TAB 11

- Water and Sanitation Report
- Custom Soils Report
- Stormwater Drainage Report

WATER AND SANITATION REPORT

The State of Montana (76-3-622, MCA) requires subdividers to provide the following water and sanitation information for any new subdivision that will include a new water supply system or new wastewater facilities. In compliance with this law, attach a separate document entitled "Water & Sanitation Report" which contains the following:

1. **Map.** A vicinity map or plan that shows:

   a. The location, within 100 feet outside of the exterior property line of the subdivision and on the proposed lots, of flood plains; surface water features; springs; irrigation ditches; ***See Existing Conditions Map. There are no floodplains, surface water features, surface springs, or irrigation ditches within 100 feet or more of the property.***

   b. Existing, previously approved, and, for parcels less than 20 acres, proposed water wells and wastewater treatment systems; for parcels less than 20 acres, mixing zones; ***The existing home at 4824 Clearview Way, built in 1947, is on a septic system and is connected to city water via a service line. The existing service line and septic system will be removed and the entire subdivision will go onto city sewer and water.***

   c. The representative drain-field site used for the soil profile description; ***Not applicable***

   d. The location, within 500 feet outside of the exterior property line of the subdivision, of public water and sewer facilities. ***See Water and Sewer Connections map.***

2. **Description.** A description of the proposed subdivision's water supply systems, storm water systems, solid waste disposal systems, and wastewater treatment systems, including whether the water supply and wastewater treatment systems are individual, shared, multiple user, or public as those systems are defined in rules published by the Montana Department of Environmental Quality (DEQ). If the water supply and wastewater treatment systems are shared, multiple user, or public, a statement of whether the systems will be public utilities as defined in 69-3-101, MCA and subject to the jurisdiction of the public service commission or exempt from public service commission jurisdiction and, if exempt, an explanation for the exemption.

   The subdivision will be served by City of Missoula Sewer and Water. Water supply will be via 8-inch mains in the street connecting outside the subdivision at two locations- in the western end off Clearview Way (in the Skyview Pressure Zone) and through the northwest corner of the property about 150 feet to the north, along the west side of Hillview Way to tie in with the High Park Pressure Zone. PRV's will be installed at both locations.

   Sewer mains will all gravity to the northeast corner behind Lot 13, then an 8-inch main will head southward within the existing utility corridor. The corridor also contains underground gas and overhead power; it exists from this property north to 39th Street. We will need to get permission from the City Parks Board and possibly an easement. The sewer main will leave the utility corridor through easement on private property, 4314 and 4316 21st Avenue, to the existing 8" main in 21st Avenue which then flows to the existing 15" sewer main in SW 39th Avenue.

3. **Lot layout**. A drawing of the conceptual lot layout at a scale no smaller than 1 inch equal to 200 feet that shows all information required for a lot layout document in

rules adopted by the Montana Department of Environmental Quality pursuant to 76-4-104, MCA. ***See attached preliminary plat; a 24" x 36" plat is within the subdivision packet and/ or is available.***

4. **Suitability.** Evidence of suitability for new on-site wastewater treatment systems that, at a minimum, include: ***No on-site wastewater treatment system proposed on site.***

   a. A soil profile description from a representative drain-field site identified on the vicinity map that complies with standards published by the Montana Department of Environmental Quality; ***Not applicable, but the attached Custom Soils Resource Report provides ample information about the soils on the property.***

   b. Demonstration that the soil profile contains a minimum of 4 feet of vertical separation distance between the bottom of the permeable surface of the proposed wastewater treatment system and a limiting layer; ***Not applicable, but the Geotechnical Report in the packet provides ample information about the soils on the property.***

   c. In cases in which the soil profile or other information indicates that ground water is within 7 feet of the natural ground surface, evidence that the ground water will not exceed the minimum vertical separation distance of 4 feet.

5. **Water quantity.** For new water supply systems, unless cisterns are proposed, evidence of adequate water availability:

   a. obtained from well logs or testing of onsite or nearby wells; ***Not applicable, but well logs in Section 6 are attached to this report.***

   b. obtained from information contained in published hydro-geological reports; or

   c. as otherwise specified by rules adopted by the Montana Department of Environmental Quality pursuant to 76-4-104, MCA.

6. **Water quality.** Evidence of sufficient water quality in accordance with rules adopted by the Montana Department of Environmental Quality pursuant to 76-4-104, MCA. ***Water service to be provided by City of Missoula Water.***

7. **Impacts to groundwater quality.** Preliminary analysis of potential impacts to ground water quality from new wastewater treatment systems, using as guidance rules adopted by the board of environmental review pursuant to 75-5-301, MCA and 75-5-303, MCA related to standard mixing zones for ground water, source specific mixing zones, and non-significant changes in water quality. The preliminary analysis may be based on currently available information and must consider the effects of overlapping mixing zones from proposed and existing wastewater treatment systems within and directly adjacent to the subdivision. Instead of performing the preliminary analysis, the sub-divider may perform a complete non-degradation analysis in the same manner as is required for an application that is reviewed under Title 76, Chapter 4. ***Water service to be provided by City of Missoula Water.***

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 Missoula County Area, Montana

January 31, 2023

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

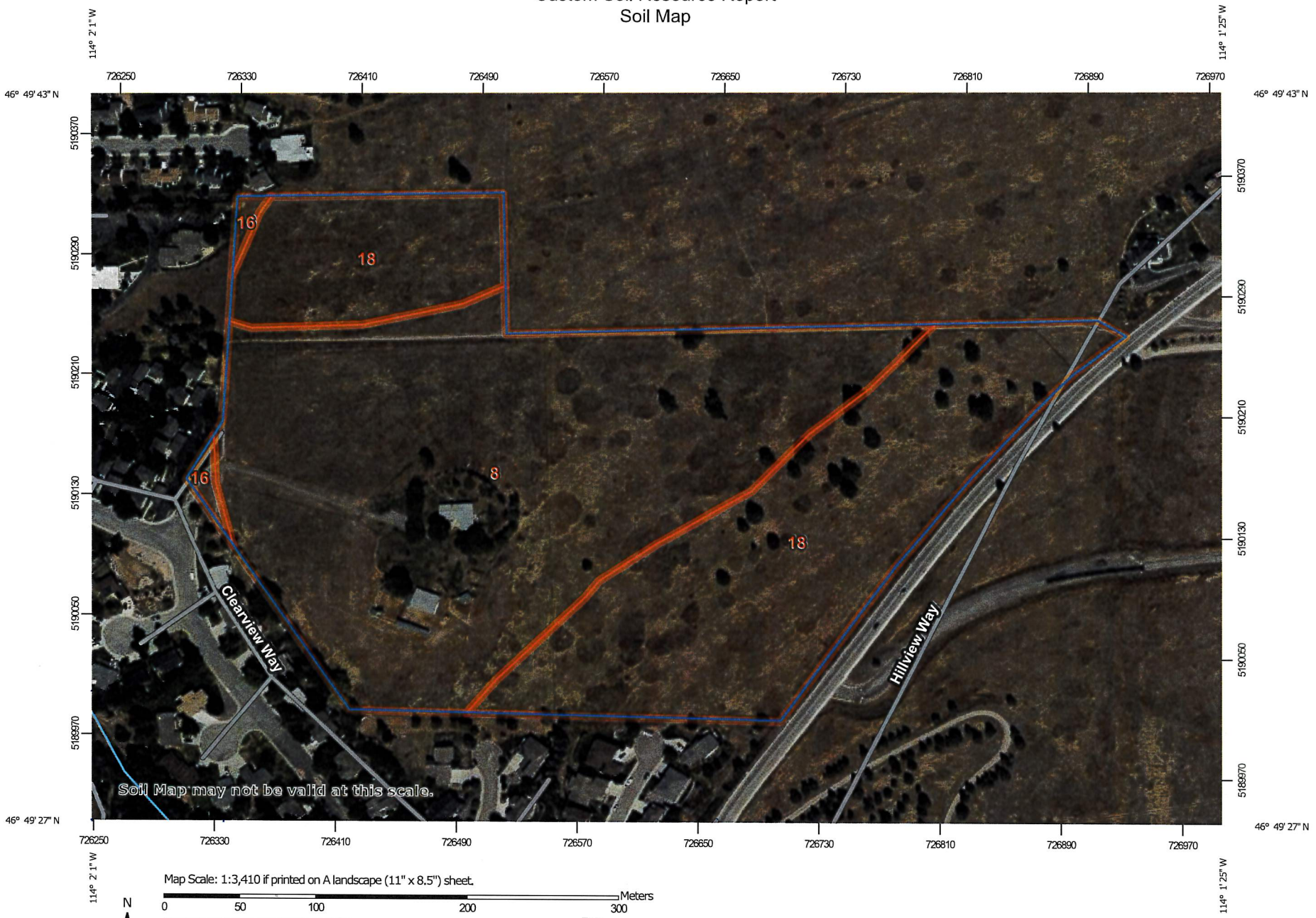
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,410 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 20, Aug 26, 2022

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

Date(s) aerial images were photographed: Aug 13, 2022—Aug 16, 2022

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
8	Minesinger-Bigarm complex, 4 to 15 percent slopes	18.9	56.8%
16	Bigarm gravelly loam, 0 to 4 percent slopes	0.3	0.9%
18	Bigarm gravelly loam, 15 to 30 percent slopes	14.1	42.3%
Totals for Area of Interest		**33.2**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Missoula County Area, Montana

8—Minesinger-Bigarm complex, 4 to 15 percent slopes

Map Unit Setting

National map unit symbol: 4wdl
Elevation: 2,600 to 5,500 feet
Mean annual precipitation: 14 to 19 inches
Mean annual air temperature: 41 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Farmland of local importance

Map Unit Composition

Minesinger and similar soils: 60 percent
Bigarm and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Minesinger

Setting

Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Tertiary slope alluvium

Typical profile

A1 - 0 to 6 inches: gravelly loam
A2 - 6 to 13 inches: cobbly loam
Bt - 13 to 24 inches: very gravelly clay
Bk - 24 to 60 inches: very gravelly clay loam

Properties and qualities

Slope: 4 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 low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 8 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R044AA036MT - Droughty (Dr) LRU 44A-A
Hydric soil rating: No

Description of Bigarm

Setting

Landform: Hills

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Tertiary slope alluvium

Typical profile

A1 - 0 to 11 inches: cobbly loam
A2 - 11 to 15 inches: very gravelly loam
Bw - 15 to 40 inches: very gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 4 to 15 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
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R044AP808MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Grassvalley

Percent of map unit: 10 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

Larry

Percent of map unit: 5 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R046XC518MT - Wet Meadow (WM) RRU 46-C 15-19 PZ
Hydric soil rating: No

16—Bigarm gravelly loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 4wbb

Elevation: 2,600 to 6,200 feet
Mean annual precipitation: 10 to 19 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 70 to 120 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Bigarm and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bigarm

Setting

Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A1 - 0 to 11 inches: gravelly loam
A2 - 11 to 15 inches: very gravelly loam
Bw - 15 to 40 inches: very gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 0 to 4 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 (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R043BP818MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Grantsdale

Percent of map unit: 5 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Moiese

Percent of map unit: 3 percent
Landform: Stream terraces
Down-slope shape: Linear

Across-slope shape: Linear
Ecological site: R044BA134MT - Shallow to Gravel (SwGr) LRU 01 Subset A
Hydric soil rating: No

Cobbly surface layers
Percent of map unit: 3 percent
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Poorly drained soils
Percent of map unit: 2 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: Yes

Stony surface layers
Percent of map unit: 2 percent
Ecological site: R044AB036MT - Droughty (Dr) LRU 44A-B
Hydric soil rating: No

18—Bigarm gravelly loam, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: 4wbd
Elevation: 2,500 to 5,500 feet
Mean annual precipitation: 14 to 22 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 90 to 125 days
Farmland classification: Not prime farmland

Map Unit Composition
Bigarm and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bigarm

Setting
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and/or colluvium

Typical profile
A1 - 0 to 11 inches: gravelly loam
A2 - 11 to 15 inches: very gravelly loam
Bw - 15 to 40 inches: very gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 15 to 30 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 (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R044AP808MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Biglake

Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB134MT - Shallow To Gravel (Swgr) LRU 44A-B
Hydric soil rating: No

Stony surface layers

Percent of map unit: 5 percent
Ecological site: R044AB036MT - Droughty (Dr) LRU 44A-B
Hydric soil rating: No

Very deep, clayey soils

Percent of map unit: 5 percent
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

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Preliminary Stormwater Drainage Report

Meadow View Homes

For

Meadowview Partners, LLC

Located in the E. Half of S6, T12N, R19W,
Missoula, Missoula County, Montana

Prepared by:

Professional Consultants Inc.
Unmatched Experience. Uncompromising Standards.

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Submittal Date: June 14, 2024

PCI Project No. 9153-21

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1.0 INTRODUCTION

This report is being submitted for review by the City of Missoula for the proposed stormwater facilities for Meadow View Homes, located in the East half of S6, T12N, R19W, Geocode: 04-2093-06-4-03-01-0000. Meadow View Homes is a proposed 96- lot single family residential development. The lots are within the city limits of the City of Missoula. The increased runoff will be addressed through the proposed stormwater facilities shown on the plans.

This report addresses the stormwater runoff for this development and the stormwater management system needed to meet the Missoula City Public Works Standards and the Department of Environmental Quality stormwater requirements.

1.1 LOCATION

The site is located within the city limits of Missoula, in the East half of S6, T12N, R19W, Geocode: 04-2093-06-4-03-01-0000.

1.2 DESCRIPTION OF PROPERTY

The existing site encompasses 31.47 acres and is covered entirely by native prairie grasses except for a single residential dwelling with a lawn encompassing 1.3 acres. The site is moderately steep sloping from the southeast to the northwest. The slopes start at ~20%, then to ~15%, evens out to 6-8%, then steepens back to ~11%. The existing site's current land use is private residential with only one house existing on the site. Due to zoning, no other uses other than residential could be used for the site. There are no existing drainage swales or channels on the site. Runoff is currently captured by an 18" pipe to the north of the site. No part of the site is in any flood zone, nor are there any irrigation ditches.

1.3 PREVIOUS STUDIES

There are no previous studies done on this site.

1.4 PROJECT DESCRIPTION

The proposed project is a 96- lot single family residential subdivision. The development will include 5760lf of new roadway, including 6ft of sidewalk on either side all within in a 50' ROW. The development will also include 7.61 ac of common area. The stormwater design includes 3 total ponds to retain and slow the water being released to the offsite 18" drainage pipe.

1.5 REGULATIONS

The design criteria for the site are governed by Missoula City Public Works Standards and DEQ-8. Furthermore, runoff leaving the site must not overwhelm the existing downstream infrastructure.

2.0 EXISTING CONDITIONS

The existing site is moderately steep. The site slopes from the southeast to the northwest starting at ~20%, then to ~15%, evens out to 6-8%, then steepens back to ~11%. According to the NRCS, the underlying soils in this area are classified as Minesinger-Bigarm complex and Bigarm gravelly loam with the complex having a very slight majority of the site. The complex is classified as Group C and the Bigarm is classified as Group B. A geologic survey was also conducted on the site. The findings correlated with the NRCS soil survey data.

3.0 DRAINAGE DESIGN CRITERIA AND DESIGN METHODOLGY

Missoula City Public Works Standards and DEQ-8 were used for the design with the former being the ruling document for this drainage plan. All DEQ-8 requirements have been met. The rest of this report is to address the Missoula City Public Works Standards and the specialty requirements for the site due to the existing infrastructure.

This report is proposed as a Standard Plan per Missoula City Public Works Standards and DEQ-8. The requirements for both state that the post-development discharge rate for the 2, 10, and 100-year 24-hour storm events cannot exceed the pre-development discharge rate. Also, the 10-year 24-hour storm cannot flood any roadways, and the 100-year 24-hour storm cannot inundate any house on site or off site.

On top of these generalized conditions, the site has restrictions due to the existing infrastructure. While the general requirement states that the post-development flow must be less than the pre-existing flow, there is an 18" downstream pipe that takes in this site and flows from offsite. Therefore, it must be shown how the post-development flows affect the 18" pipe.

Furthermore, there is also concern of flooding of the down slope homes from water that infiltrates into the ground from the site. A geological survey was then conducted on the site to map the soil profiles. Following the closest test pit to each proposed detention facility and all soil layers above the invert of the ponds being removed, the infiltration rates can be seen below:

Ponds	Test Pit	Limiting Layer from Closest Test Pit	Infiltration Rate
Upper Pond	7	Lean Clay with Gravel	0.0
Common Area 1 Pond	4	Clayey Gravel	0.07
West Pond	3	Sand with Gravel	2.6

These infiltration rates were then used to decide if the ponds should be lined and at what elevations.

The results and design may be demonstrated through either narrative descriptions or calculations. Storm and Sanitary Analysis for AutoCAD® Civil 3D® by Autodesk was chosen to estimate both pre-development and post-development storm flows and volumes. Hydrodynamic was elected for the link routing method, Hazen-Williams was elected for the force main equation, the Hydrology Method and Time of Concentration methods were elected to use SCS TR-55 methods, and the

minimum Time of Concentration was set to 5 minutes. Using this computer program/model, the United States Department of Agriculture's Soil Conservation Service [SCS] curve numbers were used. The rainfall distribution curves were acquired through the Storm and Sanitary Analysis program for the Missoula, Montana, 2, 10, and 100-year 24-hour distributions.

4.0 PROPOSED DEVELOPMENT

The proposed development includes 6,000' of 36' roadway (curb face and face of curb being included). The site is divided into subbasins which will drain to either a curb inlet or detention pond. All runoff, other than one small area on the western side of the project, will be completely routed to the detention pond in the northwest corner of the project. It will then be released through an inlet structure in the pond and piped to the swale that flows to the existing 18" culvert.

There are three detention ponds, two underground storage facilities, and as many Class V injection wells as needed to meet flow requirements are proposed for the site. The names for the ponds are upper pond, common area 1 pond, and west pond. The common area 1 pond will be lined to not allow infiltration at any elevation. The upper pond will continuously flow freely into a 1' diameter drain during every storm. The common area 1 pond will also continuously drain into a 24" diameter drain but the 12" pipe coming out of the drain will have an 8" diameter limiting orfice. Due to the small tributary area that drains into the west pond, all runoff that flows into the pond will be infiltrated. The middle storage facility will hold 30,000 gallons (4,008 ft^3) of water and the northwest storage facility will hold 56,000 gallons of water (7,519 ft^3). All water will then be sent to the injection wells except for during the 10 and 100 year storms.

The injection wells will be in vaults that will further catch sediment and filter the runoff before being gravity drained into the ground. The wells will be 12" in diameter and will be drilled to the elevation of the valley floor. Currently, they are all proposed to be located in the northwest corner of the site. Upon sufficiency approval, drilling will begin to determine the flowrate of each injection well and in turn, how many injection wells are needed. Flowrate testing will be done for each injection well and done before drilling the next well. DNRC will also be closely worked with for design of the wells.

Additionally, there will be underground storage facilities placed in Common Area 1 to retain stormwater for irrigation purposes. The facility is currently planned to retain 10,000 gallons of stormwater.

The basins for the site were created using perpendicular lining to the contours of the designed site. These basins were built with the design of the sidewalks being sloped at a 2%. The dimensions for each basin are an estimation, and not exact. However, these estimations were done with an educated approach and are accurate to the rough dimensions of each actual subbasin.

4.1 Time of Concentration

The SCS TR-55 methodology uses a Time of Concentration (TOC) parameter, defined as the amount of time it takes stormwater runoff to travel from the most distant point on a drainage basin site to a specific point of interest. For each drainage basin, the TOC was estimated for each pre-development and post-development site condition using their respective programs. The TOC 's

were modelled with Manning's roughness number (n), slopes, and lengths of flow. The maximum flow lengths used for the basins' sheet flow was 300'.

A summation of the TOC's for each basin was utilized to give an accurate time the water took to reach the outlet for basin. For example, if a subbasin has a region with relatively uniform steep slopes that sloped to an area with relatively uniform flatter slopes, then sloped to the roadway, the concentration will depend on each area within the subbasin, rather than one generalized, average, or maximum TOC from each of the areas.

As identified above, the post-development will add impervious area making the time of concentration less than that for pre-development, which results in more runoff being generated.

4.2 Curve Number

SCS Runoff Curve Numbers [CN] are estimated for the development based on the soil types identified in each drainage basin for the pre-development and post-development site conditions, individually. The SCS TR-55 methodology uses a table of CN values from which to select. The post-development lots can be classified as ¼ and 1/8 acre. The CN for each basin was chosen based on their classification and from the test pits from the geological survey of the site.

4.3 Pre-Development Runoff

Existing Site

Year Storm	Peak Flow (CFS)
2-year	0.28
10-year	2.36
100-year	7.52

Existing and Off Site Flowing Through Existing Culvert

Year Storm	Peak Flow (CFS)	Total Outflow Volume (ac-ft)
2-year	0.28	0.197
10-year	3.44	0.953
100-year	13.45	2.530

5.0 PROPOSED STORMWATER FACILITIES

Curb inlets will be utilized to capture the water from each basin, with water that is not captured being diverted to the downstream inlets. No water will be infiltrated from the inlets and will all be sent to the detention ponds and storage facilities. The upper pond will capture water that might otherwise flood the houses downstream of the swale feeding into the pond. The water

from the uphill side of the development, and including the upper pond, will be routed to the common area 1 pond. This pond will drain into a 7" drain at the bottom of the pond. The water will then be routed to the middle storage facility. The middle storage facility will also have runoff coming in from a swale running along the walking trail that captures the runoff from the adjacent lots. The middle storage facility will then drain from an 8" pipe. The stormwater from the middle pond, and stormwater from the remaining inlets, is then routed to the northwest storage facility. This facility will route the water to the injection wells. The required total peak flow from the injection wells is roughly 5 cfs. During the 10 and 100-year storm event, stormwater will drain out of a 12" pipe to the downhill swale, and further the existing 18" culvert.

The west pond will fully capture all runoff and will infiltrate at a rate of 2.6in/hr. The pond will fully drain within 72 hours of the storm. Should the pond flood, overflow will drain to the roadway, down Garland Dr, and into the existing stormwater infrastructure.

6.0 POST-DEVELOPMENT STORM ANALYSIS

The results of the analysis can be seen below, including the Storm and Sanitary Analysis Reports. The results show that no roadway will be flooded at any time during the three storm events, nor will any pond flood and cause flooding in downstream houses on or off site.

Post-Development

Year Storm	Peak Outflow (CFS)
2-year	0.00
10-year	0.00
100-year	6.82

Post-Development and Offsite Flows Through Existing Culvert

Year Storm	Peak Outflow (CFS)	Total Outflow Volume (ac-ft)
2-year	0.08	0.060
10-year	1.25	0.444
100-year	10.73	1.562

The maximum water elevations for the storm event and the top elevations for the ponds can be seen as follows:

Pond Elevations

	Pond Top Elev.	2-Year Storm Peak Water Elev.	10-Year Storm Peak Water Elev.	100-Year Storm Peak Water Elev.
Upper Pond	3346	3343.03	3343.14	3343.28
Common Area 1 Pond	3333.75	3330.81	3330.65	3331.51
West Pond	3292.5	3290.52	3291.24	3291.68

Storage Tank Volumes

	Volume (ft^3)	2-Year Max. Volume (ft^3)	10-Year Max. Volume (ft^3)	100-Year Max. Volume (ft^3)
Middle Storage	4008	490	790	3623
Northwest Storage	7519	1728	5770	7146

An analysis report, which includes time series plots, from Storm and Sanitary Analysis can be found attached to give further insight into the analysis. The report gives basin TOC calculations (including Manning's (n), slope, flow distance), outflows, elevations, and timings for the SCS Curves and the flow of water throughout the site. The time series plots give intensity of flow as a function of time, showing when peak flows are present for basins, inlets, ponds, and pipes.

7.0 OFFSITE FLOWS

There are a couple locations in which offsite runoff comes onto and affects the proposed development. Runoff from the Elk Hills subdivision to the direct south comes onto the site which equates to roughly 0.64 acres and the entirety of Block 1, Lot 23 comes onto the site which is roughly 1.32 acres. Both of these areas were included in the basins of the proposed development in the model instead of being treated as separate basins.

8.0 CONCLUSION

This report details the existing conditions and proposed improvements for Meadow View Homes in the City of Missoula, Montana. The preceding report shows how the proposed stormwater facilities shall handle 2-, 10-, and 100-year 24-hour storm event. Based upon these results found in this analysis, the facilities are adequately designed using the methods discussed in the City of Missoula's Public Works Standards manual and DEQ-8.

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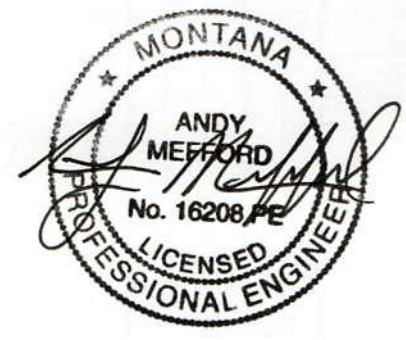
Matt Shaffer, PE

Date: June 14, 2024



Andy Mefford, PE

Date: June 14, 2024