump Calculations

| | |
|---|---|
| Cone | |
| Height | 4 |
| Top Diameter (ft) | 2 |
| Bottom Diameter (ft) | 4 |
| Barrel | |
| Height (ft) | 4 |
| Top Diameter (ft) | 4 |
| Bottom Diameter (ft) | 4 |
| Wall Thickness (in) | 4 |
| Sump Rock | |
| Depth Around Barrel (ft) | 2 |

| Inside Sump Volume | |
|---|---|
| Cone (CF) | 29.32 |
| Barrel (CF) | 50.24 |
| Total (CF) | 79.56 |

| Gravel Storage Volume | |
|---|---|
| Volume Around Barrel | 159.09 |
| Volume Under Barrel | 109.03 |
| Total (CF) | 268.12 |
| Storage in Gravel 30% (CF) | 80.44 |

| **Total Storage (CF)** | **160.00** |
|---|---|

| Infiltration per Sump @ 1.1 in/hr | |
|---|---|
| Infiltration Area (SF) | 54.51 |
| Total Infiltration (CF/HR) | 5.00 |
| **Infiltration - 1 hr Event (CF)** | **5.00** |

| **Total Storg and Infiltr in 1 Hr** | **164.99** |
|---|---|

# STORM DRAINAGE REPORT

PREPARED IN ACCORDANCE WITH
MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ) CIRCULAR 8

**Phase 15-Wilderness Escalante Preserve**

On property located at Sophie Lake Road
legally described as COS 4389
in S28, 29, 32 & 33, T37N, R27W, PMM, Lincoln County.

Published: January 7, 2026

**Prepared For:**
Escalante Wilderness
Preserve US LP
PO Box 2092
Eureka, MT 59917

**Prepared By:**
406 Engineering, Inc.
35 8th Street East
Kalispell, MT 59901

## 1.0 GENERAL

Escalante Wilderness Preserve US LP owns the 7.50-acre property referenced above, which is a portion of the property generally known as the Wilderness Club. The owners intend to develop phase 15 of the project, which includes the development of 25 lots. The new development will include a road extension, 25 single-family homes, landscaping, and undeveloped natural land. The remaining portions of the property are to remain undeveloped.

This report aims to outline the current hydrological conditions of this site compared to the hydrological conditions that will exist after the proposed development. This report is prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The organization of the report follows the outlined requirements of DEQ-8. The report identifies storm water management with routing and storage requirements based on the analysis of the pre-development and post-development conditions.

This report and any attachments shall be submitted to the DEQ or to a delegated division of local government for review and approval. The report and attachments demonstrate that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owner. This report qualifies as a “Standard Plan” per DEQ-8.

## 2.0 SITE INFORMATION

GEOTECHNICAL INFORMATION:

Hydrologic soil groups are based on the estimates of runoff potential. The proposed development consists of hydrologic soil group A soils. Group A soils have high infiltration rates and low runoff potential, even when thoroughly wet. These deep, well-drained sands and gravels have high transmission rates. Refer to the appendices for the NRCS Hydrologic Soil Group map.

PRE-DEVELOPED CONDITIONS:

For this report, the predeveloped conditions of the site are assumed to be undeveloped. The existing project site is 7.50 acres, with ground cover consisting of open space in good condition. The eastern edge of the property slopes to the west, and the western edge of the property slopes to the east.

POST-DEVELOPED CONDITIONS:

The developed conditions of the [acre]-acre property will include the development of 25 single-family homes and a road extension. The remaining portions of the property will remain undeveloped. The development will result in a minor increase in impervious surfaces but will not change the overall drainage pattern or discharge point. Retention structures are proposed to manage the increased runoff from the development.

## 3.0 DRAINAGE DESIGN CRITERIA AND METHODS USED

The SCS method was used to estimate the storm runoff and volume for the property. Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2023 was used to analyze basin runoff. The runoff volume and peak flows for the 2, 10, and 100-year 24-hour storm events were analyzed for pre-developed and post-developed basins.

Primary inputs for the SCS methods are as follows:

- Basin Area: A basin is generally defined as an area that drains to a single point.
- Curve Number: A composite curve number (CN) for a basin is determined based on the hydrologic soil group, ground cover type, treatment, and hydraulic conditions. NRCS TR-55 Runoff CN tables are used to select the appropriate number.
- Time of Concentration: The time of concentration is the theoretical time it takes for runoff to travel to a point of interest from the hydraulically most distant point. Calculating a time of concentration involves summing flow times for runoff as sheet flow, shallow concentrated flow, and channel flow if applicable.
- Manning's Number: A n-value is designated for each surface type, providing an effective roughness coefficient for the water path selected to calculate the time of concentration. Standard tables and figures provided by *Technical Release 55 – Urban Hydrology for Small Watersheds* (TR-55) were used to select the appropriate number.
- Design Storm Depth: The SCS Method uses 24-hour storm depths developed by the National Oceanic and Atmospheric Administration (NOAA), with a selected design recurrence interval, such as 2, 10, or 100 years.
- Storm Distribution: To evaluate the peak flows, selecting a design storm hydrograph or rainfall time distribution pattern is necessary. A Type I storm distribution was utilized for sizing control facilities.

The selection of the curve number enables the SCS method to model the soil capacity and land cover to capture and infiltrate rainfall. The model is highly non-linear, meaning a relatively small percent increase in rainfall can lead to larger increases in runoff. This occurs because as the infiltrative capacity of the soil is used up, a higher percentage of precipitation will run off.

Both the TR-55 Manual and DEQ-8 have been used as reference for the SCS method in this report. The SCS method uses 24-hour storm depths developed by the NOAA with a selected design recurrence interval, such as 2, 10, 50, or 100-year storms. The precipitation data used in this report were obtained from NOAA Atlas 14, Volume 12, Version 2 and can be seen below in Table 1.

Table 1: NOAA Precipitation Depths

| Recurrence Interval | 2-year | 10-year | 100-year |
|---|---|---|---|
| 24-hour Precipitation Depth (in) | 1.24 | 1.74 | 2.55 |

This report is proposed as a Standard Plan per DEQ 8 and therefore must address storm water drainage peak flow and volume. Standard Plans must also demonstrate that the proposed development will not allow storm water to do any of the following:

- Exceed the pre-development runoff to an adjoining property during the 2-year storm event;
- Overtop roadways or driveways during a 10-year storm event; or
- Inundate any buildings or drainfields during a 100-year storm event. This may be demonstrated through either narrative descriptions or calculations.

**4.0 DELINEATION OF DRAINAGE BASINS**

For this report section, the property is considered to have six drainage basins representing flow from the proposed homes and driveway development as well as the proposed asphalt road extensions. Drainage basin 7 is a “typical basin” representing flow from lots that slope away from the roadside stormwater facilities. The proposed property boundaries, the proposed development, and the topography across the site defined the drainage study extent. Although the proposed development will alter the localized drainage pattern, the overall drainage pattern will remain the same. Therefore, the pre-development and post-development drainage basins will remain the same size and shape.

PRE-DEVELOPED ON-SITE DRAINAGE BASINS:

For the pre-developed drainage basins, storm water moves as sheet flow with slopes ranging between 0%-15%. The basins are considered vacant, undeveloped land with no existing structures or impervious areas. No significant storm water runoff concerns are known to exist on the property. The curve number (CN) for the pre-developed site is based on the ground cover conditions of the existing open space in good condition for the soil group A (CN 39). Refer to the appendices for the TR-55 Runoff curve number tables and the TR-55 time of concentration calculations. Table 2 provides a summary of the pre-developed time of concentrations and curve numbers.

Table 2: Pre-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 1.06 | 39 | 34.6 |
| Basin 2 | 1.34 | 39 | 31.4 |
| Basin 3 | 0.24 | 39 | 8.9 |
| Basin 4 | 1.19 | 39 | 13.3 |
| Basin 5 | 1.78 | 39 | 21.5 |
| Basin 6 | 0.43 | 39 | 46.8 |
| Basin 7-TB Lot 14 | 0.26 | 39 | 7.1 |

POST-DEVELOPED ON-SITE DRAINAGE BASINS:

As mentioned above, the post-development drainage basins will remain the same size and shape as the pre-development drainage basins. The post-development conditions for the basins include the proposed development of the land including the homes, proposed asphalt drives, asphalt road extensions, and undeveloped natural land. The composite CN is calculated land cover of open space in good condition for soil group A (CN 39), rooftops (98), and asphalt (98). Table 3 provides a summary of the post-developed time of concentrations and curve numbers.

Table 3: Post-Developed Basin Information

| Basin ID | Area (ac) | Curve Number | Time of Concentration (min.) |
|---|---|---|---|
| Basin 1 | 1.059458 | 55 | 34.6 |
| Basin 2 | 1.338017 | 60 | 31.4 |
| Basin 3 | 0.243274 | 66 | 8.9 |
| Basin 4 | 1.189348 | 53 | 13.3 |
| Basin 5 | 1.777571 | 54 | 21.5 |
| Basin 6 | 0.429316 | 56 | 46.8 |
| Basin 7-TB Lot 14 | 0.260399 | 50 | 7.1 |

OFF-SITE BASINS:

The property is surrounded by land with similar ground cover. No off-site flows contribute to flows onto the property. All off-site flows are negligible and have not been considered in this drainage analysis.

## 5.0 RUNOFF VOLUMES AND FLOWS

Utilizing the procedures outlined in DEQ 8, runoff volumes and peak flows for the 2-year, 10-year, and 100-year 24-hour storm events were evaluated for the pre- and post-developed drainage basins. Refer to the attached calculations for the pre-developed peak flows and runoff volumes and Table 4 for the post-developed peak flows and runoff volumes.

Table 4: Post-Developed Peak Flows

| Basin ID | 2-year | | 10-year | | 100-year | |
|---|---|---|---|---|---|---|
| | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) | Peak Flow (cfs) | Volume (cf) |
| Basin 1 | 0 | 0 | 0.001 | 4.93 | 0.009 | 349 |
| Basin 2 | 0 | 0 | 0.004 | 115 | 0.022 | 925 |
| Basin 3 | 0 | 7.15 | 0.002 | 74.9 | 0.021 | 302 |
| Basin 4 | 0 | 0 | 0 | 0 | 0.008 | 278 |
| Basin 5 | 0 | 0 | 0 | 1.01 | 0.014 | 503 |
| Basin 6 | 0 | 0 | 0 | 5.48 | 0.004 | 168 |
| Basin 7-TB Lot 14 | 0 | 0 | 0 | 0 | 0.001 | 27.1 |

## 6.0 PROVISIONS TO MITIGATE ON-SITE STORM WATER FLOWS

INITIAL STORM WATER FACILITY

Utilizing the procedures identified in DEQ-8, the initial storm water facilities have been sized to infiltrate, evapotranspire, and/or capture the post-development runoff generated from the first 0.5 inches of rainfall on the impervious areas. The required volume of the initial storm water facilities have been included in the design of the proposed retention facility. Refer to attached calculations for the initial storm water facility volume for the drainage basins.

CONVEYANCE FACILITIES

Utilizing the procedures outlines within DEQ-8, conveyance facilities have been provided for numerous basins. Conveyance swales, check dams, and culverts have been proposed throughout the site and have been sized to convey the 100-year post developed peak flows ensuring storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, will not overtop the roadway during the 10-year storm event and will not inundate drainfields and buildings during the 100-year storm event. Refer to Table 5 and the attached calculations for more detail.

Table 5: Drainage Basin Conveyance

| | | Swales | | Swales and Check Dams | | | Culverts | |
|---|---|---|---|---|---|---|---|---|
| **Basin ID** | **10-year peak flow (cfs)** | **Swale ID** | **Maximum Conveyance (cfs)** | **Retention Structure ID** | **Maximum Conveyance Through Swale (cfs)** | **Maximum Conveyance Over Check Dam (cfs)** | **Culvert ID** | **Max Conveyance (cfs)** |
| Basin 1 | 0.00 | A | 12.78 | A | 34.11 | 22.61 | 1 | 2 |
| Basin 2 | 0.00 | A | 12.78 | A | 34.11 | 22.61 | 1 | 2 |
| Basin 3 | 0.00 | A | 12.78 | A | 34.11 | 22.61 | 1 | 2 |
| Basin 4 | 0.00 | A | 12.78 | A | 34.11 | 22.61 | 1 | 2 |
| Basin 5 | 0.00 | A | 12.78 | A | 34.11 | 22.61 | 1 | 2 |
| Basin 6 | 0.00 | A | 12.78 | A | 34.11 | 22.61 | 1 | 2 |
| Basin 7-TB Lot 14 | 0.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

**Swale A**

- Side slope: 3:1
- Depth: 1 ft
- Cross-Sectional Area: 3 sf
- Capacity: 12.78 cfs

**Driveway Culvert 1**

- Diameter: 12”
- Length: 14’
- Capacity: 2.0 cfs
- Material: CMP

RETENTION AND DETENTION FACILITIES

Utilizing the procedures outlined in DEQ-8, the required and provided retention and infiltration facilities size for each basin can be seen in Table 6. With the existing topography on the property where storm water naturally sheets, the storm water will collect in the proposed retention facilities. The proposed retention facilities have been sized to retain the post-developed 10-year and 100-year runoff volume. Refer to Table 6 and to the attached calculations for more detail.

Table 6: Drainage Basin Storage Volumes

| Basin ID | Design Storm Event | Design Volume (cf) | Proposed Retention/Infiltration Structure | Proposed Retention/Infiltration Structure Volume (cf) |
|---|---|---|---|---|
| Basin 1 | 100-year and ISWFV | 518 | Structure A with 3 check dams and 1 sump | 518 |
| Basin 2 | 10-year and ISWFV | 848.92 | Structure A with 4 check dams and 2 sumps | 859 |
| Basin 3 | 10-year and ISWFV | 195.83 | Structure A with 1 check dam and 1 sump | 266 |
| Basin 4 | 100-year and ISWFV | 506.96 | Structure A with 3 check dams and 2 sumps | 533 |
| Basin 5 | 100-year and ISWFV | 777.42 | Structure A with 4 check dams and 2 sumps | 863 |
| Basin 6 | 100-year and ISWFV | 219.79 | Structure A with 1 check dam and 1 sump | 359 |
| Basin 7-TB Lot 14 | 100-year and ISWFV | 83.33 | 1 sump | 165 |

**Retention Swale A, Check Dam A**

- Side slope: 3:1
- Depth: 1.75 ft
- Cross-Sectional area: 9.1875 sf
- Check Dam Depth: 1.5 ft
- Minimum space between check dams: varies per basin
- Total storage per check dam: varies per basin

DRAINAGE BASIN 1

Drainage Basin 1 represents runoff from lots 1-3 and the road extension development. This parcel generally slopes to the south and north, with a low spot in the middle of the basin. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with three check dams and one infiltration sump. Retention Structure A and the sump are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 2

Drainage Basin 2 represents runoff from lots 5-11 and the road extension development. This parcel generally slopes to the south and north, with a low spot in the center of the basin. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with four check dams and two infiltration sumps. Retention Structure A and the sumps are designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 3

Drainage Basin 3 represents runoff from the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with one check dam and one infiltration sump. Retention Structure A and the sump is designed to retain the post-developed 10-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event.

DRAINAGE BASIN 4

Drainage Basin 4 represents runoff from lots 16-18 and the road extension development. This parcel generally slopes to the southeast. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with three check dams and two infiltration sumps. Retention Structure A and the sumps are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 5

Drainage Basin 5 represents runoff from lots 20-24 and the road extension development. This parcel generally slopes to the south. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with four check dams and two infiltration sumps. Retention Structure A and the sumps are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 6

Drainage Basin 5 represents runoff from lot 25 and the road extension development. This parcel generally slopes to the north. Runoff from this basin will be conveyed via conveyance swale A to retention structure A with one check dam and one infiltration sump. Retention Structure A and the sump are designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

DRAINAGE BASIN 7-TYPICAL BASIN

Drainage Basin 7 represents runoff from the development of lot 14. This parcel generally slopes to the southeast. This basin will be considered typical for each lot that slopes away from stormwater facilities. On the drainage basin exhibit these lots are labeled as “TB” and include lots 12-15. Runoff from a typical basin will sheet flow from a vegetative filter strip and will be stored in an infiltration sump that is designed to retain the post-developed 100-year runoff volume and the initial storm water facility volume. As such, the storm water will not exceed the pre-development runoff to an adjoining property during the 2-year storm event and that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

INFILTRATION FACILITIES

Infiltration sumps are proposed to be installed throughout the development. These will capture any runoff not retained in check dams. Not taking into consideration infiltration, each sump is capable of storing 165 cubic feet of runoff volume. Lots 12-15 will require sumps to be installed after development. Pre-treatment facilities must be provided for infiltration facilities. Vegetative filter strips and vegetated swales will be used to satisfy the pre-treatment requirement. Refer to attachments for more detail on sump locations and storage calculations.

PRE-TREATMENT FACILITIES

The rural nature of the site will provide superb pretreatment of any storm water before leaving the site.

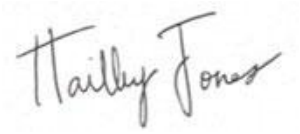
## 7.0 OPERATION AND MAINTENANCE

The operation and maintenance of the storm water management infrastructure are essential to the longevity of the storm water treatment. The lot layout includes an Operation and Maintenance Plan.

## 8.0 CONCLUSIONS

This report was prepared as required by the Department of Environmental Quality, Circular DEQ-8, Montana Standards for Subdivision Storm Water Drainage, 2024 Edition. The development of the 7.50-acre property will include a road extension and the development of 25 single-family homes, which will increase the impervious area and therefore increase both runoff rates and volume. The proposed retention structures have been sized to collect storm water and ensure that the development does not adversely impact the surrounding area, the environment, or the health and safety of the property owners. The plan was developed to ensure that storm water does not exceed the pre-development runoff to an adjoining property during the 2-year storm event, that no roads, driveways, or other access points are overtopped during the 10-year storm event, and that no drain fields or buildings will be inundated during the 100-year storm event.

Prepared by:
**406 Engineering, Inc.**



Hailley Jones, Staff Engineer

**ATTACHMENTS**

- ✓ *NRCS Hydrologic Soil Group (3 pages)*
- ✓ *NOAA Precipitation Data (4 pages)*
- ✓ *TR-55 Curve Number Values (2 pages)*
- ✓ *Composite Curve Number Calculations (1 page)*
- ✓ *Hydraflow Time of Concentration and Runoff Calculations (15 pages)*
- ✓ *Stormwater Facilities (5 pages)*

*https://406engineeringinc.sharepoint.com/Shared Documents/406 Work/1_Projects/2021 Projects/21-007K Escalante Wilderness Preserve/3_DESIGN & PERMITTING/1_DEQ JOINT APP/5.Appendix E.-Drainage Report/Phase 15/5.Appendix E - Drainage Report/rpt.2025-10-30.CLIENT.DEQ 8.docx*
*Wednesday, January 7, 2026, 9:43 AM*




Map Scale: 1:1,830 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Lines**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Points**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Kootenai National Forest Area, Montana-Idaho
Survey Area Data: Version 25, Aug 30, 2025

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

Date(s) aerial images were photographed: Jul 14, 2023—Aug 13, 2023

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.

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1111 | Canusa-Felt family complex, 0 to 15 percent slopes | A | 6.3 | 68.8% |
| 1112 | Canusa sandy loam, 1 to 20 percent slopes | A | 2.9 | 31.1% |
| **Totals for Area of Interest** | | | **9.2** | **100.0%** |

## Description

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.

**NOAA Atlas 14, Volume 12, Version 2**
**Location name: Eureka, Montana, USA***
**Latitude: 48.9386°, Longitude: -115.1253°**
**Elevation: 2656 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Carl Trypaluk, Dale Unruh, Michael St.Laurent, Austin Jordan, Rama Sesha Sridhar Mantripragada, Sandra Pavlovic, Greg Fall, Fernando Salas

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.139** (0.122-0.157) | **0.182** (0.161-0.209) | **0.251** (0.219-0.292) | **0.307** (0.263-0.362) | **0.380** (0.314-0.458) | **0.435** (0.346-0.533) | **0.488** (0.370-0.613) | **0.539** (0.389-0.703) | **0.605** (0.409-0.837) | **0.652** (0.429-0.947) |
| 10-min | **0.192** (0.170-0.218) | **0.253** (0.224-0.289) | **0.348** (0.303-0.405) | **0.425** (0.364-0.502) | **0.527** (0.435-0.636) | **0.603** (0.480-0.739) | **0.677** (0.514-0.850) | **0.748** (0.540-0.976) | **0.839** (0.568-1.16) | **0.904** (0.596-1.31) |
| 15-min | **0.223** (0.197-0.253) | **0.294** (0.260-0.336) | **0.405** (0.353-0.471) | **0.494** (0.423-0.583) | **0.613** (0.506-0.739) | **0.701** (0.558-0.859) | **0.786** (0.597-0.987) | **0.869** (0.627-1.13) | **0.974** (0.660-1.35) | **1.05** (0.692-1.53) |
| 30-min | **0.272** (0.241-0.309) | **0.358** (0.317-0.410) | **0.494** (0.430-0.574) | **0.602** (0.516-0.711) | **0.747** (0.616-0.901) | **0.854** (0.680-1.05) | **0.958** (0.728-1.20) | **1.06** (0.764-1.38) | **1.19** (0.804-1.64) | **1.28** (0.843-1.86) |
| 60-min | **0.326** (0.288-0.369) | **0.427** (0.378-0.489) | **0.588** (0.512-0.684) | **0.717** (0.614-0.846) | **0.888** (0.733-1.07) | **1.02** (0.809-1.24) | **1.14** (0.865-1.43) | **1.26** (0.909-1.64) | **1.41** (0.956-1.96) | **1.52** (1.00-2.21) |
| 2-hr | **0.419** (0.377-0.469) | **0.527** (0.473-0.596) | **0.698** (0.617-0.802) | **0.837** (0.727-0.974) | **1.02** (0.860-1.22) | **1.16** (0.947-1.41) | **1.30** (1.02-1.61) | **1.43** (1.07-1.85) | **1.60** (1.13-2.20) | **1.73** (1.19-2.50) |
| 3-hr | **0.492** (0.448-0.546) | **0.600** (0.544-0.672) | **0.773** (0.690-0.879) | **0.914** (0.803-1.05) | **1.10** (0.942-1.30) | **1.25** (1.04-1.50) | **1.39** (1.11-1.71) | **1.54** (1.18-1.97) | **1.72** (1.25-2.34) | **1.85** (1.32-2.66) |
| 6-hr | **0.642** (0.589-0.704) | **0.753** (0.689-0.831) | **0.935** (0.843-1.04) | **1.08** (0.965-1.22) | **1.29** (1.12-1.48) | **1.45** (1.23-1.70) | **1.61** (1.33-1.94) | **1.77** (1.42-2.23) | **1.98** (1.52-2.65) | **2.14** (1.60-3.02) |
| 12-hr | **0.846** (0.776-0.925) | **0.978** (0.895-1.08) | **1.20** (1.08-1.32) | **1.38** (1.23-1.54) | **1.63** (1.43-1.84) | **1.82** (1.58-2.10) | **2.02** (1.71-2.39) | **2.22** (1.84-2.73) | **2.48** (2.00-3.24) | **2.69** (2.11-3.68) |
| 24-hr | **1.08** (0.990-1.19) | **1.24** (1.14-1.37) | **1.52** (1.37-1.68) | **1.74** (1.56-1.94) | **2.06** (1.82-2.31) | **2.30** (2.01-2.62) | **2.55** (2.19-2.97) | **2.80** (2.36-3.39) | **3.14** (2.58-4.02) | **3.39** (2.74-4.56) |
| 2-day | **1.30** (1.18-1.42) | **1.49** (1.36-1.64) | **1.82** (1.64-2.02) | **2.09** (1.87-2.33) | **2.47** (2.18-2.79) | **2.76** (2.40-3.16) | **3.05** (2.62-3.58) | **3.35** (2.83-4.07) | **3.75** (3.09-4.82) | **4.06** (3.28-5.46) |
| 3-day | **1.43** (1.31-1.57) | **1.65** (1.51-1.82) | **2.01** (1.82-2.24) | **2.31** (2.07-2.59) | **2.73** (2.40-3.10) | **3.05** (2.65-3.51) | **3.38** (2.88-3.97) | **3.71** (3.11-4.52) | **4.14** (3.41-5.35) | **4.48** (3.62-6.06) |
| 4-day | **1.55** (1.41-1.70) | **1.78** (1.62-1.97) | **2.17** (1.96-2.41) | **2.50** (2.23-2.79) | **2.94** (2.58-3.34) | **3.29** (2.85-3.79) | **3.63** (3.10-4.28) | **3.98** (3.34-4.87) | **4.45** (3.66-5.76) | **4.81** (3.89-6.51) |
| 7-day | **1.83** (1.67-2.02) | **2.10** (1.91-2.32) | **2.55** (2.29-2.83) | **2.92** (2.60-3.27) | **3.43** (3.00-3.90) | **3.82** (3.30-4.41) | **4.21** (3.59-4.98) | **4.62** (3.87-5.64) | **5.15** (4.23-6.65) | **5.55** (4.49-7.50) |
| 10-day | **2.07** (1.89-2.28) | **2.37** (2.16-2.62) | **2.86** (2.57-3.18) | **3.27** (2.91-3.66) | **3.83** (3.35-4.35) | **4.26** (3.68-4.91) | **4.69** (4.00-5.54) | **5.12** (4.30-6.26) | **5.70** (4.69-7.36) | **6.14** (4.97-8.27) |
| 20-day | **2.77** (2.53-3.06) | **3.16** (2.87-3.49) | **3.77** (3.39-4.21) | **4.28** (3.81-4.81) | **4.97** (4.36-5.67) | **5.49** (4.77-6.36) | **6.01** (5.15-7.12) | **6.52** (5.52-8.00) | **7.20** (5.98-9.32) | **7.70** (6.30-10.4) |
| 30-day | **3.34** (3.05-3.69) | **3.78** (3.43-4.19) | **4.50** (4.03-5.01) | **5.07** (4.51-5.69) | **5.84** (5.13-6.66) | **6.41** (5.58-7.43) | **6.97** (6.00-8.27) | **7.52** (6.40-9.23) | **8.23** (6.89-10.6) | **8.74** (7.24-11.8) |
| 45-day | **4.12** (3.75-4.55) | **4.63** (4.19-5.12) | **5.44** (4.87-6.04) | **6.08** (5.40-6.80) | **6.92** (6.08-7.86) | **7.53** (6.57-8.70) | **8.11** (7.01-9.58) | **8.66** (7.42-10.6) | **9.34** (7.92-12.0) | **9.82** (8.32-13.2) |
| 60-day | **4.79** (4.36-5.30) | **5.36** (4.85-5.93) | **6.24** (5.58-6.93) | **6.93** (6.15-7.74) | **7.81** (6.88-8.86) | **8.44** (7.38-9.73) | **9.02** (7.83-10.6) | **9.56** (8.24-11.6) | **10.2** (8.74-13.1) | **10.6** (9.17-14.2) |

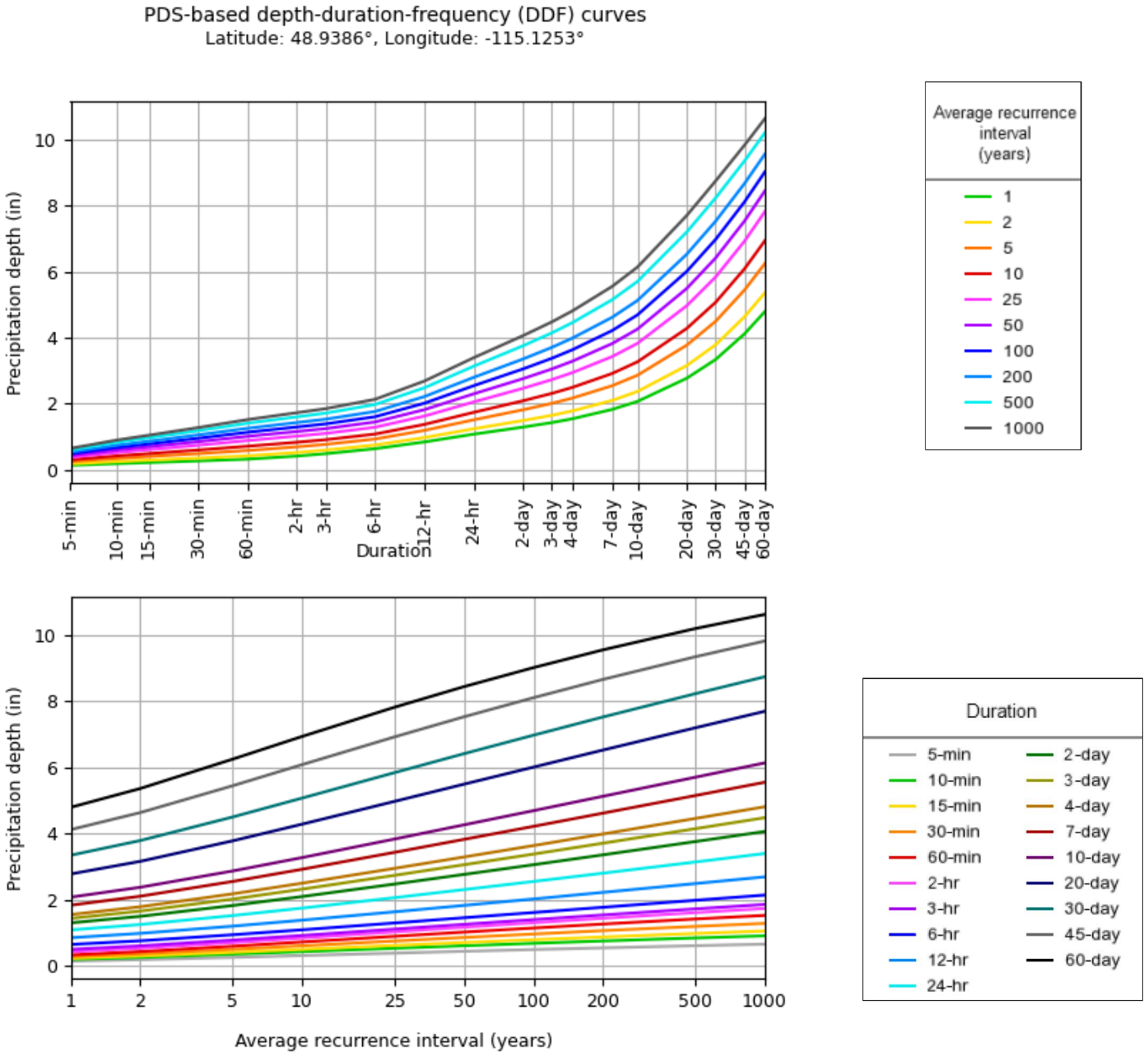
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

## PF graphical



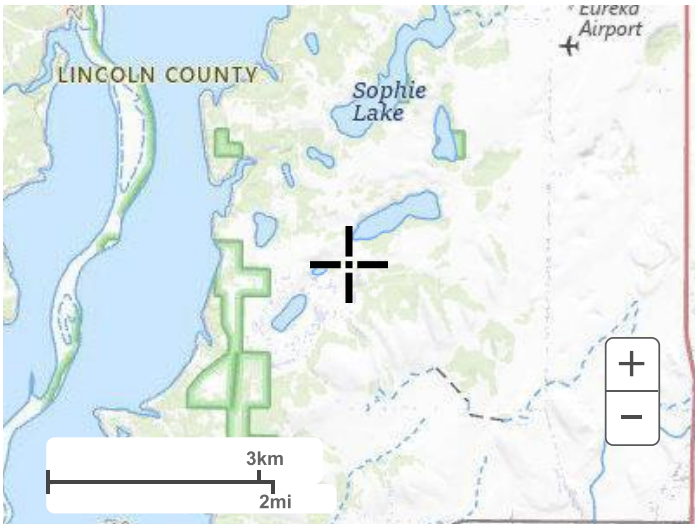

NOAA Atlas 14, Volume 12, Version 2

Created (GMT): Fri Aug 1 16:57:16 2025

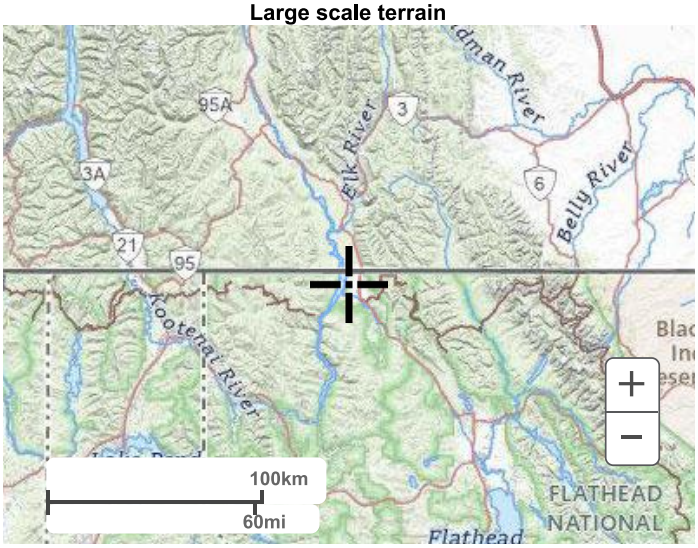
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## Maps & aerials

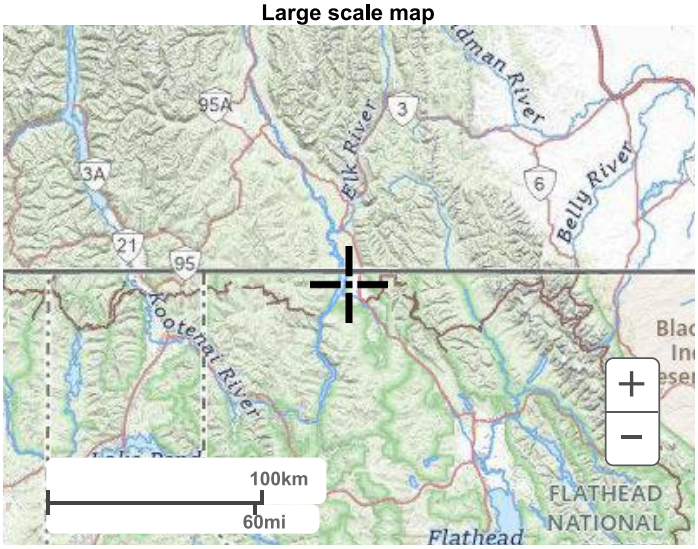
**Small scale terrain**



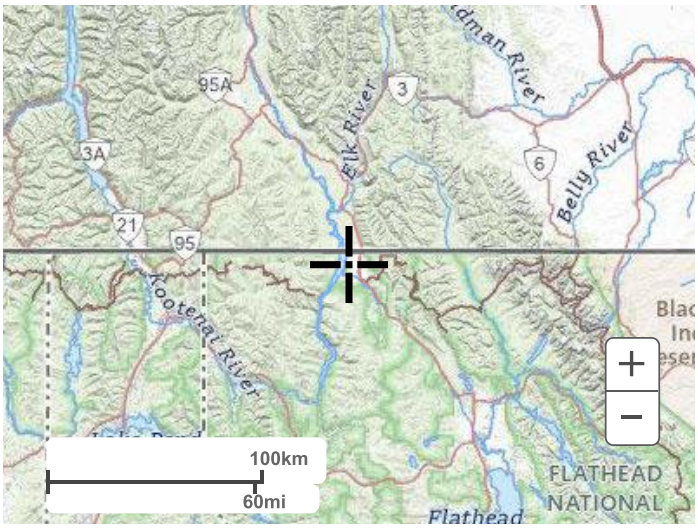

Large scale terrain




Large scale map




Large scale aerial




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Disclaimer

Table 2-2a Runoff curve numbers for urban areas [1/]

| Cover description: Cover type and hydrologic condition | Average percent impervious area [2/] | Curve numbers for hydrologic soil group: A | B | C | D |
|---|---|---|---|---|---|
| ***Fully developed urban areas (vegetation established)*** | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only) [4/] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| ***Developing urban areas*** | | | | | |
| Newly graded areas (pervious areas only, no vegetation) [5/] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

| Cover description | | Curve numbers for hydrologic soil group | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic condition | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing. [2/] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element. [3/] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | 30 [4/] | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm). [5/] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods. [6/] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 30 [4/] | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

1 Average runoff condition, and $I_a = 0.2S$.

2 ***Poor:*** <50%) ground cover or heavily grazed with no mulch.
***Fair:*** 50 to 75% ground cover and not heavily grazed.
***Good:*** > 75% ground cover and lightly or only occasionally grazed.

3 ***Poor:*** <50% ground cover.
***Fair:*** 50 to 75% ground cover.
***Good:*** >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 ***Poor:*** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
***Fair:*** Woods are grazed but not burned, and some forest litter covers the soil.
***Good:*** Woods are protected from grazing, and litter and brush adequately cover the soil.

**Post-Developed Composite Curve Number & Initial Storm Water Facility Volume**
**PROJECT: Escalante Wilderness Preserve-Phase 15**
**PREPARED BY: 406 Engineering Inc**
November 4, 2025

| Basin ID | Total Area | | Open Space-Good Condition | | Asphalt | | Roof | | Composite CN | Total Impervious Area (SF) | Initial Storm Water Facility Volume (CF) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Acres) | (SF) | Area (SF) | CN | Area (SF) | CN | Area (SF) | CN | | | |
| Basin 1 | 1.06 | 46150 | 33718 | 39 | 6832 | 98 | 5600 | 98 | **55** | 12432 | 518 |
| Basin 2 | 1.34 | 58284 | 37910 | 39 | 10574 | 98 | 9800 | 98 | **60** | 20374 | 849 |
| Basin 3 | 0.24 | 10597 | 5897 | 39 | 4700 | 98 | 0 | 98 | **66** | 4700 | 196 |
| Basin 4 | 1.19 | 51808 | 39641 | 39 | 7967 | 98 | 4200 | 98 | **53** | 12167 | 507 |
| Basin 5 | 1.78 | 77431 | 58773 | 39 | 10258 | 98 | 8400 | 98 | **54** | 18658 | 777 |
| Basin 6 | 0.43 | 18701 | 13426 | 39 | 3875 | 98 | 1400 | 98 | **56** | 5275 | 220 |
| Basin 7-TB Lot 14 | 0.26 | 11343 | 9343 | 39 | 600 | 98 | 1400 | 98 | **50** | 2000 | 83 |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 7-Typical Basin |
| 9 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 1 |
| 10 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 2 |
| 11 | SCS Runoff | 0.000 | 2 | 1324 | 7 | ------ | ------ | ------ | Developed Basin 3 |
| 12 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 4 |
| 13 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 5 |
| 14 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 6 |
| 15 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 7-Typical Basin |

# TR55 Tc Worksheet



## Hyd. No. 1

Pre-Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 189.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 1.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 34.56** | **+** | **0.00** | **+** | **0.00** | **=** | **34.56** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 34.60 min**

# TR55 Tc Worksheet



## Hyd. No. 2

Pre-Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 290.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 31.37** | **+** | **0.00** | **+** | **0.00** | **=** | **31.37** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 31.40 min**

# TR55 Tc Worksheet



## Hyd. No. 3

Pre-Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 71.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.25 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.85** | **+** | **0.00** | **+** | **0.00** | **=** | **8.85** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.90 min**

# TR55 Tc Worksheet



## Hyd. No. 4

Pre-Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 222.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.31** | **+** | **0.00** | **+** | **0.00** | **=** | **13.31** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.30 min**

# TR55 Tc Worksheet



## Hyd. No. 5

Pre-Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 198.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.60 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 21.49** | **+** | **0.00** | **+** | **0.00** | **=** | **21.49** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 21.50 min**

# TR55 Tc Worksheet



## Hyd. No. 6

Pre-Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 276.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 1.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 46.79** | **+** | **0.00** | **+** | **0.00** | **=** | **46.79** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 46.80 min**

# TR55 Tc Worksheet



## Hyd. No. 7

Pre-Developed Basin 7-Typical Basin

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 83.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.12** | **+** | **0.00** | **+** | **0.00** | **=** | **7.12** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.10 min**

# TR55 Tc Worksheet



## Hyd. No. 9

Developed Basin 1

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 189.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 1.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 34.56** | **+** | **0.00** | **+** | **0.00** | **=** | **34.56** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 34.60 min**

# TR55 Tc Worksheet



## Hyd. No. 10

Developed Basin 2

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 290.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 31.37** | **+** | **0.00** | **+** | **0.00** | **=** | **31.37** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 31.40 min**

# TR55 Tc Worksheet



## Hyd. No. 11

Developed Basin 3

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 71.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 4.25 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 8.85** | **+** | **0.00** | **+** | **0.00** | **=** | **8.85** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 8.90 min**

# TR55 Tc Worksheet



## Hyd. No. 12

Developed Basin 4

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 222.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 15.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 13.31** | **+** | **0.00** | **+** | **0.00** | **=** | **13.31** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 13.30 min**

# TR55 Tc Worksheet



## Hyd. No. 13

Developed Basin 5

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 198.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 3.60 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 21.49** | **+** | **0.00** | **+** | **0.00** | **=** | **21.49** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 21.50 min**

# TR55 Tc Worksheet



## Hyd. No. 14

Developed Basin 6

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 276.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 1.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 46.79** | **+** | **0.00** | **+** | **0.00** | **=** | **46.79** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 46.80 min**

# TR55 Tc Worksheet



## Hyd. No. 15

Developed Basin 7-Typical Basin

| Description | A | | B | | C | | Totals |
|---|---|---|---|---|---|---|---|
| **Sheet Flow** | | | | | | | |
| Manning's n-value | = 0.150 | | 0.011 | | 0.011 | | |
| Flow length (ft) | = 83.0 | | 0.0 | | 0.0 | | |
| Two-year 24-hr precip. (in) | = 1.24 | | 0.00 | | 0.00 | | |
| Land slope (%) | = 10.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 7.12** | **+** | **0.00** | **+** | **0.00** | **=** | **7.12** |
| **Shallow Concentrated Flow** | | | | | | | |
| Flow length (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Watercourse slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Surface description | = Paved | | Paved | | Paved | | |
| Average velocity (ft/s) | =0.00 | | 0.00 | | 0.00 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |
| **Channel Flow** | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | | 0.00 | | 0.00 | | |
| Wetted perimeter (ft) | = 0.00 | | 0.00 | | 0.00 | | |
| Channel slope (%) | = 0.00 | | 0.00 | | 0.00 | | |
| Manning's n-value | = 0.015 | | 0.015 | | 0.015 | | |
| Velocity (ft/s) | =0.00 | | | | | | |
| | | | 0.00 | | | | |
| | | | | | 0.00 | | |
| Flow length (ft) | ({0})0.0 | | 0.0 | | 0.0 | | |
| **Travel Time (min)** | **= 0.00** | **+** | **0.00** | **+** | **0.00** | **=** | **0.00** |

**Total Travel Time, Tc ..... 7.10 min**

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 7-Typical Basin |
| 9 | SCS Runoff | 0.001 | 2 | 1440 | 5 | ------ | ------ | ------ | Developed Basin 1 |
| 10 | SCS Runoff | 0.004 | 2 | 1266 | 115 | ------ | ------ | ------ | Developed Basin 2 |
| 11 | SCS Runoff | 0.002 | 2 | 1066 | 75 | ------ | ------ | ------ | Developed Basin 3 |
| 12 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 4 |
| 13 | SCS Runoff | 0.000 | 2 | 1442 | 1 | ------ | ------ | ------ | Developed Basin 5 |
| 14 | SCS Runoff | 0.000 | 2 | 1440 | 5 | ------ | ------ | ------ | Developed Basin 6 |
| 15 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Developed Basin 7-Typical Basin |

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to Peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 1 |
| 2 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 2 |
| 3 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 3 |
| 4 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 4 |
| 5 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 5 |
| 6 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 6 |
| 7 | SCS Runoff | 0.000 | 2 | n/a | 0 | ------ | ------ | ------ | Pre-Developed Basin 7-Typical Basin |
| 9 | SCS Runoff | 0.009 | 2 | 1136 | 349 | ------ | ------ | ------ | Developed Basin 1 |
| 10 | SCS Runoff | 0.022 | 2 | 784 | 925 | ------ | ------ | ------ | Developed Basin 2 |
| 11 | SCS Runoff | 0.021 | 2 | 602 | 302 | ------ | ------ | ------ | Developed Basin 3 |
| 12 | SCS Runoff | 0.008 | 2 | 1174 | 278 | ------ | ------ | ------ | Developed Basin 4 |
| 13 | SCS Runoff | 0.014 | 2 | 1154 | 503 | ------ | ------ | ------ | Developed Basin 5 |
| 14 | SCS Runoff | 0.004 | 2 | 1118 | 168 | ------ | ------ | ------ | Developed Basin 6 |
| 15 | SCS Runoff | 0.001 | 2 | 1268 | 27 | ------ | ------ | ------ | Developed Basin 7-Typical Basin |

# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Sep 2 2025

## Swale A

**Triangular**

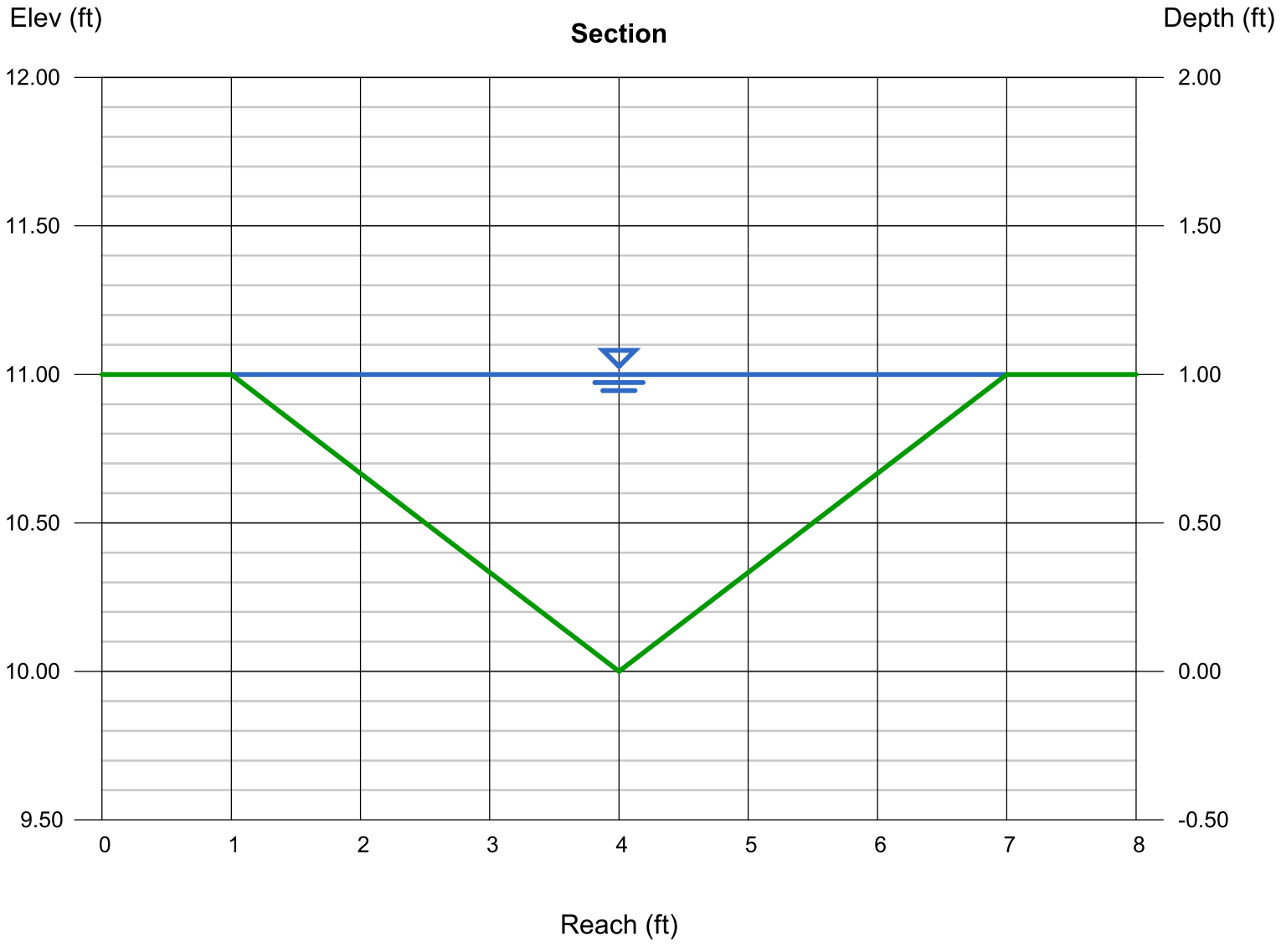
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.00 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.015 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.00 |
| Q (cfs) | = 12.78 |
| Area (sqft) | = 3.00 |
| Velocity (ft/s) | = 4.26 |
| Wetted Perim (ft) | = 6.32 |
| Crit Depth, Yc (ft) | = 1.00 |
| Top Width (ft) | = 6.00 |
| EGL (ft) | = 1.28 |



# Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Sep 4 2025

## Typical Driveway Culvert

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 10.00 |
| Pipe Length (ft) | = | 14.00 |
| Slope (%) | = | 0.36 |
| Invert Elev Up (ft) | = | 10.05 |
| Rise (in) | = | 12.0 |
| Shape | = | Circular |
| Span (in) | = | 12.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.013 |
| Culvert Type | = | Circular Corrugate Metal Pipe |
| Culvert Entrance | = | Mitered to slope (C) |
| Coeff. K,M,c,Y,k | = | 0.021, 1.33, 0.0463, 0.75, 0.7 |

**Embankment**

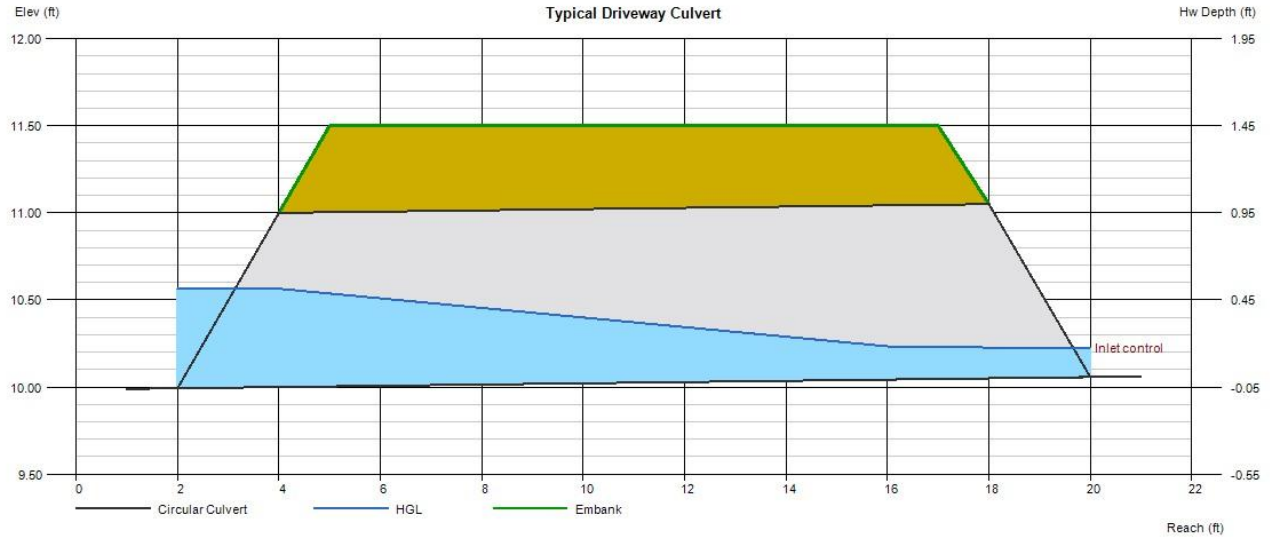
| | | |
|---|---|---|
| Top Elevation (ft) | = | 11.50 |
| Top Width (ft) | = | 12.00 |
| Crest Width (ft) | = | 6.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 0.00 |
| Qmax (cfs) | = | 2.00 |
| Tailwater Elev (ft) | = | (dc+D)/2 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 0.10 |
| Qpipe (cfs) | = | 0.10 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 0.22 |
| Veloc Up (ft/s) | = | 1.69 |
| HGL Dn (ft) | = | 10.56 |
| HGL Up (ft) | = | 10.18 |
| Hw Elev (ft) | = | 10.23 |
| Hw/D (ft) | = | 0.18 |
| Flow Regime | = | Inlet Control |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 31 2025

## Retention Swale A

**Triangular**

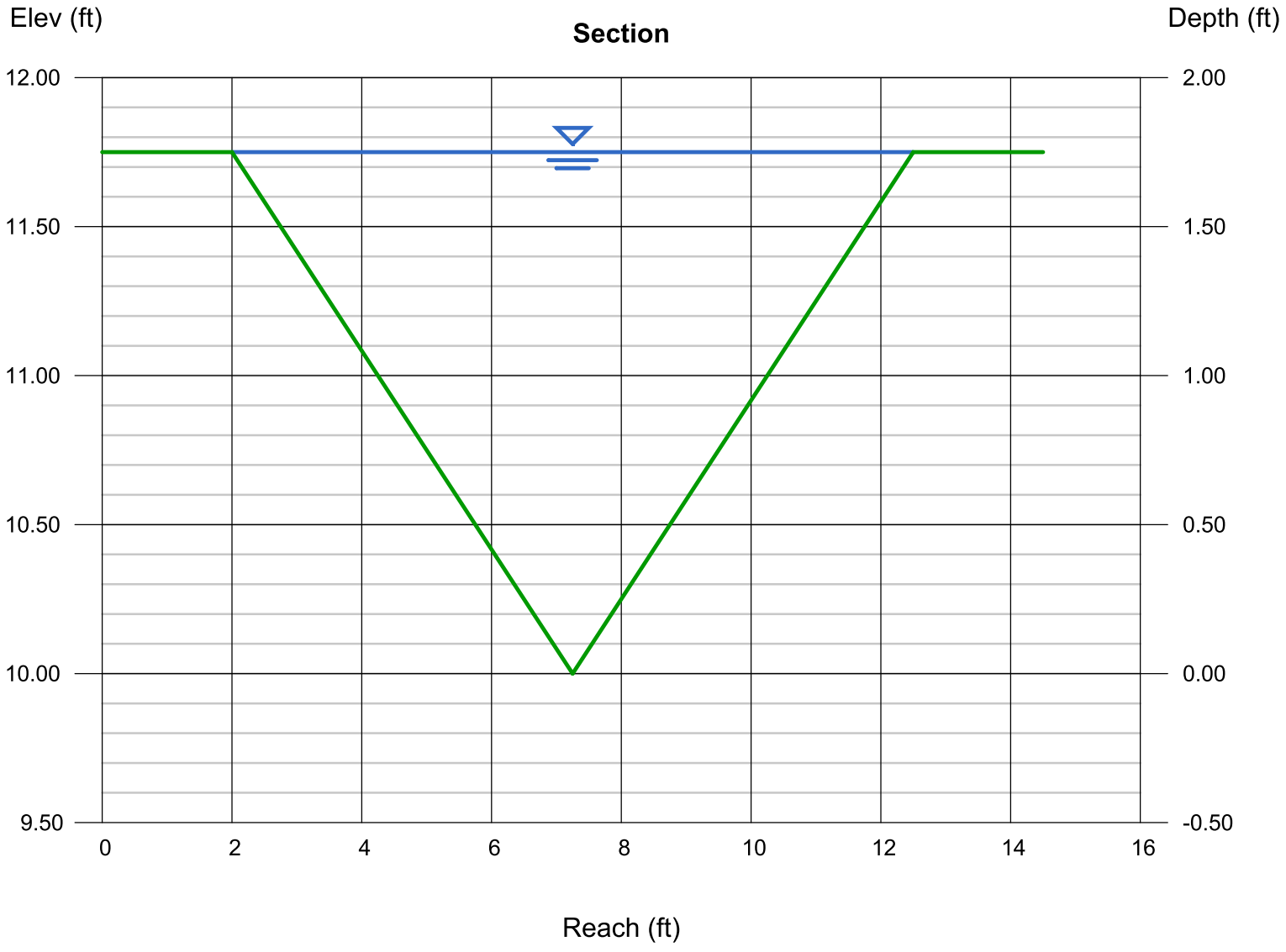
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.75 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.025 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.75 |
| Q (cfs) | = 34.11 |
| Area (sqft) | = 9.19 |
| Velocity (ft/s) | = 3.71 |
| Wetted Perim (ft) | = 11.07 |
| Crit Depth, Yc (ft) | = 1.52 |
| Top Width (ft) | = 10.50 |
| EGL (ft) | = 1.96 |



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Oct 31 2025

## Check Dam A

**Triangular**

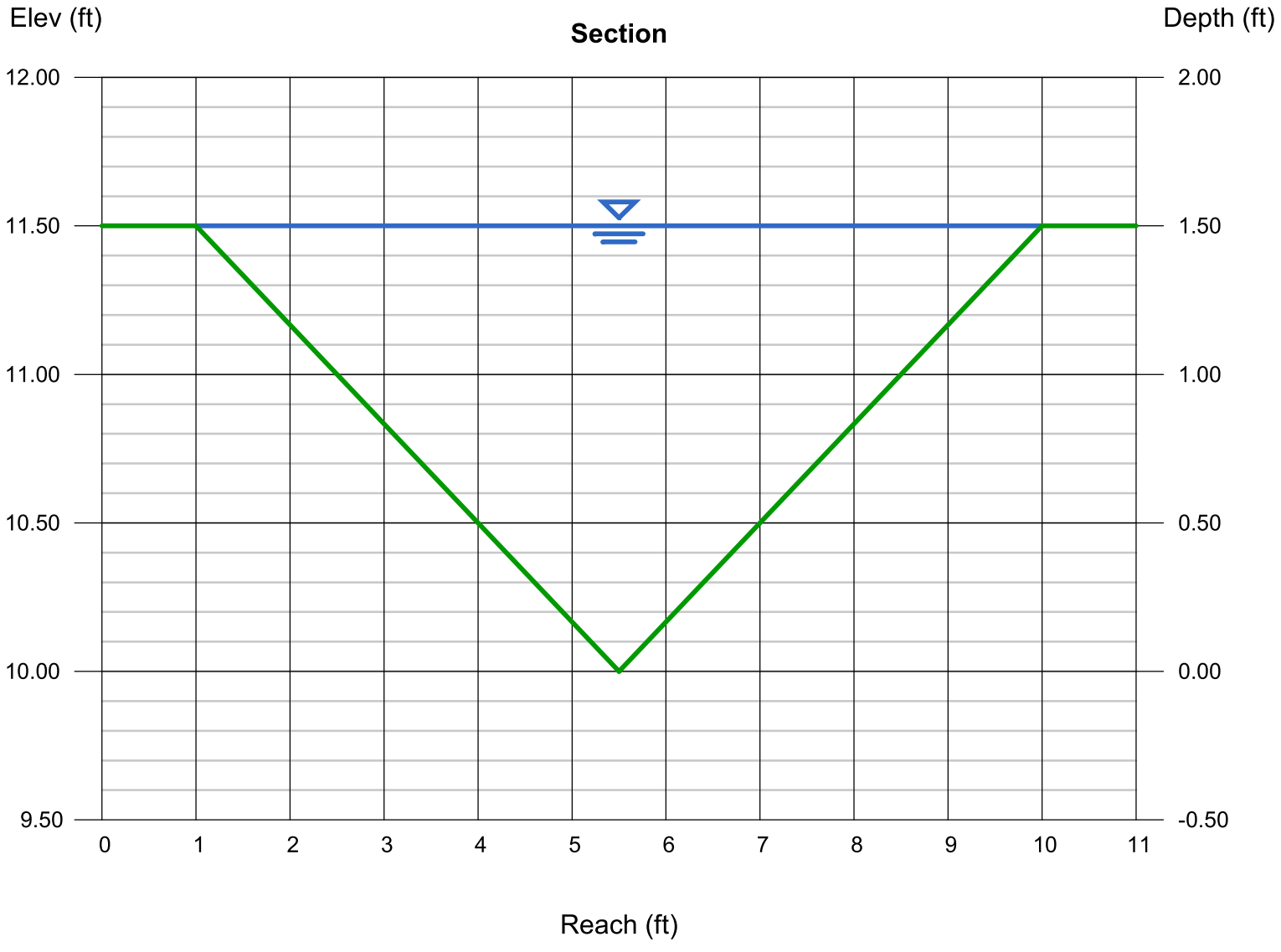
| | |
|---|---|
| Side Slopes (z:1) | = 3.00, 3.00 |
| Total Depth (ft) | = 1.50 |
| Invert Elev (ft) | = 10.00 |
| Slope (%) | = 0.50 |
| N-Value | = 0.025 |

**Calculations**

| | |
|---|---|
| Compute by: | Q vs Depth |
| No. Increments | = 10 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 1.50 |
| Q (cfs) | = 22.61 |
| Area (sqft) | = 6.75 |
| Velocity (ft/s) | = 3.35 |
| Wetted Perim (ft) | = 9.49 |
| Crit Depth, Yc (ft) | = 1.29 |
| Top Width (ft) | = 9.00 |
| EGL (ft) | = 1.67 |



## Sump Calculations

| | |
|---|---|
| Cone | |
| Height | 4 |
| Top Diameter (ft) | 2 |
| Bottom Diameter (ft) | 4 |
| Barrel | |
| Height (ft) | 4 |
| Top Diameter (ft) | 4 |
| Bottom Diameter (ft) | 4 |
| Wall Thickness (in) | 4 |
| Sump Rock | |
| Depth Around Barrel (ft) | 2 |

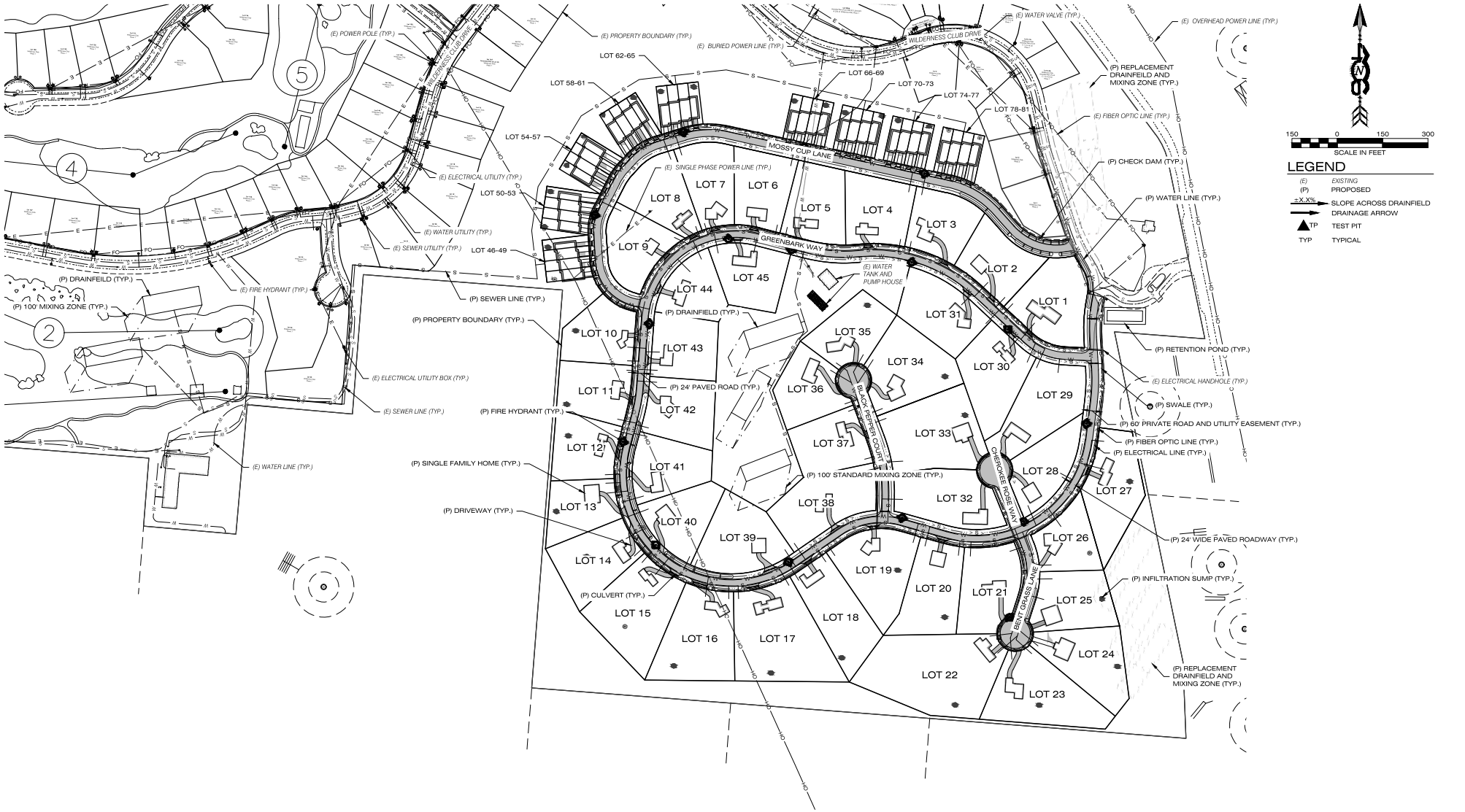
| Inside Sump Volume | |
|---|---|
| Cone (CF) | 29.32 |
| Barrel (CF) | 50.24 |
| Total (CF) | 79.56 |

| Gravel Storage Volume | |
|---|---|
| Volume Around Barrel | 159.09 |
| Volume Under Barrel | 109.03 |
| Total (CF) | 268.12 |
| Storage in Gravel 30% (CF) | 80.44 |

| **Total Storage (CF)** | **160.00** |
|---|---|

| Infiltration per Sump @ 1.1 in/hr | |
|---|---|
| Infiltration Area (SF) | 54.51 |
| Total Infiltration (CF/HR) | 5.00 |
| **Infiltration - 1 hr Event (CF)** | **5.00** |

| **Total Storg and Infiltr in 1 Hr** | **164.99** |
|---|---|



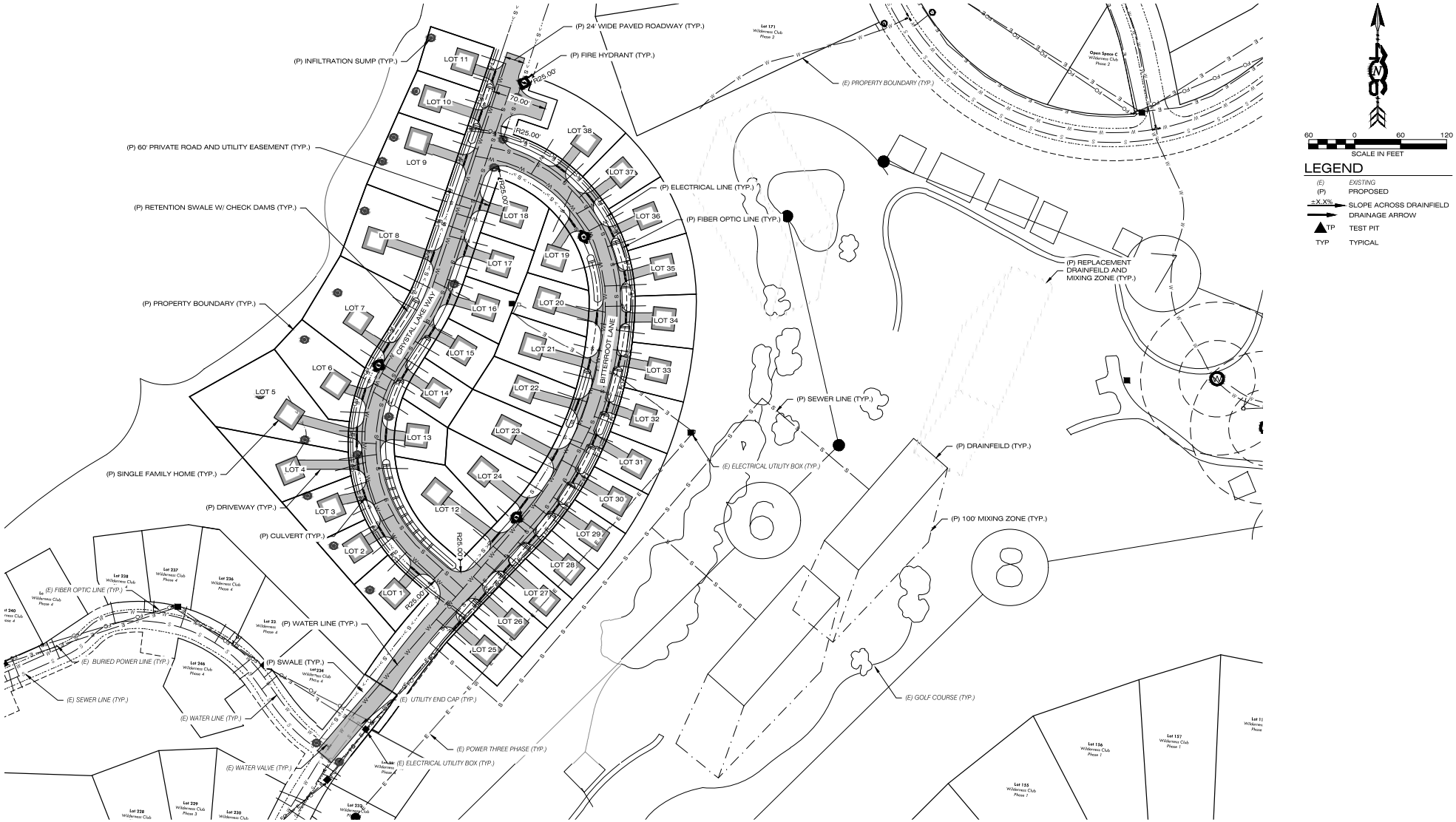

DATE: 9/11/26
PREPARED BY: B. CAMPBELL

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| | | | |
|---|---|---|---|
| PROJECT NAME: ESCALANTE WILDERNESS PRESERVE | LOCATION: SOPHIE LAKE ROAD COS 4389 SEC. 28, 29, 32 & 33, T37N, R27W, PMM LINCOLN COUNTY | 406 PROJECT NO. 21-007K | |
| SHEET TITLE: LOT LAYOUT PHASE 11 | PREPARED FOR: WILDERNESS PRESERVE US LP | SHEET: 1 OF 1 | |

DWG LOCATION: C:\USERS\BENCAMPBELL\.406\406 ENGINEERING - DOCUMENTS\406 WORK\1_PROJECTS\2021 PROJECTS\21-007K ESCALANTE WILDERNESS PRESERVE\02_DRAFTING\02.1_DRAWINGS\DEQ-21-007K - PHASE 11.DWG

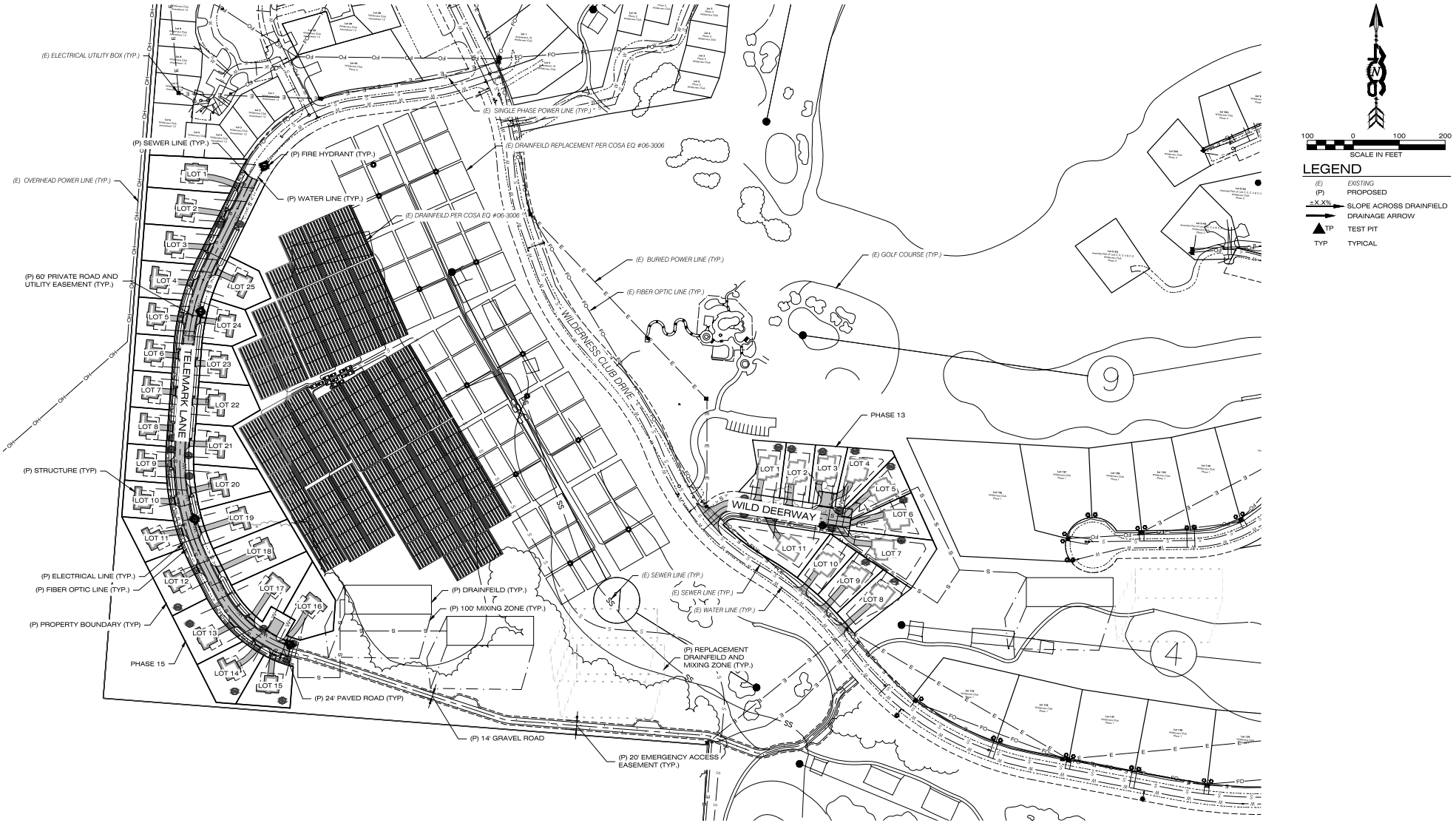
PLOT DATE: 9/11/2026 1:43 PM BY BEN CAMPBELL / BENCAMPBELL




DATE: 9/11/26
PREPARED BY: B. CAMPBELL

406 ENGINEERING
CIVIL ENGINEERING
LAND USE CONSULTING
1201 S. 6th St. W.
Missoula, MT 59801
(406) 317-1131
35 8th St. E.
Kalispell, MT 59901
(406) 257-0679
www.406engineeringinc.com

| | | | |
|---|---|---|---|
| PROJECT NAME: ESCALANTE WILDERNESS PRESERVE | LOCATION: SOPHIE LAKE ROAD COS 4389 SEC. 28,29, 32 & 33, T37N, R27W, PMM LINCOLN COUNTY | 406 PROJECT NO. 21-007K | |
| SHEET TITLE: LOT LAYOUT PHASE 12 | PREPARED FOR: WILDERNESS PRESERVE US LP | SHEET: 1 OF 1 | |

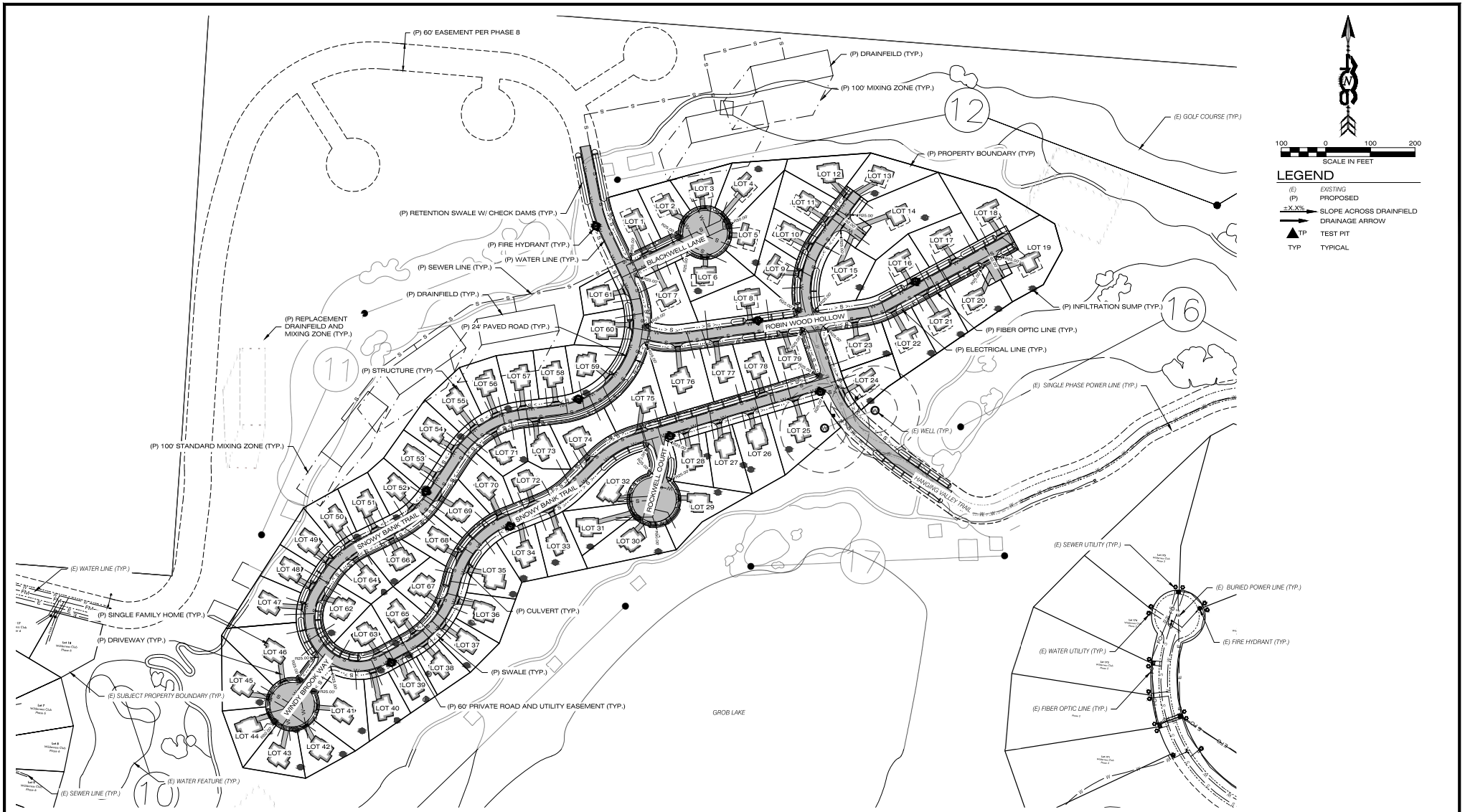



DATE: 9/11/26
PREPARED BY: B. CAMPBELL

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Missoula, MT 59801
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35 8th St. E.
Kalispell, MT 59901
(406) 257-0679
www.406engineeringinc.com

| PROJECT NAME: | LOCATION: | 406 PROJECT NO. |
|---|---|---|
| ESCALANTE WILDERNESS PRESERVE | SOPHIE LAKE ROAD<br>COS 4389<br>SEC. 28,29, 32 & 33, T37N, R27W, PMM<br>LINCOLN COUNTY | 21-007K |
| SHEET TITLE: | PREPARED FOR: | SHEET: |
| LOT LAYOUT PHASES 13 & 15 | WILDERNESS PRESERVE<br>US LP | 1 OF 1 |

DWG LOCATION: C:\USERS\BENCAMPBELL\406-406 ENGINEERING - DOCUMENTS\406 WORK\1_PROJECTS\2021 PROJECTS\21-007K ESCALANTE WILDERNESS PRESERVE\02_DRAFTING\02.1_DRAWINGS\DEQ-21-007K - PHASE 15.DWG
PLOT DATE: 9/11/2026 1:58 PM BY BEN CAMPBELL / BENCAMPBELL




DATE: 9/11/26
PREPARED BY: B. CAMPBELL

406 ENGINEERING
CIVIL ENGINEERING
LAND USE CONSULTING
1201 S. 6th St. W.
Missoula, MT 59801
(406) 317-1131
35 8th St. E.
Kalispell, MT 59901
(406) 257-0679
www.406engineeringinc.com

| PROJECT NAME: | LOCATION: | 406 PROJECT NO. |
|---|---|---|
| ESCALANTE WILDERNESS PRESERVE | SOPHIE LAKE ROAD<br>COS 4389<br>SEC. 28,29, 32 & 33, T37N, R27W, PMM<br>LINCOLN COUNTY | 21-007K |
| SHEET TITLE: | PREPARED FOR: | SHEET: |
| LOT LAYOUT PHASE 14 | WILDERNESS PRESERVE<br>US LP | 1 OF 1 |

DWG LOCATION: C:\USERS\BENCAMPBELL\406\406 ENGINEERING - DOCUMENTS\406 WORK\1_PROJECTS\2021 PROJECTS\21-007K ESCALANTE WILDERNESS PRESERVE\8_DRAFTING\8.1_DRAWINGS\DEQ-21-007K - PHASE 14.DWG
PLOT DATE: 9/11/2026 1:26 PM BY BEN CAMPBELL / BENCAMPBELL

**STATE OF MONTANA**

**DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION**

1424 9TH AVENUE P.O. BOX 201601 HELENA, MONTANA 59620-1601

# GENERAL ABSTRACT

**Water Right Number:** 76D 30045578 PROVISIONAL PERMIT

**Version:** 1 -- ORIGINAL RIGHT

**Version Status:** ACTIVE

**Owners:** ESCALANTE WILDERNESS PRESERVE US LLC
2930 BLEDSOE ST
SUITE 124
FORT WORTH, TX 76107-2942

**Priority Date:** APRIL 1, 2009 at 01:40 P.M.

**Enforceable Priority Date:** APRIL 1, 2009 at 01:40 P.M.

**Purpose (Use):** COMMERCIAL
LAWN AND GARDEN
MULTIPLE DOMESTIC

**Maximum Flow Rate:** 150.00 GPM
NO MORE THAN 150 GPM MAY BE PUMPED FROM ANY OF THE FOUR WELLS IN COMBINATION
NO MORE THAN 100 GPM MAY BE PUMPED FROM WELLS LISTED AS POINTS OF DIVERSION #1 AND #2 IN COMBINATION
NO MORE THAN 150 GPM MAY BE PUMPED FROM WELLS LISTED AS POINTS OF DIVERSION #3 AND #4 IN COMBINATION

**Maximum Volume:** 187.90 AC-FT

**Maximum Acres:** 68.38

**Source Name:** GROUNDWATER

**Source Type:** GROUNDWATER

**Point of Diversion and Means of Diversion:**

| ID | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|
| 1 | | SWNWNW | 33 | 37N | 27W | LINCOLN |

**Period of Diversion:** JANUARY 1 TO DECEMBER 31

**Diversion Means:** WELL

**Well Depth:** 330.00 FEET

**Static Water Level:** 85.00 FEET

**Casing Diameter:** 12.00 INCHES

**Pump Size:** 15.00 HP

| ID | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|
| 2 | | SWNWNW | 33 | 37N | 27W | LINCOLN |

**Period of Diversion:** JANUARY 1 TO DECEMBER 31

**Diversion Means:** WELL

**Well Depth:** 325.00 FEET

**Static Water Level:** 81.00 FEET

**Casing Diameter:** 12.00 INCHES

**Pump Size:** 15.00 HP

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | SWSESE | 29 | 37N | 27W | LINCOLN | |

**Period of Diversion:** JANUARY 1 TO DECEMBER 31

**Diversion Means:** WELL

**Well Depth:** 180.00 FEET

**Static Water Level:** 45.34 FEET

**Casing Diameter:** 8.00 INCHES

**Pump Size:** 10.00 HP

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | SWSESE | 29 | 37N | 27W | LINCOLN | |

**Period of Diversion:** JANUARY 1 TO DECEMBER 31

**Diversion Means:** WELL

**Well Depth:** 140.00 FEET

**Static Water Level:** 57.65 FEET

**Casing Diameter:** 8.00 INCHES

**Pump Size:** 15.00 HP

POINT OF DIVERSION ID NUMBERS 1 & 2 CORRESPOND RESPECTIVELY TO APPLICANT'S WELLS 1 & 2, WHILE POINT OF DIVERSION ID NUMBERS 3 & 4 CORRESPOND RESPECTIVELY TO APPLICANT'S WELLS 4 & 5.

FOR POINT OF DIVERSION #1, THE WELL LOG AND FINAL ORDER STATE THE TOTAL DEPTH IS 320 FEET; HOWEVER, THE LITHOLOGIC REPORT INDICATES THE WELL WAS DRILLED TO 330 FEET. FOR POINT OF DIVERSION #2, THE WELL LOG AND FINAL ORDER STATE THE TOTAL DEPTH IS 265 FEET; HOWEVER, THE LITHOLOGIC REPORT INDICATES THE WELL WAS DRILLED TO 325 FEET.

**Purpose (Use):** COMMERCIAL **Purpose Clarification:** GOLF COURSE CLUBHOUSE

**Volume:** 5.80 AC-FT

**Period of Use:** JANUARY 1 to DECEMBER 31

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | NESENW | 32 | 37N | 27W | LINCOLN |

**Purpose (Use):** LAWN AND GARDEN **Purpose Clarification:** SUBDIVISION IRRIGATION

**Volume:** 75.00 AC-FT

**Period of Use:** APRIL 20 to OCTOBER 21

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | 5.70 | | W2 | 28 | 37N | 27W | LINCOLN |
| 2 | 9.70 | | E2 | 29 | 37N | 27W | LINCOLN |
| 3 | 20.30 | | E2 | 32 | 37N | 27W | LINCOLN |
| 4 | 11.58 | | N2 | 32 | 37N | 27W | LINCOLN |
| 5 | 15.00 | | N2 | 33 | 37N | 27W | LINCOLN |
| 6 | 6.10 | | W2 | 33 | 37N | 27W | LINCOLN |
| **Total:** | 68.38 | | | | | | |

**Purpose (Use):** MULTIPLE DOMESTIC **Purpose Clarification:** WILDERNESS CLUB SUBDIVISION

**Households:** 319

**Volume:** 107.10 AC-FT

**Period of Use:** JANUARY 1 to DECEMBER 31

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | W2 | 28 | 37N | 27W | LINCOLN |
| 2 | | | E2 | 29 | 37N | 27W | LINCOLN |
| 3 | | | E2 | 32 | 37N | 27W | LINCOLN |
| 4 | | | N2 | 32 | 37N | 27W | LINCOLN |
| 5 | | | N2 | 33 | 37N | 27W | LINCOLN |
| 6 | | | W2 | 33 | 37N | 27W | LINCOLN |

**Geocodes/Valid:** -- NO VALID GEOCODES --

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**Remarks:**

**CONFEDERATED SALISH AND KOOTENAI TRIBES - RESERVED WATER RIGHTS**

THIS RIGHT IS SUBJECT TO ALL PRIOR INDIAN RESERVED WATER RIGHTS OF THE CONFEDERATED SALISH AND KOOTENAI TRIBES IN THE SOURCE OF SUPPLY. IT IS THE TRIBE'S POSITION THAT THE EXERCISE OF JUNIOR WATER RIGHTS EITHER WITHIN OR OUTSIDE OF THE EXTERIOR BOUNDARIES OF THE FLATHEAD INDIAN RESERVATION MAY AFFECT THE RESERVED WATER RIGHTS OF THE TRIBE WITHIN THE EXTERIOR BOUNDARIES OF THE RESERVATION. IT IS THE TRIBE'S POSITION THAT ECONOMIC INVESTMENTS MADE IN RELIANCE UPON THIS RIGHT DO NOT CREATE IN THE APPROPRIATOR ANY EQUITY OR VESTED RIGHT AGAINST THE TRIBES. THE APPROPRIATOR IS HEREBY NOTIFIED THAT ANY FINANCIAL OUTLAY OR WORK INVESTED IN A PROJECT PURSUANT TO THIS RIGHT IS AT APPROPRIATOR'S RISK. THE ISSUANCE OF THIS RIGHT DOES NOT REDUCE THE APPROPRIATOR'S LIABILITY FOR DAMAGE CAUSED BY THE EXERCISE OF THE RIGHT. IT DOES NOT MAKE THE DEPARTMENT LIABLE FOR DAMAGE CAUSED BY THE EXERCISE OF THE RIGHT. NOR IS THE DEPARTMENT LIABLE FOR ANY LOSS TO THE APPROPRIATOR CAUSED BY THE EXERCISE OF SENIOR RESERVED WATER RIGHTS.

**IMPORTANT INFORMATION**

LAWN & GARDEN IRRIGATION INCLUDES 0.78 ACRES ASSOCIATED WITH THE GOLF COURSE CLUBHOUSE.

**REISSUED RIGHT**

THE RIGHT ISSUED ON 03/11/2011 WAS REISSUED. THE RIGHT WAS REISSUED BECAUSE A PROJECT COMPLETION NOTICE DUE DATE AND CSKT INFORMATION REMARK WERE ADDED.

**WATER MEASUREMENT - VOLUME MEASUREMENT RECORDS REQUIRED**

**WATER MEASUREMENT REQUIREMENT - UNIQUE TYPE**

THE APPROPRIATOR SHALL INSTALL A DEPARTMENT APPROVED IN-LINE FLOW METER AT A POINT IN THE DELIVERY LINE APPROVED BY THE DEPARTMENT. WATER MUST NOT BE DIVERTED UNTIL THE REQUIRED MEASURING DEVICE IS IN PLACE AND OPERATING. ON A FORM PROVIDED BY THE DEPARTMENT, THE APPROPRIATOR SHALL KEEP WRITTEN MONTHLY RECORD OF THE FLOW RATE AND VOLUME OF ALL WATER DIVERTED, INCLUDING THE PERIOD OF TIME. RECORDS SHALL BE SUBMITTED BY NOVEMBER 30 OF EACH YEAR AND UPON REQUEST AT OTHER TIMES DURING THE YEAR. FAILURE TO SUBMIT REPORTS MAY BE CAUSE FOR REVOCATION OF A PERMIT OR CHANGE. THE RECORDS MUST BE SENT TO THE WATER RESOURCES REGIONAL OFFICE. THE APPROPRIATOR SHALL MAINTAIN THE MEASURING DEVICE SO IT ALWAYS OPERATES PROPERLY AND MEASURES FLOW RATE AND VOLUME ACCURATELY.

**OWNERSHIP UPDATE RECEIVED**

OWNERSHIP UPDATE TYPE PND # 71011 RECEIVED 05/12/2010.

OWNERSHIP UPDATE TYPE DOR # 90288 RECEIVED 08/31/2011.

OWNERSHIP UPDATE TYPE 608 # 258388 RECEIVED 02/12/2024.

**STATE OF MONTANA**

**DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION**

1424 9TH AVENUE P.O. BOX 201601 HELENA, MONTANA 59620-1601

# GENERAL ABSTRACT

**Water Right Number:** 76D 30009942 GROUND WATER CERTIFICATE

**Version:** 1 -- ORIGINAL RIGHT

**Version Status:** ACTIVE

**Owners:** ESCALANTE WILDERNESS PRESERVE US LLC
2930 BLEDSOE ST
SUITE 124
FORT WORTH, TX 76107-2942

**Priority Date:** MARCH 15, 2004 at 10:38 A.M.

**Enforceable Priority Date:** MARCH 15, 2004 at 10:38 A.M.

**Purpose (Use):** DOMESTIC

IRRIGATION

LAWN AND GARDEN

STOCK

**Maximum Flow Rate:** THIS RIGHT IS LIMITED TO THE ACTUAL AMOUNT USED UP TO 35 GALLONS PER MINUTE.

**Maximum Volume:** THIS RIGHT IS LIMITED TO THE ACTUAL AMOUNT USED UP TO 10 ACRE-FEET.

**Source Name:** GROUNDWATER

**Source Type:** GROUNDWATER

**Point of Diversion and Means of Diversion:**

| ID | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|
| 1 | | SWNE | 33 | 37N | 27W | LINCOLN |

**Period of Diversion:** JANUARY 1 TO DECEMBER 31

**Diversion Means:** WELL

**Purpose (Use):** DOMESTIC

**Households:**

**Volume:**

**Period of Use:** JANUARY 1 to DECEMBER 31

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | SWNE | 33 | 37N | 27W | LINCOLN |

**Purpose (Use):** IRRIGATION

**Volume:**

**Period of Use:** MAY 1 to OCTOBER 30

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | SWNE | 33 | 37N | 27W | LINCOLN |

**Purpose (Use):** LAWN AND GARDEN

**Volume:**

**Period of Use:** APRIL 1 to OCTOBER 31

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | SWNE | 33 | 37N | 27W | LINCOLN |

**Purpose (Use):** STOCK

**Volume:**

**Period of Use:** JANUARY 1 to DECEMBER 31

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | SWNE | 33 | 37N | 27W | LINCOLN |

**Geocodes/Valid:** 56-4928-33-1-02-04-0000 - Y

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**Remarks:**

**OWNERSHIP UPDATE RECEIVED**

OWNERSHIP UPDATE TYPE 608 # 33324 RECEIVED 02/06/2006.

OWNERSHIP UPDATE TYPE 608 # 71010 RECEIVED 05/12/2010.

OWNERSHIP UPDATE TYPE DOR # 90288 RECEIVED 08/31/2011.

OWNERSHIP UPDATE TYPE 608 # 258388 RECEIVED 02/12/2024.

**STATE OF MONTANA**

**DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION**

1424 9TH AVENUE P.O. BOX 201601 HELENA, MONTANA 59620-1601

# GENERAL ABSTRACT

**Water Right Number:** 76D 55784-00 PROVISIONAL PERMIT

**Version:** 1 -- ORIGINAL RIGHT

**Version Status:** ACTIVE

**Owners:** ESCALANTE WILDERNESS PRESERVE US LLC
2930 BLEDSOE ST
SUITE 124
FORT WORTH, TX 76107-2942

**Priority Date:** APRIL 11, 1984 at 12:01 P.M.

**Enforceable Priority Date:** APRIL 11, 1984 at 12:01 P.M.

**Purpose (Use):** STOCK

**Maximum Flow Rate:** 5.00 GPM

**Maximum Volume:** 0.12 AC-FT

**Source Name:** UNNAMED TRIBUTARY OF LAKE KOOCANUSA

**Source Type:** SURFACE WATER

**Point of Diversion and Means of Diversion:**

| ID | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|
| 1 | | NESESE | 29 | 37N | 27W | LINCOLN |

**Period of Diversion:** JANUARY 1 TO DECEMBER 31

**Diversion Means:** LIVESTOCK DIRECT FROM SOURCE

**Purpose (Use):** STOCK

**Volume:** 0.12 AC-FT

**Period of Use:** JANUARY 1 to DECEMBER 31

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | NESESE | 29 | 37N | 27W | LINCOLN |

**Geocodes/Valid:** -- NO VALID GEOCODES --

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**Remarks:**

**OWNERSHIP UPDATE RECEIVED**

OWNERSHIP UPDATE TYPE 608 # 32845 RECEIVED 01/26/2006.

OWNERSHIP UPDATE TYPE 608 # 71010 RECEIVED 05/12/2010.

OWNERSHIP UPDATE TYPE DOR # 90288 RECEIVED 08/31/2011.

OWNERSHIP UPDATE TYPE 608 # 258388 RECEIVED 02/12/2024.

**STATE OF MONTANA**

**DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION**

1424 9TH AVENUE P.O. BOX 201601 HELENA, MONTANA 59620-1601

# GENERAL ABSTRACT

**Water Right Number:** 76D 9681-00 STATEMENT OF CLAIM

**Version:** 2 -- REEXAMINED

**Version Status:** ACTIVE

**Owners:** ESCALANTE WILDERNESS PRESERVE US LLC
2930 BLEDSOE ST
SUITE 124
FORT WORTH, TX 76107-2942

**Priority Date:** AUGUST 5, 1970

**Enforceable Priority Date:** AUGUST 5, 1970

**Type of Historical Right:** FILED

**Purpose (Use):** IRRIGATION

**Irrigation Type:** SPRINKLER

**Maximum Flow Rate:** 2.23 CFS

**Maximum Volume:** THE TOTAL VOLUME OF THIS WATER RIGHT SHALL NOT EXCEED THE AMOUNT PUT TO HISTORICAL AND BENEFICIAL USE.

**Climatic Area:** 3 - MODERATE

**Maximum Acres:** 126.00

**Source Name:** GROB LAKE

**Source Type:** SURFACE WATER

SOURCE LOCATED WITHIN AN INTERIOR DRAINAGE.

**Point of Diversion and Means of Diversion:**

| ID | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|
| 1 | | SWNENE | 32 | 37N | 27W | LINCOLN |

**Period of Diversion:** MAY 1 TO SEPTEMBER 15

**Diversion Means:** PUMP

**Period of Use:** MAY 1 to SEPTEMBER 15

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | 65.00 | | E2NW | 32 | 37N | 27W | LINCOLN |
| 2 | 31.00 | | E2NE | 32 | 37N | 27W | LINCOLN |
| 3 | 30.00 | | NWNW | 33 | 37N | 27W | LINCOLN |
| **Total:** | 126.00 | | | | | | |

**Geocodes/Valid:** -- NO VALID GEOCODES --

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**Remarks:**

STARTING IN 2008, PERIOD OF DIVERSION WAS ADDED TO MOST CLAIM ABSTRACTS, INCLUDING THIS ONE.

NOTICE OF WATER RIGHT TRANSFER RECEIVED 12/09/88.

**OWNERSHIP UPDATE RECEIVED**

OWNERSHIP UPDATE TYPE 608 # 33324 RECEIVED 02/06/2006.

OWNERSHIP UPDATE TYPE 608 # 71010 RECEIVED 05/12/2010.

OWNERSHIP UPDATE TYPE DOR # 90288 RECEIVED 08/31/2011.

OWNERSHIP UPDATE TYPE 608 # 258388 RECEIVED 02/12/2024.

**STATE OF MONTANA**

**DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION**

1424 9TH AVENUE P.O. BOX 201601 HELENA, MONTANA 59620-1601

# GENERAL ABSTRACT

**Water Right Number:** 76D 30027767 PROVISIONAL PERMIT

**Version:** 1 -- ORIGINAL RIGHT

**Version Status:** ACTIVE

**Owners:** ESCALANTE WILDERNESS PRESERVE US LLC
2930 BLEDSOE ST
SUITE 124
FORT WORTH, TX 76107-2942

**Priority Date:** MAY 11, 2007 at 02:50 P.M.

**Enforceable Priority Date:** MAY 11, 2007 at 02:50 P.M.

**Purpose (Use):** IRRIGATION

RECREATION

**Maximum Flow Rate:** 900.00 GPM

**Maximum Volume:** 326.54 AC-FT

**Maximum Acres:** 120.00

**Source Name:** GROUNDWATER

**Source Type:** GROUNDWATER

**Point of Diversion and Means of Diversion:**

| ID | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|
| 1 | | NWNENE | 32 | 37N | 27W | LINCOLN |

**Period of Diversion:** APRIL 15 TO OCTOBER 15 **Flow Rate:** 450.00 GPM

**Diversion Means:** WELL

**Well Depth:** 54.00 FEET

**Static Water Level:** 11.37 FEET

**Casing Diameter:** 12.00 INCHES

**Flowing:** NO

**Pump Size:** 20.00 HP

| ID | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|
| 2 | | NWNENE | 32 | 37N | 27W | LINCOLN |

**Period of Diversion:** APRIL 15 TO OCTOBER 15 **Flow Rate:** 450.00 GPM

**Diversion Means:** WELL

**Well Depth:** 58.00 FEET

**Static Water Level:** 14.15 FEET

**Casing Diameter:** 12.00 INCHES

**Pump Size:** 20.00 HP

**Reservoir:** OFF STREAM **Reservoir Name:** GREEN #8

| Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|
| | SWNWNW | 33 | 37N | 27W | LINCOLN |

**Reservoir:** OFF STREAM **Reservoir Name:** GREEN #8

| Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|
| | SENENE | 32 | 37N | 27W | LINCOLN |

**Depth:** 10.00 FEET
**Surface Area:** 3.56 ACRES
**Current Capacity:** 29.00 ACRE-FEET
**Original Capacity:** 21.00 ACRE-FEET

**Reservoir:** OFF STREAM **Reservoir Name:** GREEN #5

| Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|
| | W2SENE | 32 | 37N | 27W | LINCOLN |

**Depth:** 10.00 FEET
**Surface Area:** 1.12 ACRES
**Current Capacity:** 7.30 ACRE-FEET
**Original Capacity:** 7.30 ACRE-FEET

**Reservoir:** OFF STREAM **Reservoir Name:** GREEN #10

| Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|
| | NENENW | 32 | 37N | 27W | LINCOLN |

**Depth:** 9.00 FEET
**Surface Area:** 0.60 ACRES
**Current Capacity:** 2.70 ACRE-FEET
**Original Capacity:** 2.63 ACRE-FEET

**Purpose (Use):** IRRIGATION **Purpose Clarification:** GOLF COURSE IRRIGATION

**Irrigation Type:** SPRINKLER
**Climatic Area:** 3 - MODERATE
**Volume:** 311.59 AC-FT
**Period of Use:** APRIL 15 to OCTOBER 15
**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | 2.59 | | NWSWSW | 28 | 37N | 27W | LINCOLN |
| 2 | 3.83 | | SWSWSW | 28 | 37N | 27W | LINCOLN |
| 3 | 3.73 | | SESWSW | 28 | 37N | 27W | LINCOLN |
| 4 | 1.60 | | NWSWSE | 29 | 37N | 27W | LINCOLN |
| 5 | 2.37 | | NESWSE | 29 | 37N | 27W | LINCOLN |
| 6 | 2.25 | | SWSWSE | 29 | 37N | 27W | LINCOLN |
| 7 | 0.93 | | SESWSE | 29 | 37N | 27W | LINCOLN |
| 8 | 3.77 | | NWSESE | 29 | 37N | 27W | LINCOLN |
| 9 | 7.33 | | NESESE | 29 | 37N | 27W | LINCOLN |
| 10 | 3.79 | | SWSESE | 29 | 37N | 27W | LINCOLN |
| 11 | 0.48 | | SESESE | 29 | 37N | 27W | LINCOLN |
| 12 | 1.46 | | NENENW | 32 | 37N | 27W | LINCOLN |
| 13 | 1.49 | | SENENW | 32 | 37N | 27W | LINCOLN |
| 14 | 4.39 | | NWNWNE | 32 | 37N | 27W | LINCOLN |

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | 1.23 | NENWNE | 32 | 37N | 27W | LINCOLN |
| 16 | 4.20 | SWNWNE | 32 | 37N | 27W | LINCOLN |
| 17 | 4.23 | NENENE | 32 | 37N | 27W | LINCOLN |
| 18 | 1.57 | SWNENE | 32 | 37N | 27W | LINCOLN |
| 19 | 7.99 | SENENE | 32 | 37N | 27W | LINCOLN |
| 20 | 0.58 | NWSENW | 32 | 37N | 27W | LINCOLN |
| 21 | 3.01 | NESENW | 32 | 37N | 27W | LINCOLN |
| 22 | 4.13 | SESENW | 32 | 37N | 27W | LINCOLN |
| 23 | 3.63 | NWSWNE | 32 | 37N | 27W | LINCOLN |
| 24 | 3.12 | NESWNE | 32 | 37N | 27W | LINCOLN |
| 25 | 3.04 | SWSWNE | 32 | 37N | 27W | LINCOLN |
| 26 | 2.47 | SESWNE | 32 | 37N | 27W | LINCOLN |
| 27 | 4.23 | NWSENE | 32 | 37N | 27W | LINCOLN |
| 28 | 2.15 | NESENE | 32 | 37N | 27W | LINCOLN |
| 29 | 2.08 | SWSENE | 32 | 37N | 27W | LINCOLN |
| 30 | 7.19 | NWNWSE | 32 | 37N | 27W | LINCOLN |
| 31 | 7.51 | NENWSE | 32 | 37N | 27W | LINCOLN |
| 32 | 2.53 | NWNESE | 32 | 37N | 27W | LINCOLN |
| 33 | 2.64 | NWNWNW | 33 | 37N | 27W | LINCOLN |
| 34 | 8.03 | NENWNW | 33 | 37N | 27W | LINCOLN |
| 35 | 2.45 | SWNWNW | 33 | 37N | 27W | LINCOLN |
| 36 | 1.98 | SENWNW | 33 | 37N | 27W | LINCOLN |
| **Total:** | 120.00 | | | | | |

**Purpose (Use):** RECREATION **Purpose Clarification:** GOLF COURSE FEATURES

**Volume:** 14.95 AC-FT

**Period of Use:** APRIL 15 to OCTOBER 15

**Place of Use:**

| ID | Acres | Govt Lot | Qtr Sec | Sec | Twp | Rge | County |
|---|---|---|---|---|---|---|---|
| 1 | | | W2SENE | 32 | 37N | 27W | LINCOLN |
| 2 | | | NENENW | 32 | 37N | 27W | LINCOLN |

**Geocodes/Valid:** -- NO VALID GEOCODES --

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**Remarks:**

**ASSOCIATED RIGHT**

76D 9681-00 IS ASSOCIATED BECAUSE THEY SHARE OVERLAPPING PLACES OF USE.

**POSSIBLE COMPLAINT RECEIVED**

IF AT ANY TIME AFTER THIS RIGHT IS ISSUED, A WRITTEN COMPLAINT IS RECEIVED BY THE DEPARTMENT ALLEGING THAT DIVERTING WATER FROM THIS SOURCE IS ADVERSELY AFFECTING A PRIOR WATER RIGHT, THE DEPARTMENT MAY MAKE A FIELD INVESTIGATION OF THE PROJECT. IF DURING THE FIELD INVESTIGATION THE DEPARTMENT FINDS SUFFICIENT EVIDENCE SUPPORTING THE ALLEGATION, IT MAY CONDUCT A HEARING IN THE MATTER ALLOWING THE APPROPRIATOR TO SHOW CAUSE WHY THE RIGHT SHOULD NOT BE MODIFIED OR REVOKED. THE DEPARTMENT MAY THEN MODIFY OR REVOKE THIS RIGHT TO PROTECT EXISTING RIGHTS OR LEAVE THIS RIGHT UNCHANGED IF THE HEARING OFFICER DETERMINES NO EXISTING WATER RIGHTS ARE BEING ADVERSELY AFFECTED.

**OWNERSHIP UPDATE RECEIVED**

OWNERSHIP UPDATE TYPE 608 # 71010 RECEIVED 05/12/2010.

OWNERSHIP UPDATE TYPE DOR # 90288 RECEIVED 08/31/2011.

OWNERSHIP UPDATE TYPE 608 # 258388 RECEIVED 02/12/2024.