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Website Posting

July 2, 2026

Based on information at the time of required posting, the City experienced no violation of the NPDES Permit conditions effective as of December 1, 2025 for the month of June 2026.

June's DEQ Correspondence is attached below:



United States
Department of
Agriculture

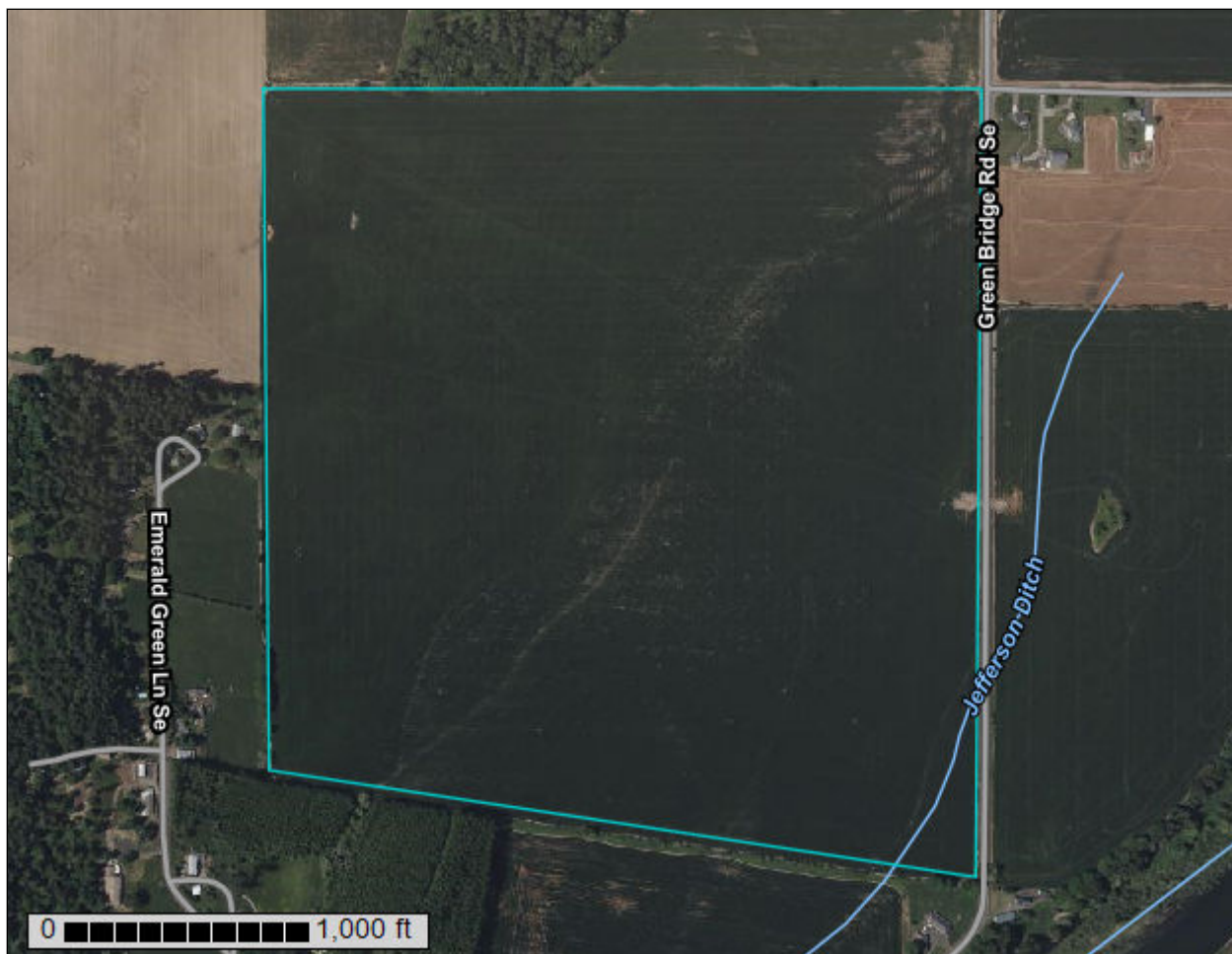
NRCS

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 Marion County Area, Oregon

Glaser Site



May 16, 2026

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

Custom Soil Resource Report

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



Custom Soil Resource Report

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 1:20,000.

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: Marion County Area, Oregon
Survey Area Data: Version 23, Sep 10, 2025

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

Date(s) aerial images were photographed: May 17, 2023—Jun 3, 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
2224A	Courtney gravelly silty clay loam, 0 to 3 percent slopes	0.0	0.0%
Am	Amity silt loam	49.5	24.6%
CeC	Chehalem silt loam, 2 to 12 percent slopes	13.4	6.6%
Ck	Clackamas gravelly loam	8.4	4.2%
Co	Concord silt loam	48.5	24.1%
Da	Dayton silt loam	44.6	22.2%
Mb	McBee silty clay loam	4.5	2.2%
SnB	Santiam silt loam, 3 to 6 percent slopes	20.9	10.4%
SnC	Santiam silt loam, 6 to 15 percent slopes	8.8	4.3%
WIA	Willamette silt loam, 0 to 3 percent slopes	0.7	0.3%
WuA	Woodburn silt loam, 0 to 3 percent slopes	2.2	1.1%
Totals for Area of Interest		201.4	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.

Marion County Area, Oregon

2224A—Courtney gravelly silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xpsh
Landscape: Willamette valleys
Elevation: 160 to 800 feet
Mean annual precipitation: 39 to 59 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Courtney and similar soils: 85 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Courtney

Setting

Landscape: Willamette valleys
Landform: Drainageways on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Concave
Parent material: Alluvium

Typical profile

A1 - 0 to 8 inches: gravelly silty clay loam
A2 - 8 to 17 inches: gravelly silty clay loam
2Btg1 - 17 to 24 inches: gravelly clay
2Btg2 - 24 to 33 inches: gravelly clay
3Cg - 33 to 48 inches: very gravelly clay loam
4C - 48 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 10 to 19 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.01 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: R002XC005OR - High Flood Plain Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Awbrig

Percent of map unit: 6 percent
Landscape: Willamette valleys
Landform: Drainageways on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Bashaw

Percent of map unit: 4 percent
Landscape: Willamette valleys
Landform: Depressions on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Conser

Percent of map unit: 2 percent
Landscape: Willamette valleys
Landform: Depressions on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Am—Amity silt loam

Map Unit Setting

National map unit symbol: 24ns
Elevation: 120 to 350 feet
Mean annual precipitation: 40 to 45 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Amity and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Amity

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Parent material: Mixed silty alluvium

Typical profile

H1 - 0 to 24 inches: silt loam
H2 - 24 to 37 inches: silty clay loam
H3 - 37 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: R002XC007OR - Valley Swale Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Concord

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

CeC—Chehalem silt loam, 2 to 12 percent slopes

Map Unit Setting

National map unit symbol: 24nx
Elevation: 150 to 300 feet

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Mean annual precipitation: 40 to 45 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Chehalem

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 60 inches: silty clay

Properties and qualities

Slope: 2 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly 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: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: R002XC010OR - Claypan Low Hill Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Ck—Clackamas gravelly loam

Map Unit Setting

National map unit symbol: 24nz
Elevation: 170 to 800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Clackamas and similar soils: 85 percent

Minor components: 8 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clackamas

Setting

Landform: Terraces

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Gravelly mixed alluvium

Typical profile

H1 - 0 to 15 inches: gravelly loam

H2 - 15 to 24 inches: gravelly clay loam

H3 - 24 to 60 inches: extremely gravelly clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)

Depth to water table: About 6 to 18 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: C/D

Ecological site: R002XC005OR - High Flood Plain Group

Forage suitability group: Somewhat Poorly Drained (G002XY005OR)

Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)

Hydric soil rating: No

Minor Components

Courtney

Percent of map unit: 8 percent

Landform: Terraces

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

Co—Concord silt loam

Map Unit Setting

National map unit symbol: 24p2
Elevation: 120 to 350 feet
Mean annual precipitation: 40 to 45 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

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

Description of Concord

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Mixed mineralogy alluvium

Typical profile

H1 - 0 to 15 inches: silt loam
H2 - 15 to 29 inches: silty clay
H3 - 29 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly 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: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: R002XC007OR - Valley Swale Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Dayton

Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Da—Dayton silt loam

Map Unit Setting

National map unit symbol: 24p4
Elevation: 120 to 350 feet
Mean annual precipitation: 40 to 45 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Dayton

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Mixed alluvium with some loess in the upper layers

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 46 inches: clay
H3 - 46 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: R002XC007OR - Valley Swale Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Concord

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Mb—McBee silty clay loam

Map Unit Setting

National map unit symbol: 24qg
Elevation: 100 to 650 feet
Mean annual precipitation: 40 to 45 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Mcbee and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcbee

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 10 inches: silty clay loam
H2 - 10 to 65 inches: clay loam

Properties and qualities

Slope: 0 to 3 percent

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Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well 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: About 24 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: F002XC003OR - Low Flood Plain Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Wapato

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

SnB—Santiam silt loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: 24rc
Elevation: 300 to 370 feet
Mean annual precipitation: 40 to 45 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Santiam

Setting

Landform: High terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

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Across-slope shape: Linear

Parent material: Silty material over basalt and gravelly alluvium

Typical profile

H1 - 0 to 13 inches: silt loam

H2 - 13 to 30 inches: silty clay loam

H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 3 to 6 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately 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: About 24 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e

Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: C

Ecological site: R002XC011OR - Low Hill Group

Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)

Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)

Hydric soil rating: No

SnC—Santiam silt loam, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: 24rd

Elevation: 300 to 370 feet

Mean annual precipitation: 40 to 45 inches

Mean annual air temperature: 52 to 54 degrees F

Frost-free period: 200 to 210 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Santiam and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Santiam

Setting

Landform: High terraces

Landform position (three-dimensional): Riser, tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Silty material over basalt and gravelly alluvium

Typical profile

H1 - 0 to 13 inches: silt loam
H2 - 13 to 30 inches: silty clay loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately 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: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R002XC011OR - Low Hill Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

WIA—Willamette silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 24s0
Elevation: 150 to 350 feet
Mean annual precipitation: 40 to 45 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 200 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Willamette and similar soils: 83 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Willamette

Setting

Landform: Low terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Typical profile

H1 - 0 to 24 inches: silt loam
H2 - 24 to 54 inches: silt loam

H3 - 54 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 3 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 (0.57 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: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 1

Land capability classification (nonirrigated): 1

Hydrologic Soil Group: B

Ecological site: R002XC008OR - Valley Terrace Group

Hydric soil rating: No

WuA—Woodburn silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 24s3

Elevation: 150 to 350 feet

Mean annual precipitation: 40 to 45 inches

Mean annual air temperature: 52 to 54 degrees F

Frost-free period: 200 to 210 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Woodburn and similar soils: 85 percent

Minor components: 1 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Silty alluvium and mixed mineralogy loess

Typical profile

H1 - 0 to 17 inches: silt loam

H2 - 17 to 32 inches: silty clay loam

H3 - 32 to 68 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

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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: About 25 to 32 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w

Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: C

Ecological site: R002XC008OR - Valley Terrace Group

Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)

Other vegetative classification: Moderately Well Drained < 15% Slopes
(G002XY004OR)

Hydric soil rating: No

Minor Components

Aquolls, somewhat poorly drained

Percent of map unit: 1 percent

Landform: Terraces

Hydric soil rating: Yes

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Glossary

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the following National Soil Survey Handbook link: "[National Soil Survey Handbook](#)."

ABC soil

A soil having an A, a B, and a C horizon.

Ablation till

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

AC soil

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.

Alluvial fan

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

Alluvium

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Alpha,alpha-dipyridyl

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

Animal unit month (AUM)

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon

A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

Aspect

The direction toward which a slope faces. Also called slope aspect.

Association, soil

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity)

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low: 0 to 3

Low: 3 to 6

Moderate: 6 to 9

High: 9 to 12

Very high: More than 12

Backslope

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Backswamp

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

Badland

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluvies. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

Bajada

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

Basal area

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Base slope (geomorphology)

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Bedding plane

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology)

from the preceding or following layer; a plane of deposition. It commonly marks a change in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

Bedding system

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout (map symbol)

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

Borrow pit (map symbol)

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

Bottom land

An informal term loosely applied to various portions of a flood plain.

Boulders

Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

Breast height

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

Cable yarding

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

California bearing ratio (CBR)

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy

The leafy crown of trees or shrubs. (See Crown.)

Canyon

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

Capillary water

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena

A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

Cation

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps

See Terracettes.

Cement rock

Shaly limestone used in the manufacture of cement.

Channery soil material

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment

Control of unwanted vegetation through the use of chemicals.

Chiseling

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Cirque

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

Clay

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions

See Redoximorphic features.

Clay film

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay spot (map symbol)

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

Claypan

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

Climax plant community

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil

Sand or loamy sand.

Cobble (or cobblestone)

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility)

See Linear extensibility.

Colluvium

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Complex slope

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions

See Redoximorphic features.

Conglomerate

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Contour stripcropping

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat)

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

Corrosion (geomorphology)

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

Corrosion (soil survey interpretations)

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system

Growing crops according to a planned system of rotation and management practices.

Cross-slope farming

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown

The upper part of a tree or shrub, including the living branches and their foliage.

Cryoturbate

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

Cuesta

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or clifflike slope (scarp) that cuts through the tilted rocks.

Culmination of the mean annual increment (CMAI)

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave

The walls of excavations tend to cave in or slough.

Decreasers

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing

Postponing grazing or resting grazing land for a prescribed period.

Delta

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depression, closed (map symbol)

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

Depth, soil

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Desert pavement

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

Diatomaceous earth

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

Dip slope

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace)

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural)

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface

Runoff, or surface flow of water, from an area.

Drainageway

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

Draw

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

Drift

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

Duff

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

Earthy fill

See Mine spoil.

Ecological site

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian deposit

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Ephemeral stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (accelerated)

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion (geologic)

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion pavement

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

Erosion surface

A land surface shaped by the action of erosion, especially by running water.

Escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Escarpment, bedrock (map symbol)

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

Escarpment, nonbedrock (map symbol)

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

Esker

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left

behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

Extrusive rock

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth's surface.

Fallow

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan remnant

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

Fertility, soil

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat)

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity

The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fill slope

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil

Sandy clay, silty clay, or clay.

Firebreak

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

Flaggy soil material

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Flood-plain landforms

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

Flood-plain splay

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

Flood-plain step

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

Fluvial

Of or pertaining to rivers or streams; produced by stream or river action.

Foothills

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

Footslope

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb

Any herbaceous plant not a grass or a sedge.

Forest cover

All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glaciofluvial deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gleyed soil

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping

Growing crops in strips that grade toward a protected waterway.

Grassed waterway

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel

Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravel pit (map symbol)

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

Gravelly soil material

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gravelly spot (map symbol)

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

Green manure crop (agronomy)

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water

Water filling all the unblocked pores of the material below the water table.

Gully (map symbol)

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hard to reclaim

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Hardpan

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope (geomorphology)

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat)

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Hillslope

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

Horizon, soil

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon: An organic layer of fresh and decaying plant residue.

L horizon: A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

A horizon: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon: The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon: Soft, consolidated bedrock beneath the soil.

R layer: Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

M layer: A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

W layer: A layer of water within or beneath the soil.

Humus

The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

Illuviation

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Very low: Less than 0.2

Low: 0.2 to 0.4

Moderately low: 0.4 to 0.75

Moderate: 0.75 to 1.25

Moderately high: 1.25 to 1.75

High: 1.75 to 2.5

Very high: More than 2.5

Interfluve

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Interfluve (geomorphology)

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

Intermittent stream

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions

See Redoximorphic features.

Irrigation

Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin: Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border: Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding: Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation: Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle): Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow: Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler: Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation: Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding: Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Karst (topography)

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

Knoll

A small, low, rounded hill rising above adjacent landforms.

Ksat

See Saturated hydraulic conductivity.

Lacustrine deposit

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lake terrace

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landfill (map symbol)

An area of accumulated waste products of human habitation, either above or below natural ground level.

Landslide

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lava flow (map symbol)

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

Leaching

The removal of soluble material from soil or other material by percolating water.

Levee (map symbol)

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

Linear extensibility

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. 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. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit

The moisture content at which the soil passes from a plastic to a liquid state.

Loam

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Low strength

The soil is not strong enough to support loads.

Low-residue crops

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Marl

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

Marsh or swamp (map symbol)

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

Mass movement

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

Masses

See Redoximorphic features.

Meander belt

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

Meander scar

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

Meander scroll

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

Mechanical treatment

Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil

Very fine sandy loam, loam, silt loam, or silt.

Mesa

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

Metamorphic rock

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline.

Mine or quarry (map symbol)

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

Mine spoil

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

Mineral soil

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage

Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area

A kind of map unit that has little or no natural soil and supports little or no vegetation.

Miscellaneous water (map symbol)

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

Moderately coarse textured soil

Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil

Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Mountain

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can

occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

Muck

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat

See Hemic soil material.

Mudstone

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

Munsell notation

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules

See Redoximorphic features.

Nose slope (geomorphology)

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

Nutrient, plant

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low: Less than 0.5 percent

Low: 0.5 to 1.0 percent

Moderately low: 1.0 to 2.0 percent

Moderate: 2.0 to 4.0 percent

High: 4.0 to 8.0 percent

Very high: More than 8.0 percent

Outwash

Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Outwash plain

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Paleoterrace

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

Pan

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

Parent material

The unconsolidated organic and mineral material in which soil forms.

Peat

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped

An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

Pedon

The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation

The movement of water through the soil.

Perennial water (map symbol)

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

Permafrost

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

pH value

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Piping

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting

Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plastic limit

The moisture content at which a soil changes from semisolid to plastic.

Plasticity index

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plateau (geomorphology)

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Playa

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

Plinthite

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan

A compacted layer formed in the soil directly below the plowed layer.

Ponding

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore linings

See Redoximorphic features.

Potential native plant community

See Climax plant community.

Potential rooting depth (effective rooting depth)

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil

The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil

A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and

promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid: Less than 3.5

Extremely acid: 3.5 to 4.4

Very strongly acid: 4.5 to 5.0

Strongly acid: 5.1 to 5.5

Moderately acid: 5.6 to 6.0

Slightly acid: 6.1 to 6.5

Neutral: 6.6 to 7.3

Slightly alkaline: 7.4 to 7.8

Moderately alkaline: 7.9 to 8.4

Strongly alkaline: 8.5 to 9.0

Very strongly alkaline: 9.1 and higher

Red beds

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations

See Redoximorphic features.

Redoximorphic depletions

See Redoximorphic features.

Redoximorphic features

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
 - A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
 - B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
 - C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
 - A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
 - B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Reduced matrix

See Redoximorphic features.

Regolith

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

Relief

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

Residuum (residual soil material)

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Rill

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

Riser

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Road cut

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop (map symbol)

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where “Rock outcrop” is a named component of the map unit.

Root zone

The part of the soil that can be penetrated by plant roots.

Runoff

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline spot (map symbol)

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

Sand

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone

Sedimentary rock containing dominantly sand-sized particles.

Sandy spot (map symbol)

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

Sapric soil material (muck)

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated hydraulic conductivity (Ksat)

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are:

Very high: 100 or more micrometers per second (14.17 or more inches per hour)

High: 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

Moderately high: 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

Moderately low: 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

Low: 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

Very low: Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

Saturation

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

Sequum

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Severely eroded spot (map symbol)

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which "severely eroded," "very severely eroded," or "gullied" is part of the map unit name.

Shale

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

Sheet erosion

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Short, steep slope (map symbol)

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

Shoulder

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

Shrink-swell

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Shrub-coppice dune

A small, streamlined dune that forms around brush and clump vegetation.

Side slope (geomorphology)

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silica

A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

Similar soils

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole (map symbol)

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

Site index

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides (pedogenic)

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slide or slip (map symbol)

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

Slope

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope alluvium

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Slow refill

The slow filling of ponds, resulting from restricted water transmission in the soil.

Slow water movement

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

Sodic (alkali) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodic spot (map symbol)

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

Sodicity

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $\text{Ca}^{++} + \text{Mg}^{++}$. The degrees of sodicity and their respective ratios are:

Slight: Less than 13:1

Moderate: 13-30:1

Strong: More than 30:1

Sodium adsorption ratio (SAR)

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand: 2.0 to 1.0

Coarse sand: 1.0 to 0.5

Medium sand: 0.5 to 0.25

Fine sand: 0.25 to 0.10

Very fine sand: 0.10 to 0.05

Silt: 0.05 to 0.002

Clay: Less than 0.002

Solum

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Spoil area (map symbol)

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

Stone line

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

Stones

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stony spot (map symbol)

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

Strath terrace

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Stripcropping

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

Platy: Flat and laminated

Prismatic: Vertically elongated and having flat tops

Columnar: Vertically elongated and having rounded tops

Angular blocky: Having faces that intersect at sharp angles (planes)

Subangular blocky: Having subrounded and planar faces (no sharp angles)

Granular: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

Single grained: Entirely noncoherent (each grain by itself), as in loose sand

Massive: Occurring as a coherent mass

Stubble mulch

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil

Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum

The part of the soil below the solum.

Subsurface layer

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

Terrace (conservation)

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field

generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geomorphology)

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Terracettes

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

Texture, soil

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer

Otherwise suitable soil material that is too thin for the specified use.

Till

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tilth, soil

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tread

The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Tuff

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

Upland

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

Variegation

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very stony spot (map symbol)

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

Water bars

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

Well graded

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wet spot (map symbol)

A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

Wilting point (or permanent wilting point)

The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow

The uprooting and tipping over of trees by the wind.



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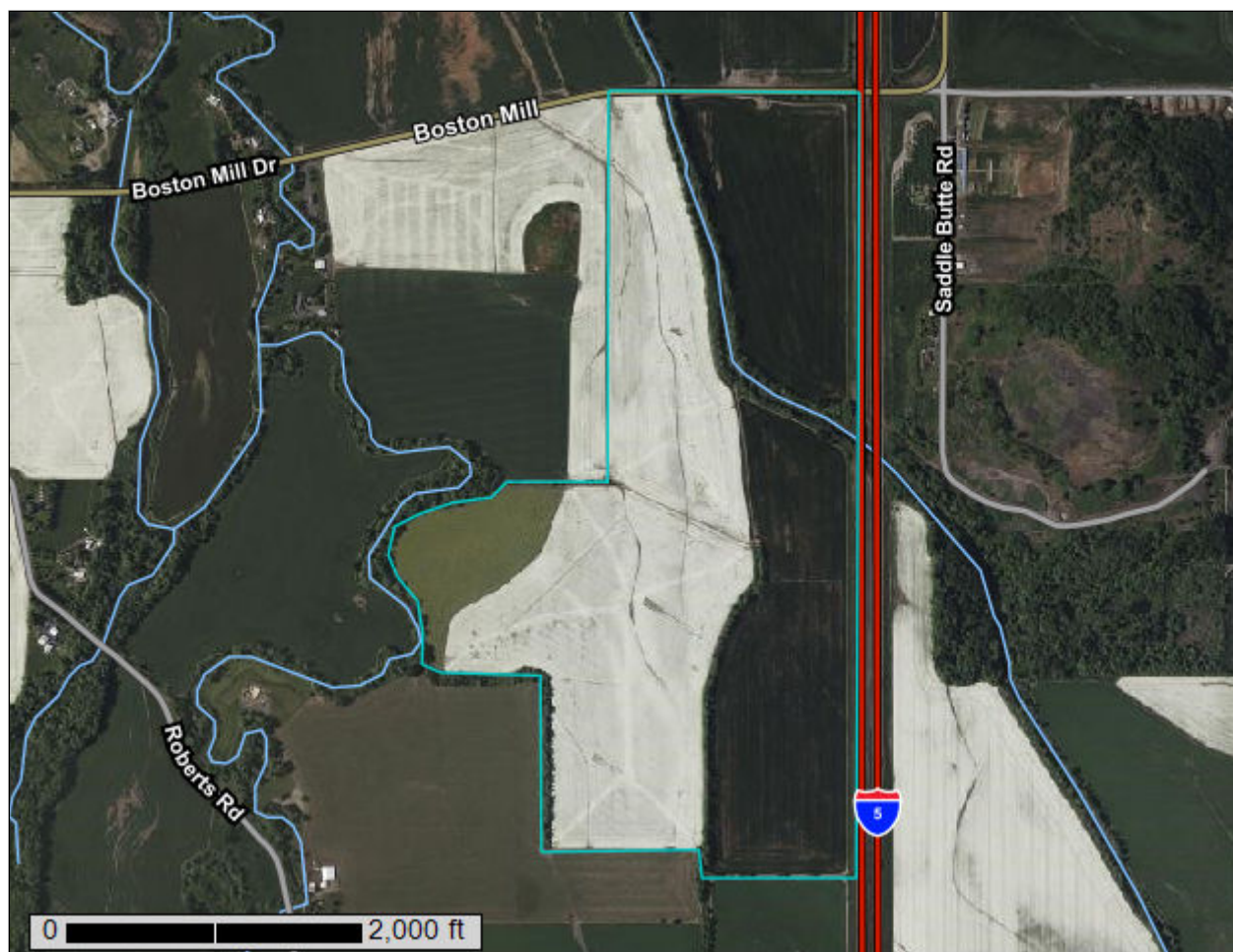
NRCS

Natural
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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 **Linn County Area, Oregon**

Wirth Farms



May 16, 2026

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

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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.

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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 1:20,000.

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: Linn County Area, Oregon
Survey Area Data: Version 21, Sep 10, 2025

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

Date(s) aerial images were photographed: May 17, 2023—Jun 3, 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
8	Bashaw silty clay	35.3	13.9%
26	Coburg silty clay loam	9.6	3.8%
39	Fluvents-Fluvaquents complex, nearly level	1.2	0.5%
63	Malabon silty clay loam	10.5	4.1%
99	Wapato silty clay loam	7.8	3.1%
100	Whiteson silt loam	54.4	21.5%
2205A	Conser silty clay loam, 0 to 3 percent slopes	78.0	30.8%
2212A	Awbrig silty clay loam, 0 to 2 percent slopes	52.7	20.8%
W	Water	3.6	1.4%
Totals for Area of Interest		253.0	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.

Linn County Area, Oregon

8—Bashaw silty clay

Map Unit Setting

National map unit symbol: 24zp

Elevation: 170 to 800 feet

Mean annual precipitation: 40 to 60 inches

Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 165 to 210 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Bashaw and similar soils: 85 percent

Minor components: 11 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bashaw

Setting

Landform: Alluvial fans, Flood plains, Alluvial terraces

Landform position (three-dimensional): Tread

Down-slope shape: Concave, linear

Across-slope shape: Linear

Parent material: Clayey alluvium derived from mixed sources

Typical profile

H1 - 0 to 4 inches: silty clay

H2 - 4 to 60 inches: clay

H3 - 60 to 70 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: Frequent

Frequency of ponding: Frequent

Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 4w

Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: D

Ecological site: R002XC005OR - High Flood Plain Group

Forage suitability group: Poorly Drained (G002XY006OR)

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

Minor Components

Awbrig

Percent of map unit: 5 percent

Landform: Low stream terraces

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Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Conser

Percent of map unit: 3 percent
Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Courtney

Percent of map unit: 2 percent
Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 1 percent
Landform: Broad valley terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

26—Coburg silty clay loam

Map Unit Setting

National map unit symbol: 24wn
Elevation: 170 to 800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Coburg and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coburg

Setting

Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Silty and clayey alluvium derived from mixed sources

Typical profile

H1 - 0 to 17 inches: silty clay loam
H2 - 17 to 62 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: R002XC006OR - Stream Terrace Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Awbrig

Percent of map unit: 3 percent
Landform: Low stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Conser

Percent of map unit: 3 percent
Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Courtney

Percent of map unit: 2 percent
Landform: Low alluvial stream terraces

Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

39—Fluents-Fluvaquents complex, nearly level

Map Unit Setting

National map unit symbol: 24xg
Elevation: 100 to 1,500 feet
Mean annual precipitation: 30 to 80 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Fluents and similar soils: 50 percent
Fluvaquents and similar soils: 35 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fluents

Setting

Landform: Low flood plains, Sloughs, Islands, Bars, Overflow stream channels, Oxbows
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Recent medium and coarse textured alluvium

Typical profile

H1 - 0 to 60 inches: variable

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Depth to water table: About 24 to 72 inches
Frequency of flooding: Frequent
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Ecological site: F002XC003OR - Low Flood Plain Group
Hydric soil rating: Yes

Description of Fluvaquents

Setting

Landform: Islands, Low flood plains, Oxbows, Overflow stream channels, Bars, Sloughs

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Moderately fine to medium textured alluvium

Typical profile

H1 - 0 to 60 inches: variable

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained

Depth to water table: About 0 to 36 inches

Frequency of flooding: Frequent

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6w

Ecological site: F002XC002OR - Backswamp Group

Hydric soil rating: Yes

Minor Components

Riverwash

Percent of map unit: 1 percent

Landform: Flood plains

Hydric soil rating: Yes

Waldo

Percent of map unit: 1 percent

Landform: Flood plains

Hydric soil rating: Yes

63—Malabon silty clay loam

Map Unit Setting

National map unit symbol: 24yv

Elevation: 200 to 600 feet

Mean annual precipitation: 40 to 50 inches

Mean annual air temperature: 52 to 54 degrees F

Frost-free period: 165 to 210 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Malabon and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Malabon

Setting

Landform: Low alluvial stream terraces

Landform position (three-dimensional): Tread

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Parent material: Silty and clayey alluvium derived from mixed sources

Typical profile

H1 - 0 to 17 inches: silty clay loam

H2 - 17 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 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 (0.20 to 0.57 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: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 1

Land capability classification (nonirrigated): 1

Hydrologic Soil Group: C

Ecological site: R002XC006OR - Stream Terrace Group

Forage suitability group: Well drained < 15% Slopes (G002XY002OR)

Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

Hydric soil rating: No

99—Wapato silty clay loam

Map Unit Setting

National map unit symbol: 250j

Elevation: 100 to 1,500 feet

Mean annual precipitation: 30 to 60 inches

Mean annual air temperature: 50 to 55 degrees F

Frost-free period: 160 to 235 days

Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Wapato and similar soils: 85 percent

Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wapato

Setting

Landform: Old abandoned river channels and depressional areas on flood plains

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Recent moderately fine textured alluvium derived from mixed
soruces

Typical profile

H1 - 0 to 17 inches: silty clay loam

H2 - 17 to 48 inches: silty clay loam

H3 - 48 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 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 (0.20
to 0.57 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: Frequent

Frequency of ponding: Frequent

Available water supply, 0 to 60 inches: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: C/D

Ecological site: F002XC002OR - Backswamp Group

Forage suitability group: Poorly Drained (G002XY006OR)

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

Minor Components

Waldo

Percent of map unit: 5 percent

Landform: Flood plains

Hydric soil rating: Yes

100—Whiteson silt loam

Map Unit Setting

National map unit symbol: 24vf

Elevation: 90 to 1,500 feet

Mean annual precipitation: 30 to 60 inches

Mean annual air temperature: 50 to 55 degrees F

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Frost-free period: 160 to 235 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Whiteson and similar soils: 85 percent

Minor components: 9 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whiteson

Setting

Landform: Flood plains

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Recent medium textured alluvium overlying fine textured older alluvium derived from mixed sources

Typical profile

H1 - 0 to 11 inches: silt loam

H2 - 11 to 15 inches: clay loam

H3 - 15 to 43 inches: clay

H4 - 43 to 60 inches: gravelly sandy clay loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: 14 to 28 inches to abrupt textural change

Drainage class: Somewhat poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: Frequent

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4w

Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: D

Ecological site: R002XC005OR - High Flood Plain Group

Forage suitability group: Somewhat Poorly Drained (G002XY005OR)

Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)

Hydric soil rating: Yes

Minor Components

Wapato

Percent of map unit: 3 percent

Landform: Old abandoned river channels and depressional areas on flood plains

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

Bashaw

Percent of map unit: 3 percent

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Landform: Flood plains

Hydric soil rating: Yes

Waldo

Percent of map unit: 3 percent

Landform: Flood plains

Hydric soil rating: Yes

2205A—Conser silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xpsk

Landscape: Willamette valleys

Elevation: 150 to 610 feet

Mean annual precipitation: 39 to 59 inches

Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 165 to 210 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Conser and similar soils: 86 percent

Minor components: 7 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Conser

Setting

Landscape: Willamette valleys

Landform: Depressions on stream terraces

Landform position (three-dimensional): Tread

Down-slope shape: Concave

Across-slope shape: Concave

Parent material: Clayey alluvium

Typical profile

A - 0 to 9 inches: silty clay loam

B_{Ag} - 9 to 14 inches: silty clay

B_{tg1} - 14 to 27 inches: clay

B_{tg2} - 27 to 41 inches: silty clay

2C_{g1} - 41 to 49 inches: loam

2C_{g2} - 49 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (K_{sat}): Moderately low (0.01 to 0.07 in/hr)

Depth to water table: About 0 to 9 inches

Frequency of flooding: Rare

Frequency of ponding: Frequent

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Available water supply, 0 to 60 inches: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: D

Ecological site: R002XC005OR - High Flood Plain Group

Forage suitability group: Poorly Drained (G002XY006OR)

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

Minor Components

Awbrig

Percent of map unit: 4 percent

Landscape: Valleys

Landform: Terraces on depressions

Landform position (three-dimensional): Tread

Down-slope shape: Concave

Across-slope shape: Concave

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

Courtney

Percent of map unit: 3 percent

Landscape: Willamette valleys

Landform: Drainageways on stream terraces

Landform position (three-dimensional): Tread

Down-slope shape: Concave, linear

Across-slope shape: Concave

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

2212A—Awbrig silty clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2xpsj

Landscape: Valleys

Elevation: 180 to 610 feet

Mean annual precipitation: 39 to 51 inches

Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 165 to 210 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Awbrig and similar soils: 87 percent

Minor components: 4 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Awbrig

Setting

Landscape: Valleys
Landform: Terraces on depressions
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Silty alluvium over silty and clayey glaciolacustrine deposits

Typical profile

Ap1 - 0 to 2 inches: silty clay loam
Ap2 - 2 to 7 inches: silty clay loam
2Btssg1 - 7 to 18 inches: clay
2Btssg2 - 18 to 29 inches: silty clay
2Btg - 29 to 48 inches: silty clay loam
2Cg - 48 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.07 in/hr)
Depth to water table: About 0 to 2 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: R002XC005OR - High Flood Plain Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Bashaw

Percent of map unit: 2 percent
Landscape: Willamette valleys
Landform: Depressions on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Courtney

Percent of map unit: 2 percent
Landscape: Willamette valleys
Landform: Drainageways on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear

Custom Soil Resource Report

Across-slope shape: Concave

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

W—Water

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

References

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- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelpdb1043084>

Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

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United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

CITY OF MOLALLA - LANDOWNER CONSENT FORM

CONSENT AGREEMENT FOR THE BENEFICIAL LAND APPLICATION OF BIOSOLIDS:

This Consent Agreement is between ^{Milton S.} Kraef (property owner) and Wirth Farms (farmer/lease holder), collectively known as "Consenters," and **City of Molalla** (City), the "Consentee," for the purpose of land applying City of Molalla biosolids at the Property described below and subject to the terms and conditions described below.

Property description:

The Property is located at Boston Mill Rd. The Property contains approximately 183 acres and 4 (number) of land application sites.

The land application sites will be available from 7/15 to 8/15 for the beneficial land application of biosolids.

Land application sites available for biosolids application are:

Field ID	Acres	Existing Crop	Harvest Date	Replant Crop	Plant Date
WF - 34	40	Annual Rye	7/10	Annual Rye	9/2026
WF - 30	55	Annual Rye	7/10	Annual Rye	9/2026
WF - 32	72	Annual Rye	7/10	Annual Rye	9/2026
WF - 33	16	Wheat	7/15	Meadow farm	10/2026

Terms and conditions:

Consenters agree:

- 1) That they have received, read and understand the Biosolids Land Application Site Authorization letter issued by DEQ;
- 2) To notify the City of the availability of the land application site(s) after crops have been harvested and all normal farming practices have been completed;
- 3) To provide the City and its contractors with access to a staging area for trucks weighing 105,500 lbs.;
- 4) To perform any pre and/or post soil preparation, including but not limited to, removal of straw prior to land applying biosolids;
- 5) To maintain setbacks and buffer strips around site features as described in the DEQ Biosolids Land Application Site Authorization;

CITY OF MOLALLA - LANDOWNER CONSENT FORM

- 6) To incorporate biosolids should odor become a problem;
- 7) To give Oregon DEQ, the City and its representatives, and authorized contractors access to the Property for the purpose of site inspection, soil sampling, groundwater sampling, and application inspection;
- 8) By signing this Consent Agreement, the parties agree that neither they nor anyone who later claims rights through them will bring claims against the Consentee for issues related to the application of City of Molalla biosolids on the Property described in this Agreement. This applies to claims that are known or unknown and to those that exist now or may arise in the future;
- 9) Consenters warrant that they have valid property interests in and/or leasehold over the Property and land application sites described herein and are authorized to enter into this Consent Agreement; and
- 10) That Consentee has made no warranty of any kind, expressed or implied, concerning the use of biosolids for post-application yield.

Consentee agrees:

- 1) To deliver biosolids to the land application site(s) as authorized by the DEQ Biosolids Land Application Site Authorization;
- 2) To use authorized contractors to land apply the City's biosolids in accordance with, and at an agronomic rate authorized by, the DEQ Biosolids Land Application Site Authorization letter and/or the US EPA, but generally at a rate equivalent to 1-5 dry tons/acre;
- 3) To maintain setbacks and buffer strips around site features as described in the DEQ Biosolids Land Application Site Authorization letter;
- 4) To maintain records of the dates and amounts of biosolids delivered to and land applied at the Property;
- 5) To provide Consenters with annual reports summarizing application activities; and
- 6) To comply with all applicable statutes and regulations concerning the application of biosolids, including requirements contained in OAR 340, Division 50, 40 CFR Part 503, City of Molalla Biosolids Management Plan, and the terms of the DEQ Biosolids Land Application Site Authorization letter.

Consenter rules/regulations agreement:

I understand that the following conditions apply to my land following biosolids applications and that I, and my lessee, if applicable, have signed an agreement form with the City of Molalla stating that I, and/or my lessee will be responsible for following these conditions where applicable:

- 1) Animals shall not be grazed on the land for **30 days** after the application of biosolids.
- 2) Food crops (crops consumed by humans including but not limited to fruits, vegetables and tobacco) with harvested parts that touch the biosolids/soil mixture and are totally

CITY OF MOLALLA - LANDOWNER CONSENT FORM

above the land surface shall not be harvested for 14 months after the application of biosolids.

- 3) Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after the application of biosolids when the biosolids remain on the land surface ≥ 4 months prior to incorporation into the soil, or 38 months when the biosolids remain on the land surface < 4 months prior to incorporation.
- 4) Food crops, feed crops and fiber crops shall not be harvested for 30 days after application of biosolids.
- 5) Public access to land with a low potential for public exposure (land the public uses infrequently including but not limited to agricultural land and forests) shall be restricted for 30 days. Public access to land with a high potential for public exposure (land the public uses frequently including but not limited to a public contact site such as parks, playgrounds and golf courses) shall be restricted for 1 year.
- 6) Turf grown on land where biosolids are applied shall not be harvested for one year after application of biosolids when the harvested turf is placed on either land with a high potential for public exposure or a lawn, unless otherwise specified by the permitting authority.

DATE 5-27-2026

Farmer (signature) _____

Farmer (print name) _____

Physical Address & Phone Number _____

DATE 5-27-2026

Landowner (signature) _____

Landowner (print name) _____

Physical Address & Phone Number _____

32796 Boston Mill Dr
Shedd, OR 97377

DATE _____

City of Molalla Representative _____

CITY OF MOLALLA - LANDOWNER CONSENT FORM

CONSENT AGREEMENT FOR THE BENEFICIAL LAND APPLICATION OF BIOSOLIDS:

This Consent Agreement is between Grandslam Ag LLC (property owner) and Worth Farms Inc. (farmer/lease holder), collectively known as "Consenters," and **City of Molalla** (City), the "Consentee," for the purpose of land applying City of Molalla biosolids at the Property described below and subject to the terms and conditions described below.

Property description:

The Property is located at Target Drive, Target OR. The Property contains approximately 180 acres and 2 (number) of land application sites.

The land application sites will be available from 8-1 to 9-30 for the beneficial land application of biosolids.

Land application sites available for biosolids application are:

Field ID	Acres	Existing Crop	Harvest Date	Replant Crop	Plant Date
WF-35	50	Barley	9-1	Corn	5-1-27
WF-39-52	130	Fescue Annual Ryegrass	7-20	Barley	5-1-27

Terms and conditions:

Consenters agree:

- 1) That they have received, read and understand the Biosolids Land Application Site Authorization letter issued by DEQ;
- 2) To notify the City of the availability of the land application site(s) after crops have been harvested and all normal farming practices have been completed;
- 3) To provide the City and its contractors with access to a staging area for trucks weighing 105,500 lbs.;
- 4) To perform any pre and/or post soil preparation, including but not limited to, removal of straw prior to land applying biosolids;
- 5) To maintain setbacks and buffer strips around site features as described in the DEQ Biosolids Land Application Site Authorization;

CITY OF MOLALLA - LANDOWNER CONSENT FORM

- 6) To incorporate biosolids should odor become a problem;
- 7) To give Oregon DEQ, the City and its representatives, and authorized contractors access to the Property for the purpose of site inspection, soil sampling, groundwater sampling, and application inspection;
- 8) By signing this Consent Agreement, the parties agree that neither they nor anyone who later claims rights through them will bring claims against the Consentee for issues related to the application of City of Molalla biosolids on the Property described in this Agreement. This applies to claims that are known or unknown and to those that exist now or may arise in the future;
- 9) Consenters warrant that they have valid property interests in and/or leasehold over the Property and land application sites described herein and are authorized to enter into this Consent Agreement; and
- 10) That Consentee has made no warranty of any kind, expressed or implied, concerning the use of biosolids for post-application yield.

Consentee agrees:

- 1) To deliver biosolids to the land application site(s) as authorized by the DEQ Biosolids Land Application Site Authorization;
- 2) To use authorized contractors to land apply the City's biosolids in accordance with, and at an agronomic rate authorized by, the DEQ Biosolids Land Application Site Authorization letter and/or the US EPA, but generally at a rate equivalent to 1-5 dry tons/acre;
- 3) To maintain setbacks and buffer strips around site features as described in the DEQ Biosolids Land Application Site Authorization letter;
- 4) To maintain records of the dates and amounts of biosolids delivered to and land applied at the Property;
- 5) To provide Consenters with annual reports summarizing application activities; and
- 6) To comply with all applicable statutes and regulations concerning the application of biosolids, including requirements contained in OAR 340, Division 50, 40 CFR Part 503, City of Molalla Biosolids Management Plan, and the terms of the DEQ Biosolids Land Application Site Authorization letter.

Consenter rules/regulations agreement:

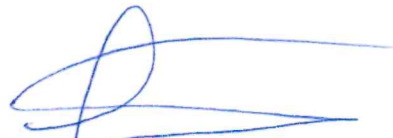
I understand that the following conditions apply to my land following biosolids applications and that I, and my lessee, if applicable, have signed an agreement form with the City of Molalla stating that I, and/or my lessee will be responsible for following these conditions where applicable:

- 1) Animals shall not be grazed on the land for **30 days** after the application of biosolids.
- 2) Food crops (crops consumed by humans including but not limited to fruits, vegetables

CITY OF MOLALLA - LANDOWNER CONSENT FORM

- and tobacco) with harvested parts that touch the biosolids/soil mixture and are totally above the land surface shall not be harvested for 14 months after the application of biosolids.
- 3) Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after the application of biosolids when the biosolids remain on the land surface ≥ 4 months prior to incorporation into the soil, or 38 months when the biosolids remain on the land surface < 4 months prior to incorporation.
- 4) Food crops, feed crops and fiber crops shall not be harvested for 30 days after application of biosolids.
- 5) Public access to land with a low potential for public exposure (land the public uses infrequently including but not limited to agricultural land and forests) shall be restricted for 30 days. Public access to land with a high potential for public exposure (land the public uses frequently including but not limited to a public contact site such as parks, playgrounds and golf courses) shall be restricted for 1 year.
- 6) Turf grown on land where biosolids are applied shall not be harvested for one year after application of biosolids when the harvested turf is placed on either land with a high potential for public exposure or a lawn, unless otherwise specified by the permitting authority.

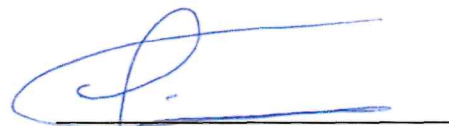
5/26/26
DATE


Farmer (signature)

Terry Wirth
Farmer (print name)

Physical Address & Phone Number

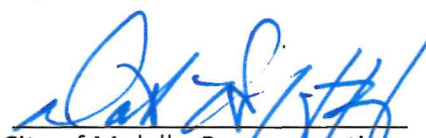
5/26/26
DATE


Landowner (signature)

Terry Wirth
Landowner (print name)

Physical Address & Phone Number

6-2-26
DATE


City of Molalla Representative

CITY OF MOLALLA - LANDOWNER CONSENT FORM

CONSENT AGREEMENT FOR THE BENEFICIAL LAND APPLICATION OF BIOSOLIDS:

This Consent Agreement is between G Five LLC (property owner) and Mid Valley Farms Inc. (farmer/lease holder), collectively known as "Consenters," and **City of Molalla** (City), the "Consentee," for the purpose of land applying City of Molalla biosolids at the Property described below and subject to the terms and conditions described below.

Property description:

The Property is located at 15901-16427 Greens Bridge Rd SE. The Property contains approximately 206 acres and 1 (number) of land application sites.

The land application sites will be available from 7-1-26 to 7-14-26 for the beneficial land application of biosolids.

Land application sites available for biosolids application are:

Field ID	Acres	Existing Crop	Harvest Date	Replant Crop	Plant Date
Jeff Hill	206	Meadow Farm		Tall Fescue	October 15

Terms and conditions:**Consenters agree:**

- 1) That they have received, read and understand the Biosolids Land Application Site Authorization letter issued by DEQ;
- 2) To notify the City of the availability of the land application site(s) after crops have been harvested and all normal farming practices have been completed;
- 3) To provide the City and its contractors with access to a staging area for trucks weighing 105,500 lbs.;
- 4) To perform any pre and/or post soil preparation, including but not limited to, removal of straw prior to land applying biosolids;
- 5) To maintain setbacks and buffer strips around site features as described in the DEQ Biosolids Land Application Site Authorization;

CITY OF MOLALLA - LANDOWNER CONSENT FORM

- 6) To incorporate biosolids should odor become a problem;
- 7) To give Oregon DEQ, the City and its representatives, and authorized contractors access to the Property for the purpose of site inspection, soil sampling, groundwater sampling, and application inspection;
- 8) By signing this Consent Agreement, the parties agree that neither they nor anyone who later claims rights through them will bring claims against the Consentee for issues related to the application of City of Molalla biosolids on the Property described in this Agreement. This applies to claims that are known or unknown and to those that exist now or may arise in the future;
- 9) Consenters warrant that they have valid property interests in and/or leasehold over the Property and land application sites described herein and are authorized to enter into this Consent Agreement; and
- 10) That Consentee has made no warranty of any kind, expressed or implied, concerning the use of biosolids for post-application yield.

Consentee agrees:

- 1) To deliver biosolids to the land application site(s) as authorized by the DEQ Biosolids Land Application Site Authorization;
- 2) To use authorized contractors to land apply the City's biosolids in accordance with, and at an agronomic rate authorized by, the DEQ Biosolids Land Application Site Authorization letter and/or the US EPA, but generally at a rate equivalent to 1-5 dry tons/acre;
- 3) To maintain setbacks and buffer strips around site features as described in the DEQ Biosolids Land Application Site Authorization letter;
- 4) To maintain records of the dates and amounts of biosolids delivered to and land applied at the Property;
- 5) To provide Consenters with annual reports summarizing application activities; and
- 6) To comply with all applicable statutes and regulations concerning the application of biosolids, including requirements contained in OAR 340, Division 50, 40 CFR Part 503, City of Molalla Biosolids Management Plan, and the terms of the DEQ Biosolids Land Application Site Authorization letter.

Consenter rules/regulations agreement:

I understand that the following conditions apply to my land following biosolids applications and that I, and my lessee, if applicable, have signed an agreement form with the City of Molalla stating that I, and/or my lessee will be responsible for following these conditions where applicable:

- 1) Animals shall not be grazed on the land for **30 days** after the application of biosolids.
- 2) Food crops (crops consumed by humans including but not limited to fruits, vegetables

CITY OF MOLALLA - LANDOWNER CONSENT FORM

and tobacco) with harvested parts that touch the biosolids/soil mixture and are totally above the land surface shall not be harvested for 14 months after the application of biosolids.

- 3) Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after the application of biosolids when the biosolids remain on the land surface ≥ 4 months prior to incorporation into the soil, or 38 months when the biosolids remain on the land surface < 4 months prior to incorporation.
- 4) Food crops, feed crops and fiber crops shall not be harvested for 30 days after application of biosolids.
- 5) Public access to land with a low potential for public exposure (land the public uses infrequently including but not limited to agricultural land and forests) shall be restricted for 30 days. Public access to land with a high potential for public exposure (land the public uses frequently including but not limited to a public contact site such as parks, playgrounds and golf courses) shall be restricted for 1 year.
- 6) Turf grown on land where biosolids are applied shall not be harvested for one year after application of biosolids when the harvested turf is placed on either land with a high potential for public exposure or a lawn, unless otherwise specified by the permitting authority.

6-10-26

DATE

Ryan T Glaser
Farmer (signature)

Ryan T Glaser Mid Valley Farms Inc
Farmer (print name)

Physical Address & Phone Number
31915 Seven Mile Ln 541-936-0530
Tangent OR 97389

6-10-26

DATE

Ryan T Glaser
Landowner (signature)

Ryan T Glaser G-Five LLC
Landowner (print name)

Physical Address & Phone Number
31915 Seven Mile Ln 541 936 0530
Tangent OR 97389

6-15-26

DATE

[Signature]
City of Molalla Representative

BMP Landowner Agreement

Seth Kelly

Thu 6/11/2026 2:41 PM

To: City Recorder <recorder@cityofmolalla.com>;

📎 1 attachments (2 MB)

20260611_Glaser_Biosolids Agreement.pdf;

Hi Ladies,

Here is another new agreement. I am waiting on one more agreement that is replacing one of the other agreements.

- Contract Title: Glaser Land Owner Agreement
- Contract Type: Land Use Agreement (Biosolids Application)
- Project Number: 2026 BMP Update
- Project or Initiative: Biosolids Removal
- Council Approval Required? N/A
- Council Approval Date: N/A
- Resolution Number N/A

Thank you,



Oregon

Tina Kotek, Governor

Department of Environmental Quality

Northwest Region Portland Office/Water Quality

700 NE Multnomah Street, Suite 600

Portland, OR 97232

(503) 229-5263

FAX (503) 229-6957

TTY 711

June 30, 2026

DAN HUFF.
CITY MANAGER
PO BOX 248
MOLALLA, OR 97038

RE: City of Molalla STP
File No: 57613 / Permit No. 101514
Clackamas County
Crompton Place Sanitary Sewer Plan Approval

Dear Mr. Huff:

The Oregon Department of Environmental Quality (DEQ) has approved sanitary sewer installation plans for the above project. John Raugust PE (AKS Engineering) submitted plans and specifications June 23rd 2026 for the City of Molalla (City), per Oregon Administrative Rule (OAR) Chapter 340, Division 052. A Land Use Compatibility Statement was approved by the City of Molalla and submitted with the project. A positive statement of capacity in the City's sewer was included. A project description and DEQ's conditions of approval are listed below.

DESCRIPTION:

- Connect to an existing sewer on S. Cromptons Lane;
- 2 standard 48-inch manholes;
- 321 LF of 8-inch diameter, ASTM D-3034 SDR-35 PVC sanitary sewer main;
- 560 LF of 6-inch ASTM D-3034 SDR-35 PVC pipe with cleanouts at the property lines;
- The sewer service will serve 8 dwelling units.

CONDITIONS OF APPROVAL

1. The laterals for buildings A,B, and C and any others connected by these laterals, especially the two that connect to the 8-inch main: the long lateral without cleanouts will be very difficult to clean without cleanouts at the 90 degree turns.
2. DEQ guidelines prefer wyes to tees for lateral to mainline connections.
3. The design engineer must field verify that the portion of mainline sewer pipe that is parallel to the mainline water pipe and within 10 feet laterally, is both below the mainline water pipe and at least 5 feet laterally from the mainline water pipe.
4. DEQ approval does not allow you to work in waterways or wetlands without proper review and approval from the Oregon Department of State Lands (DSL). Please visit DSL's website for more information about wetland identification and permitting

requirements for impacts to wetlands and waterways:

<https://www.oregon.gov/dsl/WW/Pages/WetlandConservation.aspx>

5. An erosion control permit (1200-C or 1200-CA) is required if the project will disturb one or more acres of land, either initially or ultimately. Protective erosion control measures must be installed and maintained for all areas of exposed soil regardless of whether an erosion control permit is required.
6. All materials, construction, and testing must conform to the most recent Oregon Standard Drawings, Details and Specifications for Construction. A copy of Section 0400 must be kept at the project site during construction to resolve any conflicts concerning materials, construction methods, and testing.
7. Gravity sewers are to be installed in accordance with Oregon Standard Specifications for construction section 00445. This includes but is not limited to adherence to materials, quality control, laying of the pipe, and testing of the pipe. Pipe is to be tested in accordance with section 00445.70 including video, and deflection testing in accordance with 00445.74 and 00445.73 respectively. The contractor may choose between hydrostatic or low-pressure air testing in accordance with 00445.72. The city at its discretion may waive television inspection of the sewer main however, the 95% mandrel deflection test may not be waived.
8. In accordance with the latest edition of the Oregon Standard Specifications for Construction section 00470.71. Manholes must be tested for final acceptance only after completion of all surface restoration, including paving and adjustment to grade. Manholes must be tested either hydrostatically per ASTM C497 or vacuum tested per ASTM C1244.
9. Field logs of manhole tests must accompany the above certification. A manhole test record sheet is available on DEQ's website at <https://www.oregon.gov/deq/FilterDocs/cwsrf-Manhole.pdf>;
10. This plan approval is valid for one (1) year. Technologies, materials, and standards change so it is important to keep construction approvals up to date. If construction has not commenced within one (1) year, plans must be resubmitted along with the appropriate fee for approval unless waived by DEQ. A valid Land Use Compatibility Statement (LUCS) from the local land use agency as well as a valid building permit from the local Building Codes jurisdiction will also be required.
11. Construction must be inspected and certified to DEQ in writing by the design engineer or his/her authorized representative as set forth in OAR 340-52-040. A certification form is available on DEQ's website at <https://www.oregon.gov/deq/FilterPermitsDocs/InspectCertConstruct.pdf>
12. As-built plans must be prepared upon completion of construction. The plans must be reviewed and approved by the design engineer or his/her designated individual. As-builts are not required to be submitted to DEQ. The city must retain as-builts for use in future sewer extension projects, collection system maintenance, and long-term facility/master planning endeavors.

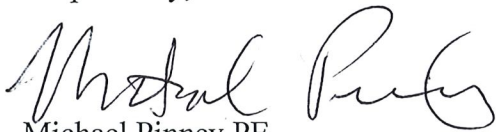
Municipal Responsibilities

The city is responsible for ensuring that the conditions of approval are adhered to, including assuring timely submittal of the engineer's certification and manhole test records and that all aspects of the project observe water quality regulations. The city must verify that the project inspector requires erosion controls, that the controls are effective, and that they are maintained. The city must verify that contractors, as well as city crews, adhere to DEQ guidelines for proper flushing of water lines. For specific procedures, refer to the state dechlorination requirements posted at: <https://www.oregon.gov/deq/FilterDocs/chlorwaterdisp.pdf>.

This plan approval is valid for one year. If construction has not commenced within one year, plans must be resubmitted along with the appropriate fee for approval, unless waived by the Department.

INQUIRIES: Please contact me at (971) 227-1765 for additional information.

Respectfully,



Michael Pinney PE

Senior Environmental Engineer NWR-WQ

CC: John Raugust PE, AKS Engineering, 12965 SW Herman Rd., Ste. 100, Tualatin OR 97062

eCC: Tiffany Yelton-Bram Manager, Source Control Section, NWR-WQ

From: [Seth Kelly](#)
To: ['RUBY Tim * DEQ'](#)
Cc: ['Jamie Olivarez'; 'R Quigley'; J McElwain](#);
Subject: BMP Update - Malpass
Attachments: [Bowers tax map.pdf](#); [LINMAL32-1 map.pdf](#); [LINMAL32-1 site map \(update\).pdf](#); [LINMAL32-1_Soil_Report.pdf](#); [Malpass_LINMAL32-1_property abutter.pdf](#);
Sent: 6/11/2026 3:59:14 PM

Hi Tim,

Here is the Malpass site maps, soil report, and abutters list for the notices that went out.

Best Regards,



Seth Kelly

Water Quality Superintendent

skelly@cityofmolalla.com

503-759-0241

From: [Seth Kelly](#)
To: [RUBY Tim * DEQ](#)
Cc: ['Jamie Olivarez'; R Quigley; J McElwain;](#)
Subject: BMP Update - Wirth Site
[Wirth site map_overview.pdf](#); [Tax map pdf.pdf](#); [LINWIR09-4 map.pdf](#); [LINWIR08-1 map.pdf](#); [LINWIR09-1 map.pdf](#); [LINWIR09-2 map.pdf](#); [LINWIR09-3 map.pdf](#); [20260516_12302112100_1_Soil_Report complete.pdf](#); [property abutters final list-Writh Farms.pdf](#);
Sent: 5/22/2026 8:24:09 AM

Hi Tim,

In effort to keep documentation for each site separated and easy for review I am sending each site separately. Here is the "Wirth Site" for review, Let Jamie or I know if there is any additional information you need.

Thank you,

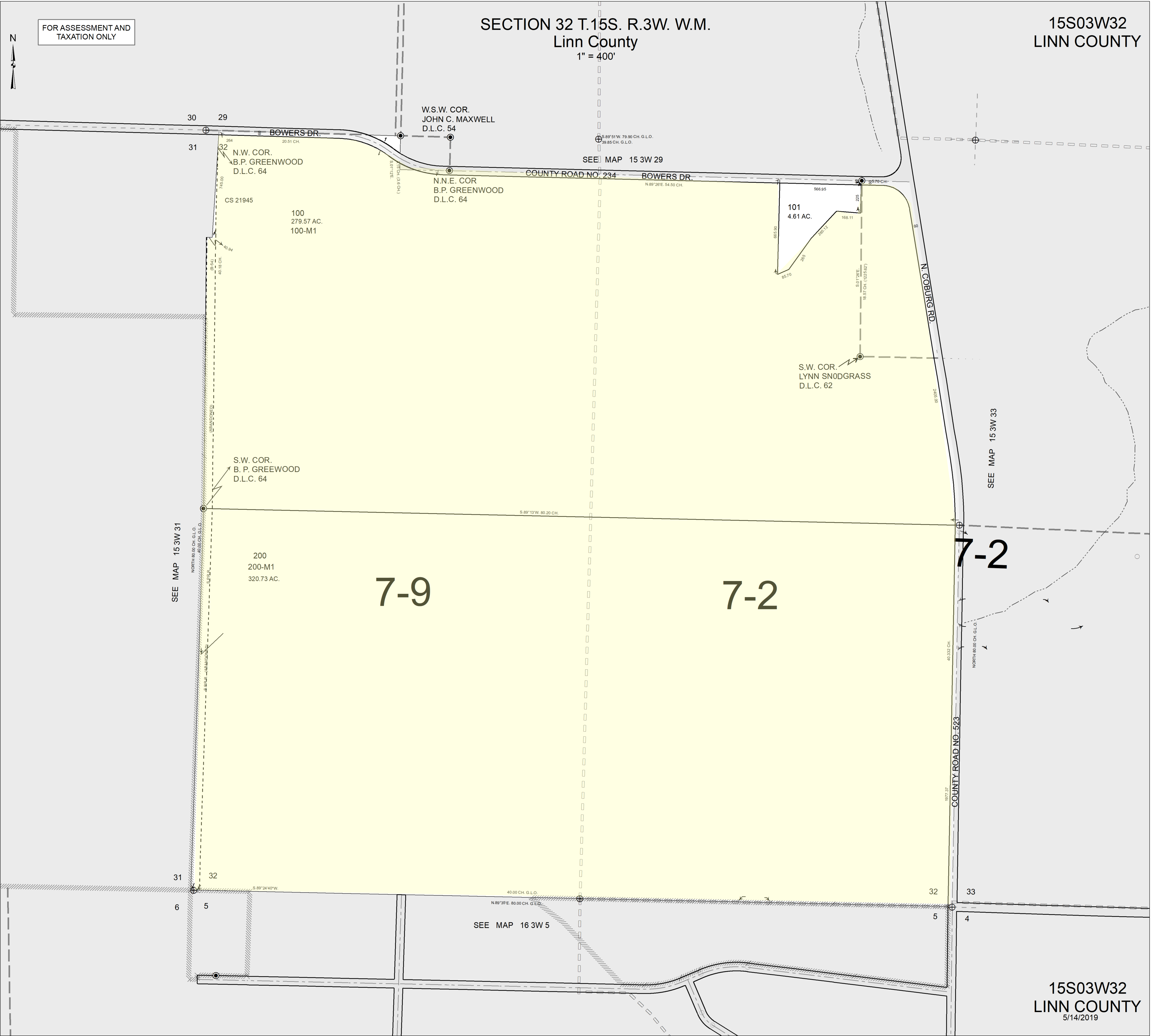


Seth Kelly

Water Quality Superintendent

skelly@cityofmolalla.com

503-759-0241



44.7193, -122.9739

Glaser Field

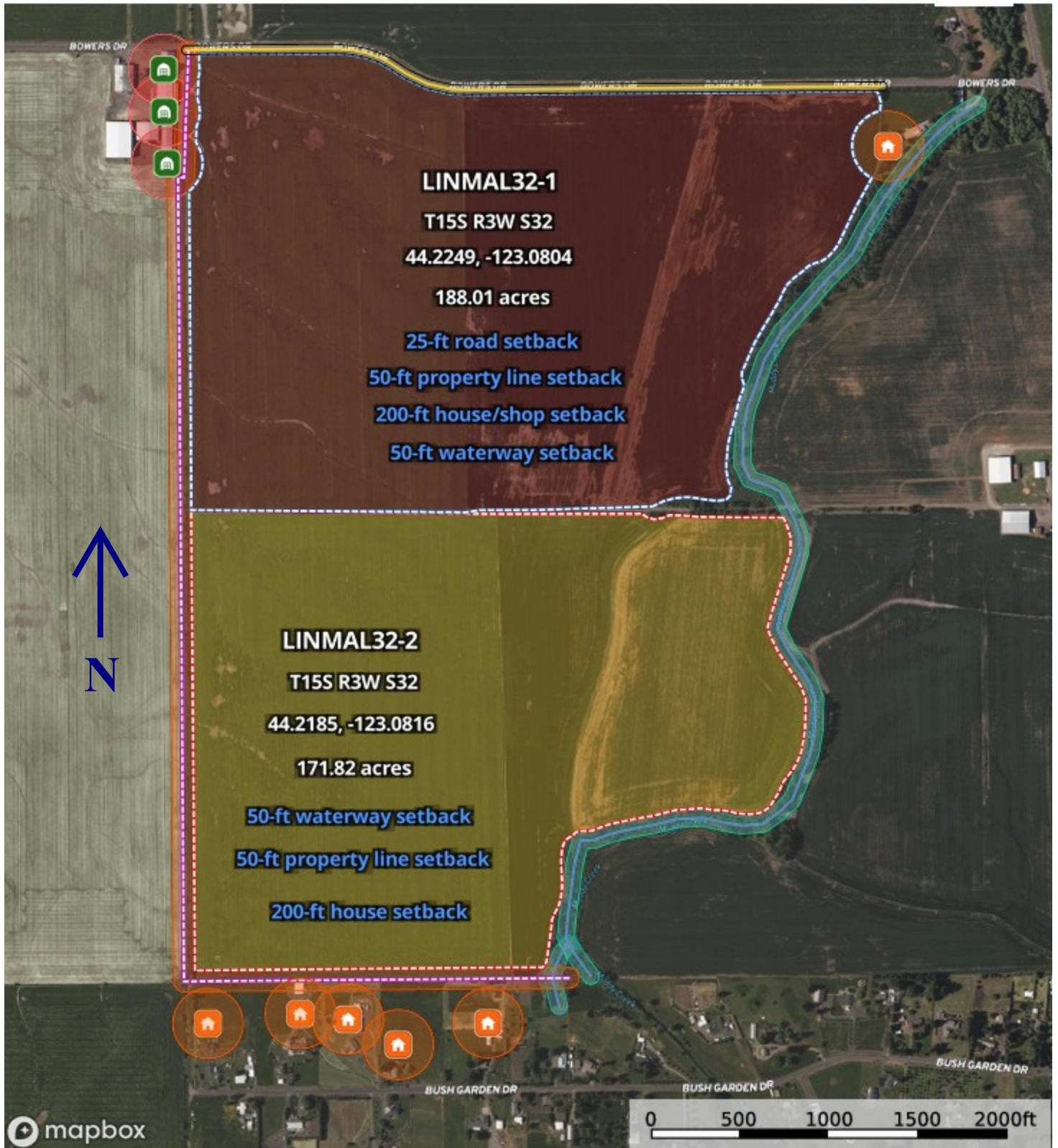
Marion County, OR



City of Molalla

**MALPASS SITE
LINMAL32-1 7 LINMAL32-2**

Linn County, OR

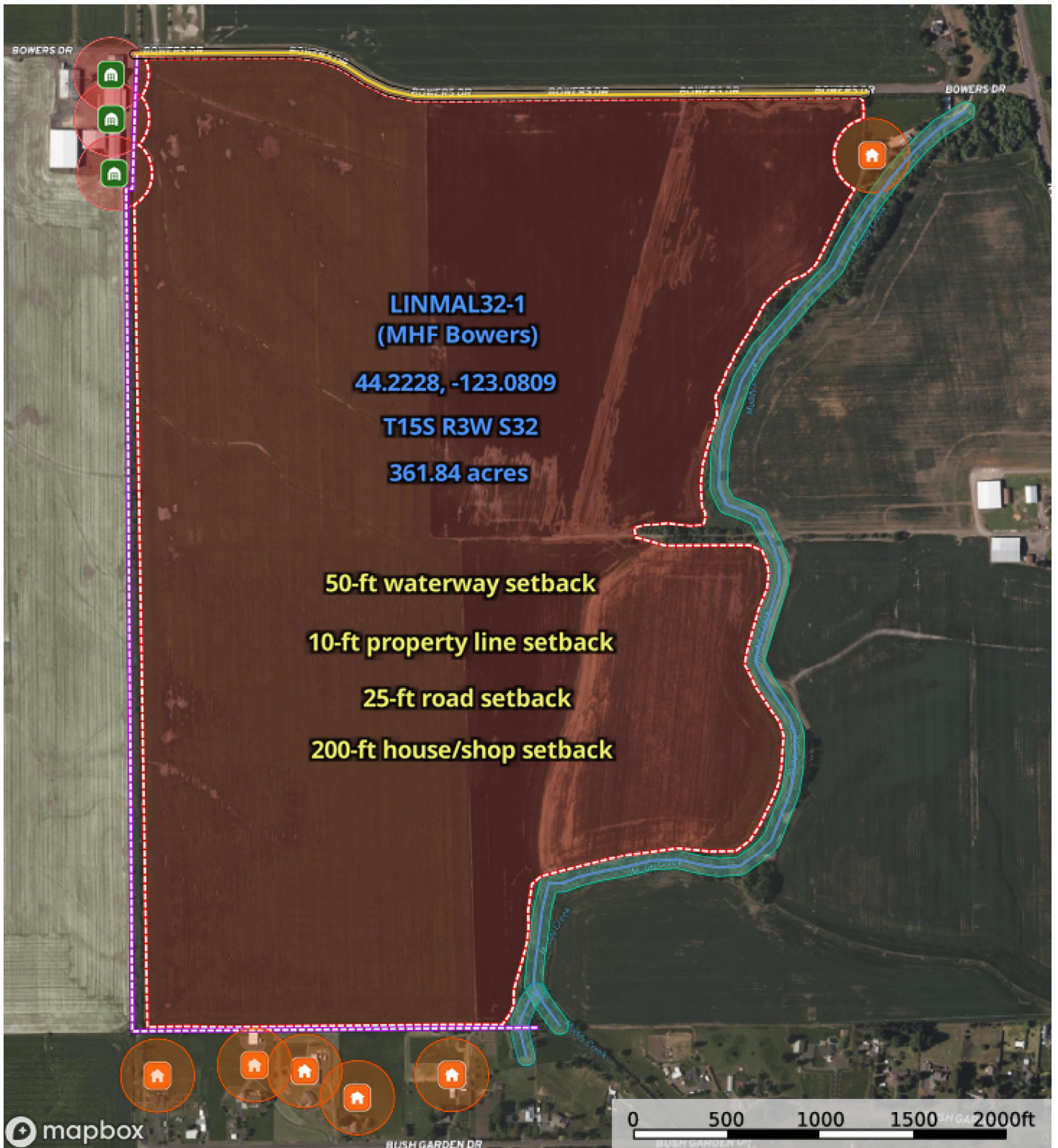


CITY OF MOLALLA

updated: 6/23/2026

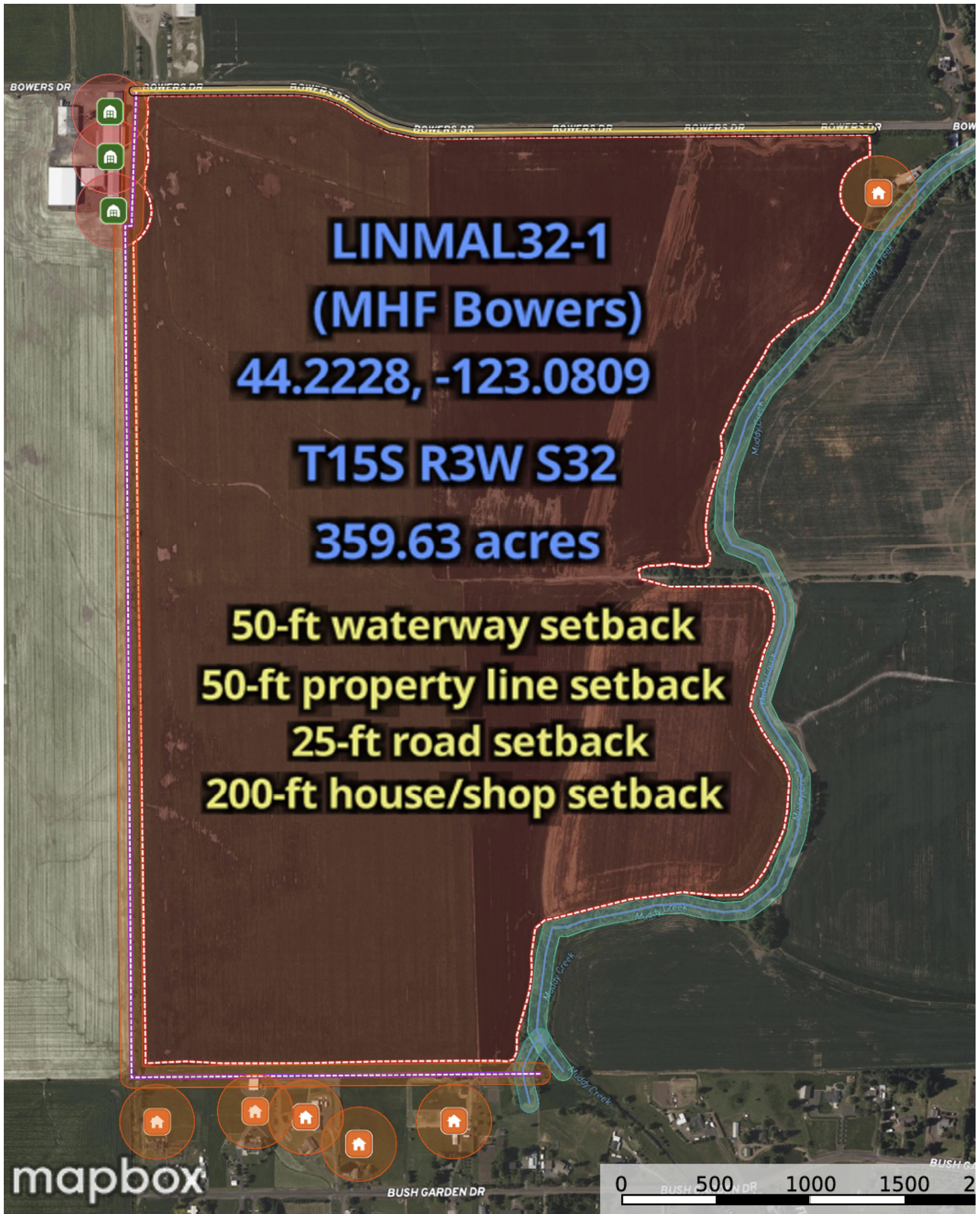
LINMAL32-1 (MHF Bowers)

Linn County, OR



City of Molalla

updated: 6/1/2026





United States
Department of
Agriculture

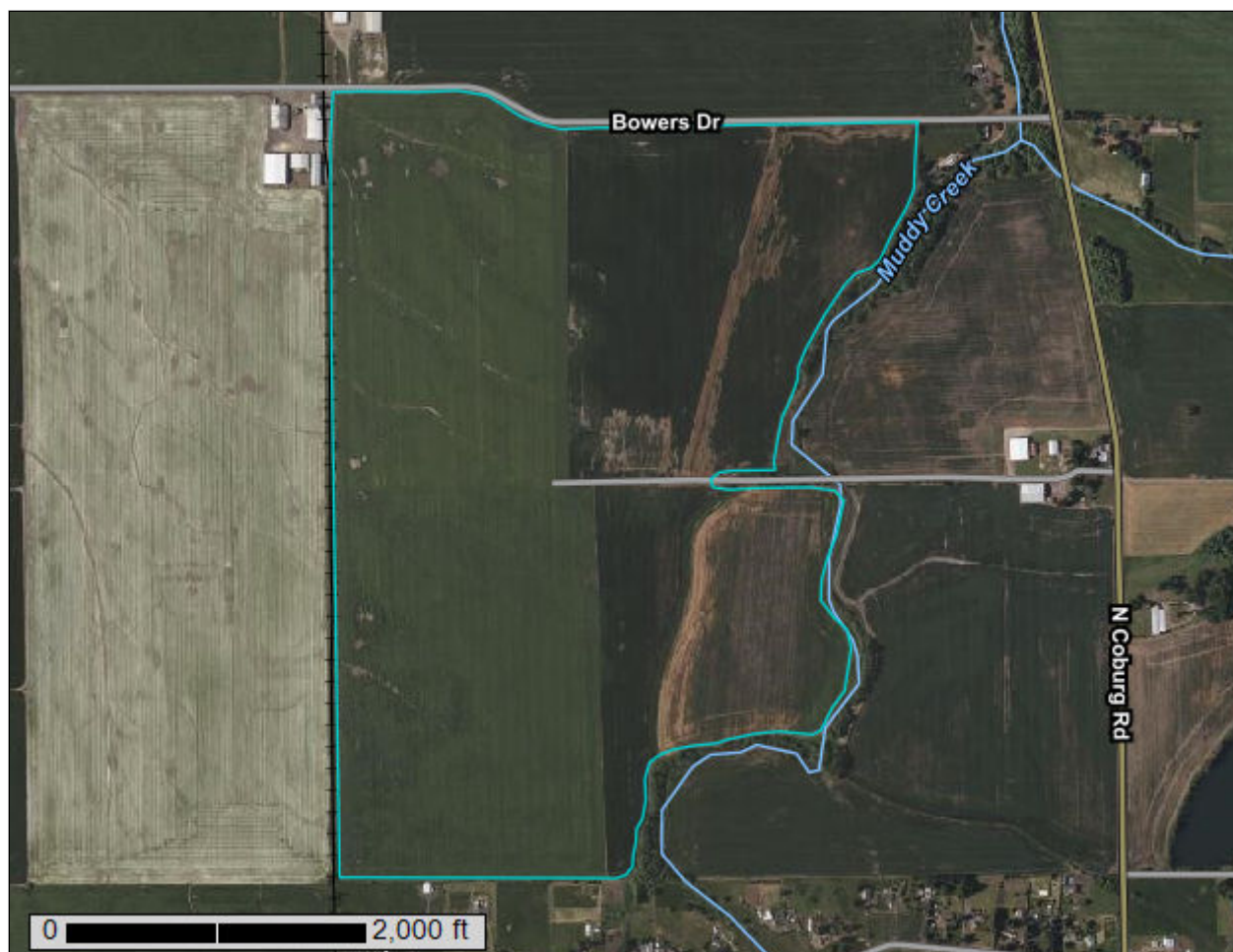
NRCS

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 **Linn County Area, Oregon**

LINMAL32-1 (MHF Bowers)



June 1, 2026

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

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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



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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 1:20,000.

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: Linn County Area, Oregon
Survey Area Data: Version 21, Sep 10, 2025

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

Date(s) aerial images were photographed: May 17, 2023—Jun 3, 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
8	Bashaw silty clay	13.5	3.7%
26	Coburg silty clay loam	114.2	31.3%
33	Dayton silt loam	187.5	51.3%
63	Malabon silty clay loam	38.0	10.4%
87	Salem gravelly silt loam	10.4	2.8%
2205A	Conser silty clay loam, 0 to 3 percent slopes	1.8	0.5%
Totals for Area of Interest		365.4	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.

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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.

Linn County Area, Oregon

8—Bashaw silty clay

Map Unit Setting

National map unit symbol: 24zp

Elevation: 170 to 800 feet

Mean annual precipitation: 40 to 60 inches

Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 165 to 210 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Bashaw and similar soils: 85 percent

Minor components: 11 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bashaw

Setting

Landform: Alluvial fans, Flood plains, Alluvial terraces

Landform position (three-dimensional): Tread

Down-slope shape: Concave, linear

Across-slope shape: Linear

Parent material: Clayey alluvium derived from mixed sources

Typical profile

H1 - 0 to 4 inches: silty clay

H2 - 4 to 60 inches: clay

H3 - 60 to 70 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: Frequent

Frequency of ponding: Frequent

Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 4w

Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: D

Ecological site: R002XC005OR - High Flood Plain Group

Forage suitability group: Poorly Drained (G002XY006OR)

Other vegetative classification: Poorly Drained (G002XY006OR)

Hydric soil rating: Yes

Minor Components

Awbrig

Percent of map unit: 5 percent

Landform: Low stream terraces

Custom Soil Resource Report

Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Conser

Percent of map unit: 3 percent
Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Courtney

Percent of map unit: 2 percent
Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 1 percent
Landform: Broad valley terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

26—Coburg silty clay loam

Map Unit Setting

National map unit symbol: 24wn
Elevation: 170 to 800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Coburg and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coburg

Setting

Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Silty and clayey alluvium derived from mixed sources

Typical profile

H1 - 0 to 17 inches: silty clay loam
H2 - 17 to 62 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: R002XC006OR - Stream Terrace Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Awbrig

Percent of map unit: 3 percent
Landform: Low stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Conser

Percent of map unit: 3 percent
Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Courtney

Percent of map unit: 2 percent
Landform: Low alluvial stream terraces

Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

33—Dayton silt loam

Map Unit Setting

National map unit symbol: 24x2
Elevation: 200 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Dayton and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dayton

Setting

Landform: Broad valley terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Silty and clayey alluvium and lacustrine deposits

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 15 inches: silt loam
H3 - 15 to 40 inches: silty clay
H4 - 40 to 76 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D

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Ecological site: R002XC007OR - Valley Swale Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Concord

Percent of map unit: 3 percent
Landform: Broad terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton, gravelly clay substratum

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: Yes

63—Malabon silty clay loam

Map Unit Setting

National map unit symbol: 24yv
Elevation: 200 to 600 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Malabon

Setting

Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Silty and clayey alluvium derived from mixed sources

Typical profile

H1 - 0 to 17 inches: silty clay loam
H2 - 17 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches

Custom Soil Resource Report

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 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: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 1

Land capability classification (nonirrigated): 1

Hydrologic Soil Group: C

Ecological site: R002XC006OR - Stream Terrace Group

Forage suitability group: Well drained < 15% Slopes (G002XY002OR)

Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

Hydric soil rating: No

87—Salem gravelly silt loam

Map Unit Setting

National map unit symbol: 2500

Elevation: 170 to 800 feet

Mean annual precipitation: 40 to 60 inches

Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 165 to 210 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Salem and similar soils: 85 percent

Minor components: 4 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salem

Setting

Landform: Low alluvial stream terraces

Landform position (three-dimensional): Tread

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Parent material: Gravelly alluvium derived from mixed sources

Typical profile

H1 - 0 to 9 inches: gravelly silt loam

H2 - 9 to 35 inches: gravelly clay loam

H3 - 35 to 60 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 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 (0.57 to 1.98 in/hr)

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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 5.6 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: R002XC006OR - Stream Terrace Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

Minor Components

Courtney

Percent of map unit: 4 percent
Landform: Low alluvial stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

2205A—Conser silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xpsk
Landscape: Willamette valleys
Elevation: 150 to 610 feet
Mean annual precipitation: 39 to 59 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Conser and similar soils: 86 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Conser

Setting

Landscape: Willamette valleys
Landform: Depressions on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Clayey alluvium

Custom Soil Resource Report

Typical profile

A - 0 to 9 inches: silty clay loam
BAg - 9 to 14 inches: silty clay
Btg1 - 14 to 27 inches: clay
Btg2 - 27 to 41 inches: silty clay
2Cg1 - 41 to 49 inches: loam
2Cg2 - 49 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.07 in/hr)
Depth to water table: About 0 to 9 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: R002XC005OR - High Flood Plain Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Awbrig

Percent of map unit: 4 percent
Landscape: Valleys
Landform: Terraces on depressions
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Courtney

Percent of map unit: 3 percent
Landscape: Willamette valleys
Landform: Drainageways on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

References

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Custom Soil Resource Report

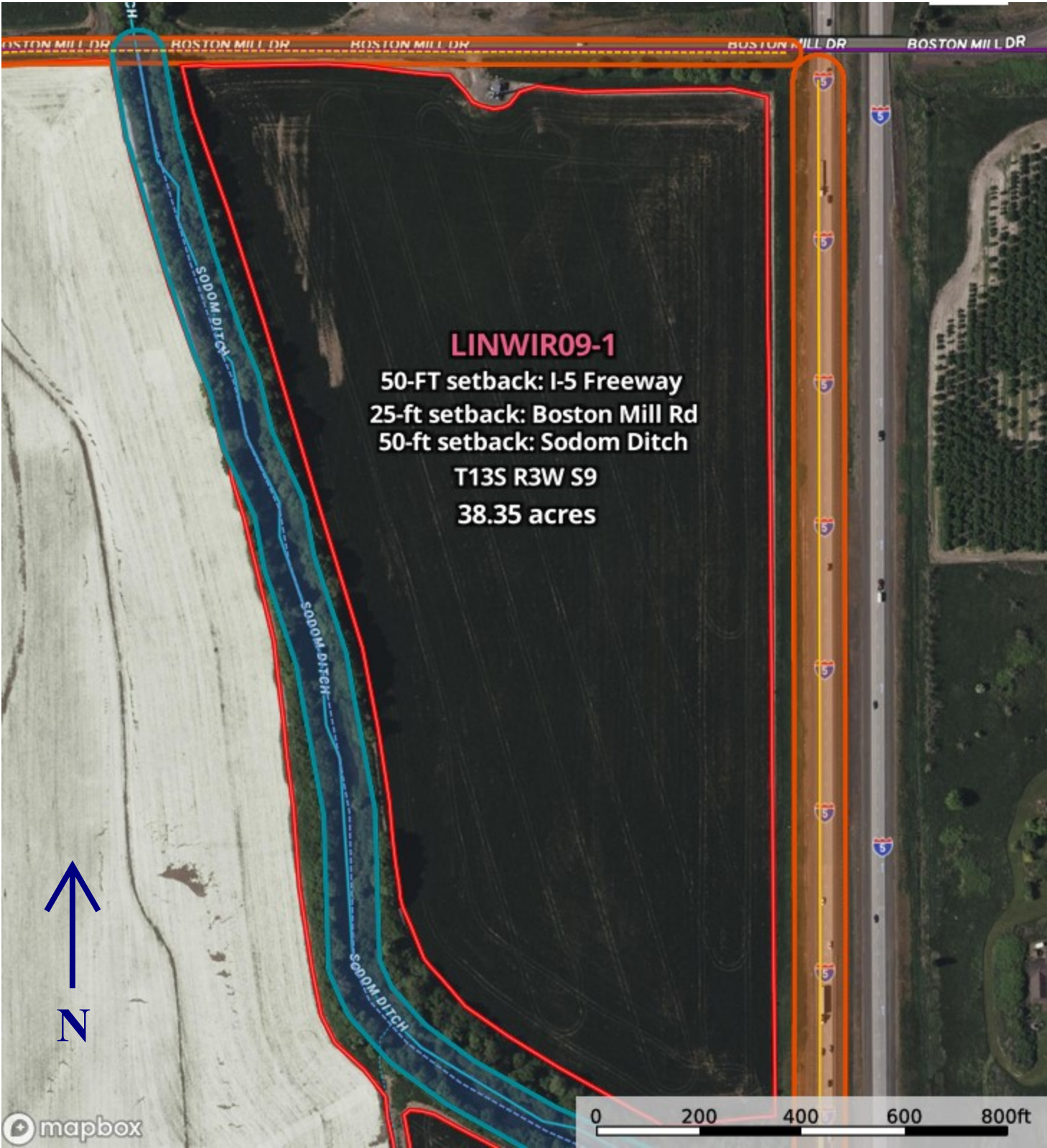
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LINWIR09-1



LINWIR09-2



LINWIR09-3



LINWIR09-4



PROPERTY ABUTTERS

Abutters were notified by US mail June 3, 2026.

PROPERTY DESCRIPTION

Tax

TAX LOT NUMBERS

LINMAL32-1:

West ½ of T15S R3W S32; 44.2228, -123.0809

Tax Lot Numbers: 100, 200

ABUTTER

ADDRESS

DESCRIPTION

TAX LOT NUMBERS

Roy A. Bowers & Sons, Inc	31950 Bowers Dr Harrisburg, OR 97446	T15S R3W S31	100
Donald Bowers	22009 Coburg Rd Harrisburg, OR 97446	T15S R3W S31	106
Owen	32215 Bush Garden Dr Harrisburg, OR 97446	T16S R3W S5	158
Dawn M. Marten	32225 Bush Garden Dr Harrisburg, OR 97446	T16S R3W S5	125
Madelyn Oconnell	32265 Bush Garden Dr Harrisburg, OR 97446	T16S R3W S5	133
Philip D. Prince	11710 Beals Butte St Crescent Lake, OR 97733	T16S R3W S5	135
Current Resident	32305 Bush Garden Dr Harrisburg, OR 97446	T16S R3W S5	135
Manuel	32323 Bush Garden Dr Harrisburg, OR 97446	T16S R3W S5	132
Shirley A. Henderson	32375 Bush Garden Dr Harrisburg, OR 97446	T16S R3W S5	124
Kirk D. Mombert	32415 Bush Garden Dr Harrisburg, OR 97446	T16S R3W S5	131
Lloyd C. Davis	32680 Bowers Dr Harrisburg, OR 97446	T15S R3W S32	101
Michael C. Dewall	32627 Bowers Dr Harrisburg, OR 97446	T15S R3W S29	400

Tax lots associated with this authorization, or with other permitted authorizations:

LINMAL32-1

T15S R3W S32

100, 200

MARGLA7-1

Marion County, OR



City of Molalla

updated: 6/1/2026

PROPERTY ABUTTERS

Abutters were notified by US mail May 29, 2026.

<u>PROPERTY DESCRIPTION</u>	<u>Tax</u>	<u>TAX LOT NUMBERS</u>
-----------------------------	------------	------------------------

Glaser field:

NE ¼ of S7, & part of the SE 1/4 of S6

Tax Lot Numbers: 100, 200

<u>ABUTTER</u>	<u>ADDRESS</u>	<u>DESCRIPTION</u>	<u>TAX LOT NUMBERS</u>
----------------	----------------	--------------------	------------------------

Oregon Valley Farms	15831 Greens Bridge RD SE Jefferson, OR 97352	T10S R2W S6	600
Larry D. McGinnis	PO Box 622 Jefferson, OR 97352	T10S R2W S7	100
Fam Loeks	16318 Emerald Green LN SE, Jefferson, OR 97352	T10S R2W S7	700
Robert B. Hill	16518 Emerald Green LN SE, Jefferson, OR 97352	T10S R2W S7	300
Lee S. Kim	16871 Greens Bridge Rd SE, Jefferson, OR 97352	T10 R2W S7	200
Allison B. Skeesick Trust	16541 Greens Bridge Rd SE, Jefferson, OR 97352	T10S R2W S7	100
Eric Allen Trefethen	16532 Greens Bridge Rd SE, Turner, OR 97392	T10S R2W S8	600
Leroy Chester Haven	4650 Haven Ln SE, Turner, OR 97392	T10S R2W S8	400
Milleson Taghon Trust	4520 Haven Ln SE, Turner, OR 97392	T10S R2W S5	402
Rose Barnes LLC	13694 Woodpecker Dr SE, Turner, OR 97392	T10S R2W S5	600

Tax lots associated with this authorization, or with other permitted authorizations:

Glaser Field	T102 R2W S6/S7	100, 200
--------------	----------------	----------

PROPERTY ABUTTERS

Abutters were notified by US mail May 29, 2026.

PROPERTY DESCRIPTION

Wirth fields:

West ½ of T13S R3W S9 and SE ¼ of T13S R3W S8

Tax Lot Numbers: 405

ABUTTER	ADDRESS	DESCRIPTION	TAX LOT NUMBERS
---------	---------	-------------	-----------------

Dennis Glaser	32381 SEVEN MILE LN, TANGENT, OR, 97389-9773	T13S R3W S4/5	200
Cody Nicole	29394 ROBERTS RD, SHEDD, OR, 97377-9741	T13S R3W S16	200
Martin Tod Elwood	29505 ROBERTS RD, SHEDD, OR, 97377-9741	T13S R3W S8/17	100

Tax lots associated with this authorization, or with other permitted authorizations:

Milton O. Kropf	T13S R3W S8/9	405
-----------------	---------------	-----

From: [RUBY Tim * DEQ](#)
To: [Seth Kelly](#)
Cc: [Jamie Olivarez](#)
Subject: RE: BMP Update - Glaser Site
Sent: 6/11/2026 2:40:24 PM

Thank you.

Tim Ruby
Natural Resource Specialist 3
DEQ Northwest Region Office – WPCF Permit Specialist
700 NE Multnomah Street, Suite 600
Portland, OR 97232
(503) 229-5292 (Office)
(971) 275-8447 (Cell)
Email: Tim.Ruby@deq.oregon.gov

From: Seth Kelly <skelly@cityofmolalla.com>
Sent: Thursday, June 11, 2026 2:23 PM
To: RUBY Tim * DEQ <Tim.RUBY@deq.oregon.gov>
Cc: Jamie Olivarez <jolivarez@synagro.com>
Subject: RE: BMP Update - Glaser Site

Hi Tim,

Here is this updated map.



Seth Kelly

Water Quality Superintendent

skelly@cityofmolalla.com

503-759-0241

From: Seth Kelly
Sent: Friday, May 22, 2026 8:29 AM
To: RUBY Tim * DEQ <Tim.RUBY@deq.oregon.gov>
Cc: 'Jamie Olivarez' <jolivarez@synagro.com>; R Quigley <rquigley@dyerpart.com>; J McElwain <jmcElwain@dyerpart.com>
Subject: BMP Update - Glaser Site

Here is the "Glaser Site" for review, Let Jamie or I know if there is any additional information you need.

Thank you,



Seth Kelly

Water Quality Superintendent

skelly@cityofmolalla.com

503-759-0241

From: [Seth Kelly](#)
To: ['RUBY Tim * DEQ'](#)
Cc: ['Jamie Olivarez'; 'R Quigley'; J McElwain;](#)
Subject: RE: BMP Update - Malpass
Attachments: [LINMAL32-1 and 2.pdf](#)
Sent: 6/25/2026 8:30:11 AM

Hello Tim,

We made an adjustment to the site map for Malpass. Due to property ownership this made it cleaner to separate the fields and make sure proper signature were on the owners agreements. application agreements with owners should be coming soon.

Thank you,



Seth Kelly

Water Quality Superintendent

skelly@cityofmolalla.com

503-759-0241

From: Seth Kelly
Sent: Monday, June 22, 2026 1:04 PM
To: 'RUBY Tim * DEQ' <Tim.RUBY@deq.oregon.gov>
Cc: 'Jamie Olivarez' <jolivarez@synagro.com>; 'R Quigley' <rquigley@dierpart.com>; J McElwain <jmcelwain@dierpart.com>
Subject: RE: BMP Update - Malpass

Hi Tim,

Attached are the executed site authorizations letters I have to this point. I am waiting on one more agreement that is hopefully coming this week for the Malpass application site.

I am wanting to verify you have all you need for site authorizations. Find list below to confirm you have all you need and let me know if I am missing anything.

I have sent you –

1. Updated Sampling Plan (approved)
2. Current site maps with setbacks
3. Tax Lot maps
4. Sent over soil reports
5. Abutter lists
6. Notifications have gone out
7. I have included you in all comments received
 - I know that you are waiting on sampling results for application rate.

I will send over the final copy of the Biosolids Management Plan for review and approval with all updates in the plan once I have all agreements. Then you can plug in your site authorization letters unless you have them ready to go before I submit and I can add them into the Plan file before I submit.

Best Regards,



Seth Kelly

Water Quality Superintendent

skelly@cityofmolalla.com

503-759-0241

From: Seth Kelly

Sent: Thursday, June 11, 2026 3:59 PM

To: 'RUBY Tim * DEQ' <Tim.RUBY@deg.oregon.gov>

Cc: 'Jamie Olivarez' <jolivarez@synagro.com>; 'R Quigley' <rquigley@dyerpart.com>; J McElwain <jmcElwain@dyerpart.com>

Subject: BMP Update - Malpass

Hi Tim,

Here is the Malpass site maps, soil report, and abutters list for the notices that went out.

Best Regards,



Seth Kelly

Water Quality Superintendent

skelly@cityofmolalla.com

503-759-0241

From: [PINNEY Mike * DEQ](#)
To: [Seth Kelly](#)
Cc: [Mitchell Jaspers](#); [R Quigley](#); [Dougherty, Ryan](#);
Subject: RE: Molalla GWMP
Sent: 6/10/2026 2:42:01 PM

Received. Thank you.



Michael Pinney PE
Senior Environmental Engineer
Northwest Region
Department of Environmental
Quality
700 NE Multnomah St. Ste.600
Portland OR 97232

503-229-5310
Cell 971-227-1765

From: Seth Kelly <skelly@cityofmolalla.com>
Sent: Wednesday, June 10, 2026 11:16 AM
To: PINNEY Mike * DEQ <Mike.PINNEY@deq.oregon.gov>
Cc: Mitchell Jaspers <mjaspers@cityofmolalla.com>; R Quigley <rquigley@dyerpart.com>; Dougherty, Ryan <rdougherty@summitwr.com>
Subject: Molalla GWMP

Hello Mr. Pinney,

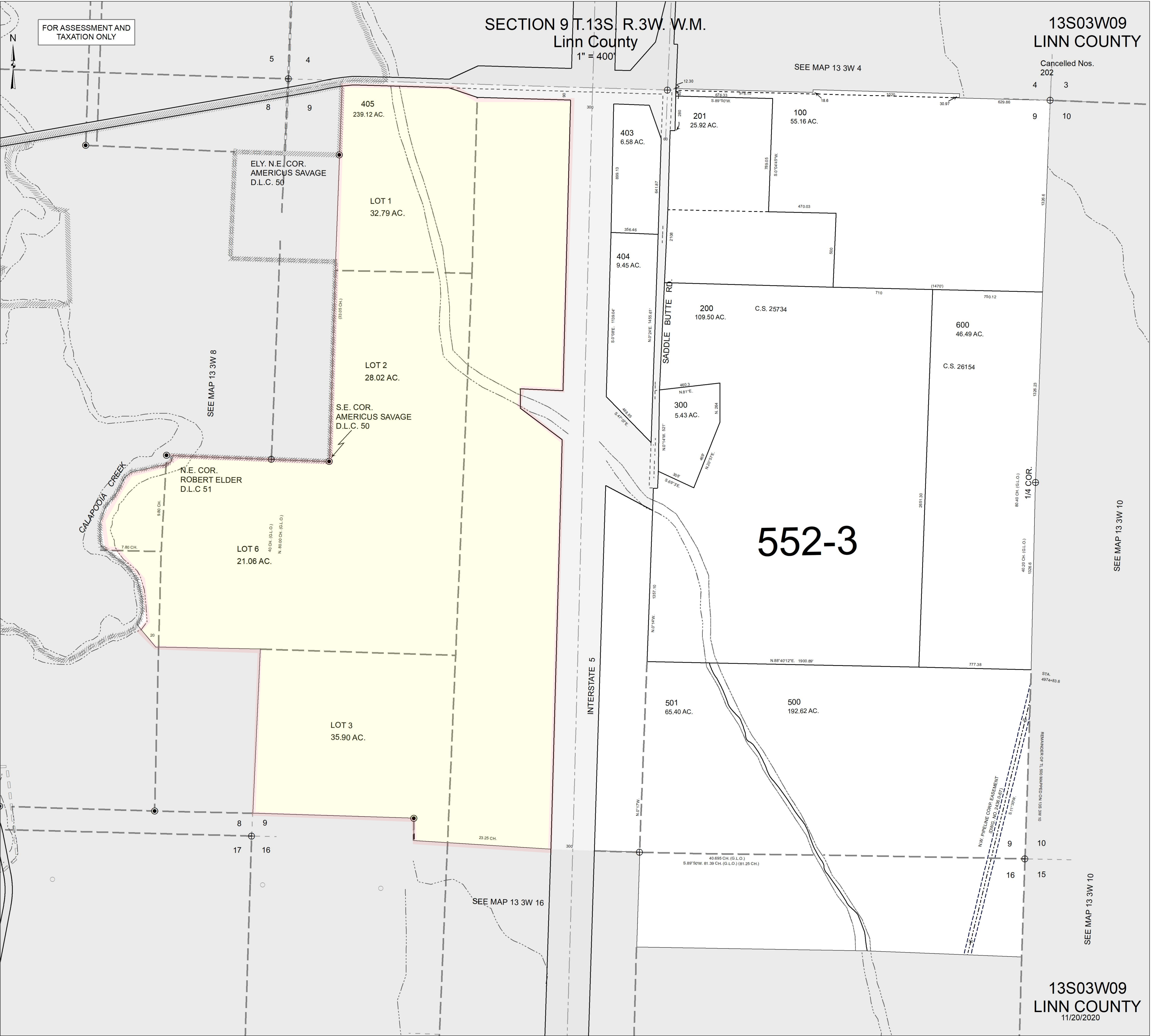
Attached is the City of Molalla's Groundwater Monitoring Plan (Word and PDF). This plan is submitted in compliance with the requirement in Table B1 and Schedule D, Section 17 of the new NPDES permit #101514, which went into effect on December 1, 2025.

If you could please provide me a receipt that you have received this email.

Respectfully,

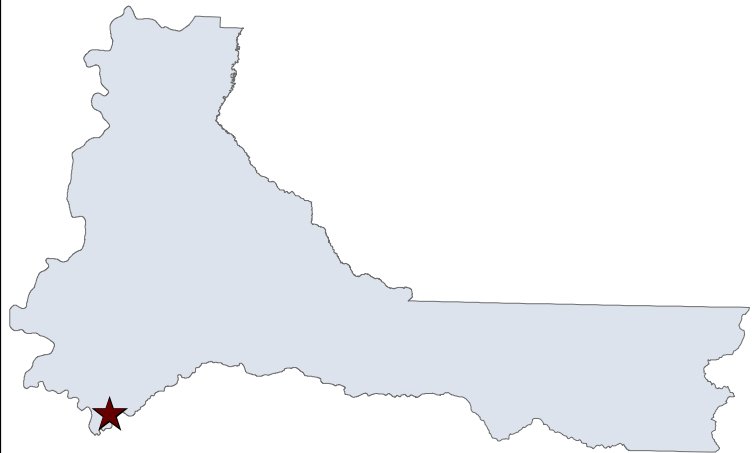


Seth Kelly
Water Quality Superintendent
skelly@cityofmolalla.com
503-759-0241



10 2W 07

10 2W 07



MARION COUNTY, OREGON
SEC 7 T10S R2W W.M.
SCALE 1" = 400'

LEGEND

LINE TYPES

- | | |
|--------------------------|-----------------------|
| Taxlot Boundary | Historical Boundary |
| Road Right-of-Way | Easement |
| Railroad Right-of-Way | Railroad Centerline |
| Private Road ROW | Taxcode Line |
| Subdivision/Plat Bndry | Map Boundary |
| Waterline - Taxlot Bndry | Waterline - Non Bndry |

CORNER TYPES

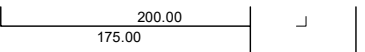
- | | |
|-----------------------|-------------------------------|
| + 1/16TH Section Cor. | 1/4 Section Cor. |
| ⊙ DLC Corner | 16 15
21 22 Section Corner |

NUMBERS

- Tax Code Number
00 00 0
- Acreage
0.25 AC
- All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW



CANCELLED NUMBERS

DISCLAIMER: THIS MAP WAS PREPARED
FOR ASSESSMENT PURPOSES ONLY



Assessors Office
Cartography Dept

FOR ADDITIONAL MAPS VISIT OUR WEBSITE AT
www.co.marion.or.us

PLOT DATE: 10/17/2020

10 2W 07

SEE MAP
103W01

1 6
12 7

NE COR
R. WOODFIN
DLC 64

100

GOV'T
LOT 11

GOV'T
LOT 4

SW COR
E.H. BELLINGER
DLC 57

NW COR
J. TERHUNE
DLC 56

07B

300

25.15 CH (1659.90)

SEE MAP
103W12

1/4 COR

49.85 CH (3292.14)

47.30 CH (3121.80)

07C

07CD

SE COR
R. WOODFIN
DLC 46

SW COR
J. TERHUNE
DLC 56

SEE MAP
102W18

SEE MAP
103W13AA

10 2W 07

SEE MAP
102W06

1/4 COR

200

14 53 0

CTR SEC

07D

LINN COUNTY

7 8
18 17

SEE MAP
102W05

GREENS BRIDGE RD

CR 933

ROAD

GREENS BRIDGE

1/4 COR 60

157'4" SOUTH OF
MOST SLY COR
E.H. BELLINGER
DLC 57

GREENS
BRIDGE
ROAD

GREENS
MEANDER LINE

NE COR
M. GUNSALVES
LAND CLAIM

SE COR
J. TERHUNE
DLC 56

44.4539, -123.0658

Wirth Fields

Linn County, OR



City of Molalla



Groundwater Monitoring Plan for NPDES Permit

City of Molalla



June 2026



PREPARED BY:

Summit Water Resources, LLC
a Geo-Logic Company

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Figure 2	Surficial Geology and Estimated Groundwater Flow
Figure 3	Existing Water Users
Figure 4	Monitoring Well Design



Tables

Table 1	Summary of Site Lithology
Table 2	Groundwater Level Measurements
Table 3	Monitoring Well Design
Table 4	Sampling Parameters, Analytical Methods, and Reporting Levels



Appendices

Appendix A	Existing WWTP Boring Logs and Well Logs
Appendix B	Existing Water Quality Information, Troutdale Aquifer
Appendix C	Example Field Forms



Acronyms

AL	action level
City	City of Molalla
DEQ	Oregon Department of Environmental Quality
ESA	endangered species act
MCL	maximum contaminant level
NPDES	National Pollution Discharge Elimination System
SMCL	secondary maximum contaminant level
Summit	Summit Water Resources, LLC
WWTP	wastewater treatment plant



SECTION 1. Introduction

1.1 Project Need and NPDES Permit Requirements

Summit Water Resources, LLC (Summit) has prepared this groundwater monitoring plan on behalf the City of Molalla (City) as required by the City's National Pollution Discharge Elimination System (NPDES) permit number 101514 to ensure the continued protection of local groundwater quality.

The City's NPDES permit includes the following requirements related to groundwater monitoring:

- The permittee must develop and submit to DEQ for review a groundwater monitoring plan by June 15, 2026.
- The groundwater monitoring plan must include the following:
 - Identification of three or more groundwater monitoring wells to be placed along the facility's property boundary. The monitoring wells must be placed at locations necessary to determine the direction of groundwater flow in the upper aquifer and to assess if the lagoons are causing an adverse impact on existing or potential beneficial uses of groundwater. The groundwater monitoring plan shall propose the design of monitoring wells and ensure that construction is performed in accordance with OAR 690-240.
 - Details regarding the monitoring well sampling program to be employed such as sampling methodology, monitoring frequency, parameters to be analyzed, data quality review, and reporting procedures. At a minimum, the permittee will be required to monitor the site for the parameters listed under Schedule B, Table B14 (Biosolids Monitoring) of the NPDES permit that can originate from the lagoon solids.
 - At a minimum, monitoring must be conducted quarterly for the duration of the permit term. Monitoring results must be reported to DEQ on a quarterly and annual basis.
- The groundwater monitoring plan must be implemented within 90 days of receiving approval from DEQ.

1.2 Report Organization

This report is organized as follows:

- [Section 1 - Introduction](#): This section provides an overview of the project need and objectives.
- [Section 2 – Site Overview and Existing Conditions](#): This section describes existing conditions associated with the site, local groundwater resources, and existing water users.
- [Section 3 – Groundwater Monitoring System Design](#): This section presents the design of the groundwater monitoring system for the site.
- [Section 4 – Sample Collection and Analysis](#): This section outlines sample collection and analysis procedures for the groundwater monitoring program.
- [Section 5 – Data Analysis and Reporting](#): This section outlines data analysis and reporting procedures for the groundwater monitoring program.



SECTION 2. Site Overview and Existing Conditions

2.1 Site Location and Operations

The existing Wastewater Treatment Plant (WWTP) utilizes two facultative lagoons, with depths of approximately 10-15 feet, for treatment and storage. The City's WWTP Upgrades project, currently under construction, includes the construction of a mechanical treatment system, utilizing Sequencing Batch Reactors (SBR), UV disinfection, tertiary filtration, and aerobic digestion with biosolids dewatering. The existing facultative lagoons will be converted into effluent storage ponds. Generally, from May 1st to October 31st, filtered and disinfected effluent from the SBR treatment system will be conveyed to the effluent storage ponds. Effluent from the Recycled Water Storage Pond No. 1 will be conveyed to the Effluent Pump Station as needed based on irrigation demands during the irrigation season. From November 1st to April 30th, disinfected effluent will be conveyed to Effluent Storage Pond No. 1 or directly to the Effluent Pump Station, prior to discharge to the Molalla River Mile 18.6.

2.2 Hydrogeologic Setting

The site is located at the margin of the Willamette Valley and Western Cascades geologic sub-provinces, which is characterized as a south-north trending structural trough containing basin fill sediments in the valley lowlands and volcanics and uplifted marine sedimentary rocks in the highlands (Coast Range and Cascades). To evaluate the hydrogeologic setting in the vicinity of the study area, Summit reviewed available geologic reports¹, geologic spatial data², and well logs.

The surficial geology of the site and surrounding area (Figure 2) is mapped as the Troutdale Formation (QTt) which generally consists of Pliocene age alluvial conglomerate, silt, sandstone, and volcanic breccia originating from the ancestral Columbia River. Review of local well logs suggests that the Troutdale Formation is estimated to have a thickness of 550-650 feet in the vicinity of the site.

To further characterize the subsurface at the site and aid in design of the City's new WWTP a geotechnical investigation was completed in 2023 by Foundation Engineering, Inc. which included the installation of eight geotechnical borings. Two of the geotechnical borings were converted to permanent monitoring wells meeting the construction standards of OAR 690-240 (see MW-2 and MW-3 on Figure 1). Descriptions of the subsurface lithology at the site are summarized below in Table 1 and boring logs and well logs are included in Appendix A.

Table 1. Summary of Site Lithology

Lithology	BH-1, BH-2	MW-2	MW-3	BH-6	Site Average
Topsoil (CL) or artificial fill (GM)	0-1	0-1	0-1	0-0.7	0-0.9
Silty clay w/ trace sand (CL / MH)	1-7.5	1-20	1-18.5	0.7-8.5	0.9-13.6
Dense clayey sand w/ some gravel (SC)	7.5-15	20-22.5	18.5-25	8.5-20	13.6-20.6
Dense silty gravel w/ some sand (GM / GC)	15-31.3	22.5-30.4	25-31.4	20-40.8	20.6-33.5

Notes:

Lithology intervals presented in feet below ground surface

¹ USGS, 1996, USGS, 1997, USGS, 2001, USG, 2005, DOGAMI, 1986

² DOGAMI, 2023



Several water level measurements were collected from MW-2 and MW-3 between October 2022 and April 2023 to assess whether vertical separation exists between the bottom of the WWTP lagoons and the water table of the Troutdale Formation. Resulting water level elevations are summarized in Table 2 below and estimated groundwater elevation contours and flow directions are presented on Figure 2. Overall, existing data suggests that vertical separation of approximately 2.5 to 7.5 feet exists between the bottom of the WWTP lagoons (average of 303.25 feet) and the water table of the Troutdale Formation depending on the time of year, however it's possible that perched groundwater conditions will develop during periods of sustained, heavy rainfall. Groundwater at the site occurs at the interface of the fine-grained soils and underlying gravels (beginning at ~20 feet below ground surface), is unconfined, and generally flows from the south to the north and then likely discharges to Bear Creek.

Table 2. Groundwater Level Measurements

Monitoring Well	Date	Depth to Water (feet bgs)	Water Level Elevation (feet)
MW-2 (CLAC-77518)	10/14/2022	25.5	298.5
	3/2/2023	26.9	297.1
	3/13/2023	27.5	296.5
	4/7/2023	25.9	298.1
	4/25/2023	25.4	298.6
MW-3 (CLAC-77517)	10/14/2022	24.7	293.3
	3/2/2023	22.3	295.2
	3/13/2023	22.8	295.7
	4/7/2023	20.3	297.7
	4/25/2023	21.2	296.8

2.3 Existing Water Quality Information

Groundwater quality data for the site is not available as samples have not been collected from the site's two existing monitoring wells. In lieu of site-specific data, Summit reviewed other publicly available information to characterize existing groundwater quality of the local Troutdale Formation including: sampling results for an existing domestic well (CLAC-66410) downgradient of the City's WWTP and the Oregon Health Authority's (OHA) Drinking Water Data Online. Findings are summarized below:

- [CLAC-66410](#): Located approximately 1,100 feet downgradient (northwest) of Lagoon 1 at 12381 Toliver Road (see Figure 3), this domestic well is completed in the Troutdale Formation with a total depth of 80 feet. Groundwater quality sampling of the well was completed in 2015 to investigate whether the City's WWTP was affecting the well's water quality. Laboratory reports are included in Appendix B which documented a low concentration of nitrate (1.11 milligrams per liter [mg/L]), and detection of total coliform with E. Coli being absent. Because these results suggested that the City's WWTP was not affecting the well further sampling and laboratory analyses were not completed.
- [OHA Drinking Water Data](#): Three public water systems with water supply wells completed in the Troutdale Formation are located in close proximity to the City's WWTP: Big Burger Drive-In (Inactive, ~415 feet upgradient of Lagoon 2), Blackmans 4-Way Grocery (Active, ~675 feet upgradient of Lagoon 2), and Titanic Ice Co (Active, ~1,875 feet crossgradient of Lagoon 1). Historical groundwater quality data associated with these three public water systems is included in Appendix B. Collectively, 51 samples between 2002-2025 have been collected for



analysis of nitrate with results indicating an average concentration of 1.5 mg/L and a maximum concentration of 2.8 mg/L. A total of 24 samples between 2023-2025 have been collected for total coliform with all results being absent.

Overall, available water quality data indicates that nitrate concentrations within the local Troutdale Formation are low (<3 mg/L), which suggests that the City's WWTP and/or nearby agricultural land uses have not adversely affected existing groundwater quality.



2.4 Existing Water Users

An overview of existing local groundwater uses and water rights in the vicinity of the site is presented on Figure 3 and summarized below:

- **Public Water Systems:** As discussed in Section 2.3, three public water systems with water supply wells completed in the Troutdale Formation are located in close proximity to the City's WWTP; two of these three public water systems are active (Blackmans 4-Way Grocery, Titanic Ice Co.). Groundwater quality data associated with these water systems is summarized in Section 2.3 above and included in Appendix B. Source area delineations (two year time of travel) developed by the Oregon Health Authority (OHA) for each water system are presented on Figure 3.
- **Domestic Drinking Water Wells:** In Oregon, domestic wells are exempt from needing to obtain a water right permit³. However, exempt use of groundwater carries the same weight as a water right, having a priority date and being subject to regulation by OWRD. In the vicinity of the site many properties outside of the City's urban growth boundary rely on water supply wells for domestic use. The majority of these wells are shallow and completed in the Willamette Aquifer which includes the Troutdale Formation. There are several domestic wells downgradient from the City's WWTP including: CLAC-10015 (~570 feet downgradient from Lagoon 1), CLAC-9999 (~680 feet downgradient from Lagoon 1), and CLAC-66410 (~1,100 feet downgradient from Lagoon 1).
- **Irrigated Agriculture:** Irrigated agriculture is the largest consumptive use of water in the Willamette Valley in terms of the quantity of water used and number of water rights (USGS, 2005). Similarly, in the vicinity of the City the majority of water rights are for irrigation or nursery use with a majority of water being obtained from the Willamette Aquifer (including Troutdale Formation). There is one existing groundwater right in the vicinity of the site (Certificate 75769, see Figure 3). The authorized point of appropriation associated with this water right (CLAC-10027) is located ~700 feet upgradient from Lagoon 2 and is completed in the Troutdale Formation with a total depth of 339 feet.
- **Fish and Aquatic Life:** Local wetlands and surface waters host a number of aquatic species that are listed as threatened or endangered including: Chinook salmon, Steelhead, Northern red-legged frog, and the Western pond turtle (Dyer, 2020). In response to aquatic ecosystems being unable to support the biologically based water quality criteria, the Oregon Department of Environmental Quality (DEQ) has designated the Molalla River, Rock Creek, and Teasel Creek as water quality limited for temperature, bacteria, and dissolved oxygen and placed these waterbodies on the 303(d) list. An updated Total Maximum Daily Load (TMDL) for temperature for the Molalla-Pudding Subbasin was approved by the EPA in 2024. An environmental assessment (EA) completed for the WWTP Upgrades project indicated that ESA listed fish and aquatic life species are not present in Bear Creek downgradient from the City's WWTP (PHS, 2024).

Overall, considering the existing water uses in the vicinity of the site, the highest designated beneficial use of groundwater from the Troutdale Formation is for drinking water. Design of the City's groundwater monitoring program should be informed by the context of these existing beneficial uses.

³ See ORS 537.545, domestic wells are considered exempt if use is <15,000 gallons per day and irrigation of lawn or noncommercial gardens is ≤0.5 acres



SECTION 3. Groundwater Monitoring System Design

3.1 Monitoring Objectives

Monitoring objectives for the WWTP's groundwater monitoring system include:

- Complying with the conditions of the City's NPDES permit related to groundwater monitoring.
- Collecting sufficient data to reliably characterize:
 - Groundwater elevations, flow directions, and flow rates within the uppermost aquifer (Troutdale Formation).
 - Background groundwater quality (upgradient from the WWTP lagoons and operations).
 - The performance of the WWTP lagoons and timely detection of potential interactions with existing groundwater quality beneath/downgradient of WWTP operations.
 - Groundwater quality downgradient of WWTP operations at the property boundary.

3.2 Monitoring Well Locations

The location of the City's groundwater monitoring system is presented on Figures 1 through 3 and includes two existing monitoring wells (MW-2 and MW-3) and two monitoring wells that have not yet been constructed (MW-1 and MW-4). The location and purpose of each monitoring well is described below.

- Background Monitoring Points: To collect data representative of background groundwater quality, one monitoring well (MW-1, to be constructed) will be located at the southern perimeter of the site (Figure 1) which is upgradient of the WWTP lagoons.
- Detection Monitoring Points: Two monitoring wells (MW-2 and MW-3, existing) will be utilized to collect data representative of the performance of the WWTP lagoons and enable the timely detection of potential interactions with existing groundwater quality beneath/immediately downgradient of WWTP operations. MW-2 is located at the northwest corner of Lagoon 2 (downgradient of Lagoon 2). MW-3 is located along the northern berm of Lagoon 1 (downgradient of both lagoons).

The City will continue to monitor groundwater levels at both MW-2 and MW-3. However, because the water quality data from these wells is redundant for the purposes of detection point monitoring, the City will only use MW-3 for groundwater quality sampling to optimize laboratory costs. Groundwater quality monitoring locations will be revisited with DEQ as necessary based on continual review and analysis of the program's groundwater quality data.

- Water Quality Compliance Points: To characterize groundwater quality downgradient of WWTP operations at the property boundary (and prior to discharge of groundwater to Bear Creek) one monitoring well (MW-4, to be constructed) will be located along the northern perimeter of tax lot 1201.



3.3 Monitoring Well Construction

Design and construction of new monitoring wells will comply with state well construction standards (OAR 690-240) and relevant DEQ guidance⁴. A summary of the design for new monitoring wells MW-1 and MW-4 is provided below in Table 3 and illustrated on Figure 4. Descriptions of drilling methods, formation sampling, well construction, and well testing procedures are outlined in the subsections below.

Table 3. Summary of Key Construction Features

Construction Feature	Description	Depth (feet bgs)
Security Casing	6-inch diameter low-carbon steel with locking cap and bollards (x3)	+3-3
Well Casing	2-inch diameter Schedule 80 PVC	+2.5-20
Well Screen	2-inch diameter Schedule 80 PVC, machine slotted (20-slot) with end cap	20-30
Surface Seal	Cement grout	0-3
Annular Seal	Sodium bentonite granules/chips	3-18
Filter Pack Seal	Fine sand (<20 sieve)	16-18
Filter Pack	Silica sand (20/40 gradation)	18-30

Notes:

bgs = below ground surface

3.3.1 Monitoring Well Drilling

Drilling methods shall be proposed by the Contractor for approval by the City's Representative and are anticipated to include auger, direct or reverse circulation rotary, or percussion. All materials used in the drilling process shall be NSF 60/61 compliant and must be approved by the City's Representative. Drilling equipment (including temporary casing, as necessary based on the Contractor's proposed drilling method) must be decontaminated prior to use at the site and between boreholes.

The Contractor shall furnish containers for collecting and storing formation samples during drilling. Formation sampling methods will be based on the Contractor's proposed drilling method and must be approved by the City's Representative. The Contractor shall collect samples from the formation being drilled at an interval of 2 feet or less. The Contractor shall account for return time of the cuttings when collecting a sample from each depth interval to ensure that the sample is representative of the formation encountered from the depth interval. The Contractor shall mark each sample container with the well name, depth interval the sample was collected from, and the date the sample was taken using waterproof ink.

3.3.2 Monitoring Well Construction

The anticipated sequence of well construction activities is outlined below:

- **Casing / Screen:** After reaching the total depth of the borehole, the Contractor shall fabricate and install the casing and well screen in accordance with the manufacturer's recommendations and according to the anticipated design depths presented on Figure 4, or

⁴ DEQ, 1992: Groundwater Monitoring Well Drilling, Construction, and Decommissioning



as directed by the City's Representative based on encountered subsurface conditions. PVC shall conform to the latest edition of ASTM F-480 and steel casing shall conform to the latest edition of ASTM A-53. The Contractor shall provide at least one screen centralizers to ensure that the well's plumbness and alignment is sufficient. The top of the well casing shall be equipped with a J-Plug and the bottom of the well screen shall be equipped with an end cap.

- **Filter Pack:** Following fabrication and installation of the casing and well screen the Contractor shall install the filter pack. Filter pack material shall consist of clean silica sand conforming to AWWA A100-20 for specific gravity, uniformity, absence of deleterious substances, and non-rounded fragments. The Contractor shall provide a measuring device to determine the filter pack level in the borehole during filter pack installation and well development to detect bridging and/or settlement. The Contractor shall install the filter pack envelope with a tremie pipe and shall maintain/replenish the filter pack envelope at all times to ensure the well screen is not directly exposed to the formation. As the filter pack is installed, the Contractor shall swab the well screen until there is no measurable settlement of the filter pack envelope. If temporary casing is used, The Contractor shall not install more than a 5-foot section of filter pack without pulling up the temporary casing. As the filter pack is installed, the Contractor shall disinfect the filter pack material with a solution of at least 50 mg/L of available chlorine.
- **Annular/ Surface Seal:** After placement of the filter pack envelope the Contractor shall install the well seal which includes an annular seal (bentonite) and a surface seal (cement grout). Installation of the bentonite seal shall conform to OAR 690-210-0330. Placement of unhydrated bentonite shall conform to the manufacturer's specifications and result in a seal that is free of voids or bridges. The Contractor shall record the volume of unhydrated bentonite used and the rate of placement (bags per minute). Following placement of the unhydrated bentonite, the Contractor shall hydrate the bentonite with potable water until the bentonite seal is fully hydrated, or at least one annular volume has been placed. In dry sealing intervals, bentonite shall be hydrated in two foot lifts to ensure activation.

Installation of cement grout shall conform to OAR 690-210-0310. The Contractor shall record the proportions of cement and water used in mixing each batch of cement grout, including a record of the cement type/manufacturer and bag weight. No work will be done on the well for a minimum of 24 hours following placing of the cement grout seal.

- **Well Development:** After allowing the well seal to cure, the Contractor shall perform well development. Well development methods shall be proposed by Contractor for approval by the City's Representative but may include surging, bailing, pumping, and/or jetting. The Contractor shall perform well development activities until at least ten casing volumes have been purged from the well and the well's water quality and fines content is no longer improving, in the opinion of the City's Representative.
- **Wellhead Completion:** Following the completion of well testing the Contractor shall equip the security casing with a locking cap and well tag and then install three (3) steel bollards in a triangular array around the wellhead. The steel bollards shall have a diameter of 3-inches and be set in cement grout to a depth of three feet. The location and elevation of the top of casing and ground surface shall be surveyed with a horizontal accuracy of 0.5 feet and a vertical accuracy of 0.01 foot. Surveying shall be performed by a professional land surveyor (PLS) in Oregon.



3.3.3 Monitoring Well Testing

Following the completion of well development and after allowing the well's static water level to recover to within 95% of pre-development levels, the Contractor shall perform well testing. Well testing methods shall be proposed by the Contractor for approval by the City's Representative but include three (3) rising or falling head slug tests. Rising/falling head slug tests shall be performed in accordance with USGS GWPD 17 "Conducting and Instantaneous Change in Head (Slug) Test with a Mechanical Slug and Submersible Pressure Transducer." Only potable water shall be used for slug testing. Throughout slug testing the Contractor shall measure and record the water level at intervals of one minute using an electronic water level meter. The time and date when each measurement is made shall also be recorded. Slug testing data will be used to calculate an estimated hydraulic conductivity.



SECTION 4. Sample Collection and Analysis

4.1 Sampling Parameters, Analytical Methods, and Reporting Levels

Table 4 below outlines sampling parameters, analytical methods, and reporting levels for the City's groundwater monitoring program for the WWTP. The sampling parameters include the minimum parameters required by the City's NPDES permit (Table B14, Biosolids Monitoring).

Table 4. Sampling Parameters, Analytical Methods, and Reporting Levels

Parameter	Measurement / Analytical Method	Reporting Limit	Units	Hold Time
Conductivity	Multiparameter field meter	-	µS/cm	
Dissolved Oxygen (DO)	Multiparameter field meter	-	mg/L	
pH	Multiparameter field meter	-	-	
Oxygen-Reduction Potential (ORP)	Multiparameter field meter	-	mV	
Temperature	Multiparameter field meter	-	°Celsius	
Arsenic	EPA 200.8	0.00100	mg/L	180 days
Cadmium	EPA 200.8	0.000500	mg/L	180 days
Copper	EPA 200.8	0.00100	mg/L	180 days
Lead	EPA 200.8	0.000500	mg/L	180 days
Mercury	EPA 200.8	0.000200	mg/L	28 days
Molybdenum	EPA 200.8	0.00200	mg/L	180 days
Nickel	EPA 200.8	0.00500	mg/L	180 days
Potassium (K)	EPA 200.7	0.200	mg/L	180 days
Selenium	EPA 200.8	0.00200	mg/L	180 days
Zinc	EPA 200.8	0.00500	mg/L	180 days
Nitrate-Nitrogen (NO ₃ -N)	EPA 353.2	0.100	mg/L	28 days
Total Ammonia-Nitrogen (NH ₃ -N)	EPA 350.1	0.0300	mg/L	28 days
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.100	mg/L	28 days
Total Phosphorus (P)	EPA 365.1	0.02000	mg/L	28 days
Total Solids	EPA 160.3	42.0	mg/L	7 days
Volatile Solids	EPA 160.4	42.0	mg/L	7 days

Notes:

Laboratory analysis for metals will include quantification of total and dissolved metal concentrations.

mg/L = milligrams per liter

mV = millivolt

µS/cm = microsiemens per centimeter

4.2 Sampling Frequency and Duration

Sampling will be performed quarterly at the monitoring wells (MW-1, MW-3, MW-4) for the duration of this permit cycle City's NPDES permit to obtain groundwater quality data for each location type (background, detection, and compliance). The specific timing of quarterly sampling events will be based on considerations of staff availability, laboratory shipping/hold times, and laboratory turnaround times. Modifications to sampling locations and sampling frequency will be revisited with DEQ during the next permit renewal cycle.



4.3 Sample Collection Methods

Monitoring wells will have water levels measured, be purged to field parameter stabilization and then sampled via bladder pump (or equivalent) using low-flow groundwater techniques following EPA methodology laid out in Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (EPA, 1996).

4.3.1 Field Recording and Documentation

Actions and observations during sampling procedures will be recorded in daily logs and well-purging data will be recorded in groundwater field logs; example field forms have been prepared for use during sampling events (see Appendix C). Forms and daily logs will be stored in digital and physical copies.

4.3.2 Equipment List

- Multi-parameter sonde
- Bladder pump (or equivalent)
- Controller box for pump
- Bonded poly tubing
- Electric tape

4.3.3 Equipment Decontamination Procedures

To minimize contamination and sample bias, equipment will be cleaned appropriately between monitoring wells. Any equipment not dedicated to a singular well (bladder pump, electric tape, etc.) should be decontaminated using the method prescribed in USGS National Field Manual for the Collection of Water-Quality Data Chapter A3: Cleaning of Equipment for Water Sampling (USGS, 2004):

1. Wipe with a clean paper towel.
2. Spray and scrub all components with distilled water.
3. Spray and scrub all components with lab-grade detergent, such as Liquinox (do not use Alconox as it contains phosphates).
4. Rinse all components with distilled water.
5. Dry all components with a clean, soft cloth.

All equipment should be decontaminated at the end of the field event.

4.3.4 Sampling Procedures

Field personnel will measure water levels within monitoring wells using an electric tape prior to purging and sampling procedures. Water levels should be measured to a tenth of a foot. Low-flow groundwater techniques shall be utilized as outlined in EPA Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (EPA, 1996). The goal is to have <0.1 drawdown in the well while purging in order to minimize agitation to the water column. The pump shall be positioned at the midpoint of each screen. Each well shall be purged of three volumes of water (determined by length of water column and diameter of well) or until field parameters stabilize (temperature, conductivity, pH, dissolved oxygen, redox potential (ORP), and turbidity). Field parameters and water levels should be recorded every time a volume of water passes through the flow-through cell of the sonde. Stabilization criteria for each field parameter will be three consecutive readings within:



- Temperature: ± 0.3 °C
- Conductivity: $\pm 3\%$
- pH: ± 0.1
- DO: $\pm 10\%$
- ORP: ± 10 mV
- Turbidity: $\pm 10\%$ or under 10 NTU

Only after stabilization occurs will sampling be conducted.

4.3.5 Sample Measurement and Collection

Upon stabilization, tubing will be disconnected from the flow-through cell and trimmed to avoid contamination. Field personnel shall wear appropriate PPE when handling samples and sample preservatives. Nitrile gloves shall be changed between different preservative types to avoid cross-contamination. Samples will be labeled with lab-specific labels prior to sampling. Samples shall be collected in containers provided the laboratory and preserved by the lab. Personnel will be careful not to splash water or spill preservatives when depositing samples into containers.

4.4 Sample Handling and Chain of Custody

Possession and transport of groundwater samples shall be traceable from sample collection in the field to the laboratory. Personnel will document when the sample was collected in the field forms, on sample labels and on the laboratory supplied chain of custody (COC) form. Field personnel will keep a digital copy of the COC and the hard copy will be transported in a watertight container to the laboratory in the same container as the samples.

4.5 Quality Assurance and Quality Control Plan

Samples will not be transferred between sample containers to avoid cross-contamination. Once samples are sealed in the field, they will not be reopened until they arrive at the lab for analysis. Groundwater samples sent to the laboratory will be placed within a watertight container in a cooler containing ice packs to maintain the maximum temperature set forth by the lab. The sample cooler will be transported or shipped to the receiving laboratory on the same day.

4.5.1 Duplicate Samples

Duplicate samples are collected as independent samples using the same sampling procedures from the same location (e.g. separate grab samples from the same monitoring well). When measuring a water quality duplicate, each measurement is repeated on the duplicate sample, and a duplicate is sent in to the laboratory for each analysis. Staff should collect one set of duplicate samples for each sampling event. For example, for the City's groundwater monitoring system consisting of three monitoring wells, one set of duplicate samples should be collected from one of the three monitoring wells. The duplicate sample location should be rotated between sampling events. Duplicate samples will be collected via the same methods described in Section 4.3. If results of the duplicate sample do not agree with those of the primary sample, reanalyze the duplicate (and/or primary) sample to confirm or deny the disagreement in results. Note the re-measurement(s) on the field data sheet; do not cross out the original results (DEQ, 2009). The variability in the results obtained from duplicate samples is a sum of the sampling and analytical variability and variability inherent in the sample (we assume representativeness, but samples have proven to be heterogeneous). This variability is the most meaningful measure of uncertainty in the individual samples obtained.



4.5.2 Equipment Inspection and Calibration

Field instrumentation and equipment will be inspected and maintained according to manufacturer's recommendations. Laboratory equipment inspection and maintenance is the responsibility of the laboratory and outlined in the contract laboratory's Quality Manual.

All field instrument calibrations are performed in accordance with the manufacturer's recommendations. All field meters are calibrated prior to use in the field. Laboratory instrument calibrations are outlined in the contract laboratory's quality manual.

4.5.3 Sample Labels

Sample labels will contain the following information:

- Sample site number and sample ID (ex. MW-XX_YYYYMMDD)
- Date and time of collection
- Laboratory analysis required
- Initials of sample collector which shall match the COC

4.5.4 Laboratory QA Program

Samples collected during the pilot testing program will be analyzed by an analytical laboratory certified by the Oregon Environmental Laboratory Accreditation Program (ORELAP).

The analytical laboratory will use trip blanks, method blanks, spikes, duplicates, surrogates, and control samples in each analytical batch containing the City's samples being analyzed, or at a frequency of at least one in every 20 samples, depending on the analysis being performed. The results from these procedures will accompany the sample test results. A copy of the analytical laboratory's QA manual is available upon request.

4.5.5 Data Management

High-quality data management is as important to a project as is high quality sampling and analysis. Improperly handled data can result in misreporting or omission of data, ultimately leading to misinformed water quality management decisions. Data management includes time spent collecting and recording sample project and sample event metadata, entering field and laboratory data into the water quality database, verifying data, performing QA/QC checks on data, and transferring data between various databases. Spending the time and resources necessary to assure high-quality data management will maintain the integrity and total quality management of data collected (DEQ, 2009). Groundwater sampling data will be kept in the City's water quality database. The administration of this database is the responsibility of the City's Water Quality Superintendent or designee. Electronic copies of laboratory reports are stored in the City's water quality database. Laboratory data is transcribed and transferred into the water quality database. Field data recorded on field data sheets are also transcribed into the water quality database by the Water Quality Superintendent or designee.

4.5.6 Data Review and Validation

Sample events are entered into the City's water quality database when laboratory results are available from the laboratory. Field data and laboratory results are reviewed by the City's Water Quality Superintendent for errors and omissions as well as data that may indicate outliers. Errors and omissions are noted in the water quality database. Laboratory QC data is included with laboratory reports and QC flags are noted in the water quality database.



SECTION 5. Data Analysis and Reporting Procedures

5.1 Comparison of Groundwater Quality Results to Applicable Standards / Criteria

As outlined in OAR 340-040-0030(3), in the absence of permit specified maximum contaminant concentrations allowed at the compliance point or approved concentration limit variances, concentration limits at existing facilities are to be established on a case-by-case basis. The concentration limit at existing facilities may be established at any level between background water quality levels and the numerical groundwater quality reference levels identified in Tables 1 through 3 of OAR 340-040.

The City's NPDES permit does not include specific maximum contaminant concentrations for groundwater. Considering the highest existing beneficial use of groundwater from the aquifer (drinking water) this groundwater monitoring plan will initially utilize drinking water maximum contaminant levels (MCLs) and action levels (ALs). Drinking water criteria associated with the groundwater monitoring program's sampling parameters (Section 4.1) are summarized below on Table 5.

Table 5. Sampling Parameters and Drinking Water Regulatory Criteria

Parameter	Regulatory Criteria	Regulatory Standard	Units
Arsenic	MCL	0.010	mg/L
Cadmium	MCL	0.005	mg/L
Copper	SMCL	1.3	mg/L
Lead	AL	0.015	mg/L
Mercury	MCL	0.002	mg/L
Molybdenum	None	-	-
Nickel	None	-	-
Potassium (K)	None	-	-
Selenium	MCL	0.05	mg/L
Zinc	SMCL	5	mg/L
Nitrate-Nitrogen (NO ₃ -N)	MCL	10	mg/L
Total Ammonia-Nitrogen (NH ₃ -N)	None	-	-
Total Kjeldahl Nitrogen (TKN)	None	-	-
Total Phosphorus (P)	None	-	-
Total Solids	None	-	-
Volatile Solids	None	-	-

Notes:

Laboratory analysis for metals will include quantification of total and dissolved metal concentrations.

AL = action level mg/L = milligrams per liter MCL = maximum contaminant level SMCL = secondary maximum contaminant level



5.2 Analysis Methods and Frequency

Initial data analysis for annual reporting will include the following standard/required data methods:

- Tables and maps of groundwater elevation contours and flow directions. Maps will be produced for each quarter of data.
- Tables and time series plots of groundwater quality data with a comparison to applicable regulatory criteria. Trendlines will be used to identify preliminary data patterns, directions, and rates of change.

5.3 Reporting

Quarterly Reporting

Tabulated groundwater monitoring data and copies of field forms and laboratory reports will be reported to DEQ on a quarterly basis. As required by OAR 340-040-0030(5), if quarterly monitoring indicates a significant increase in the concentration of a monitoring parameter, the City shall immediately resample. If resampling confirms the change in water quality the City shall report the results to DEQ within 10 days of receipt of laboratory data and then submit a plan for preliminary assessment within 30 days (unless a different schedule is approved by DEQ).

Annual Reporting

Annual reports will be submitted to DEQ by January 31st of each year with a summary of the following information:

- Review of significant events or WWTP operations.
- Tables and maps of groundwater elevation contours and flow directions.
- Tables and time series plots of groundwater quality data with a comparison to applicable regulatory criteria.
- Data quality review.

The frequency of reporting will be based on the program's sampling frequency (Section 4.2) which will be revisited with DEQ during the next permit renewal cycle.



SECTION 6. References

- Burton & Pitt, 2002 Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists and Engineers. August 2001.
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Figures

Figure 1	WWTP Site Overview
Figure 2	Surficial Geology and Estimated Groundwater Flow
Figure 3	Existing Groundwater Users
Figure 4	Monitoring Well Design





LEGEND

- City of Molalla**
- Urban Growth Boundary (2019)
 - Water Mains
 - Stormwater System
 - Sanitary Manholes
 - Storm Manholes
 - Storm Catch Basins
- Wastewater Treatment Plant (WWTP)**
- Geotechnical Hole
 - Existing Monitoring Well
 - Proposed Monitoring Well
 - WWTP Parcels

USGS

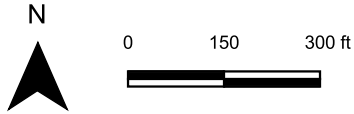
- Ground Surface Elevation (3DEP Lidar)**
- 5 ft
 - 1 ft
- Watercourse**
- Perennial

Transportation

- Highways
- Roads

PLSS

- Sections
- Quarter Quarters

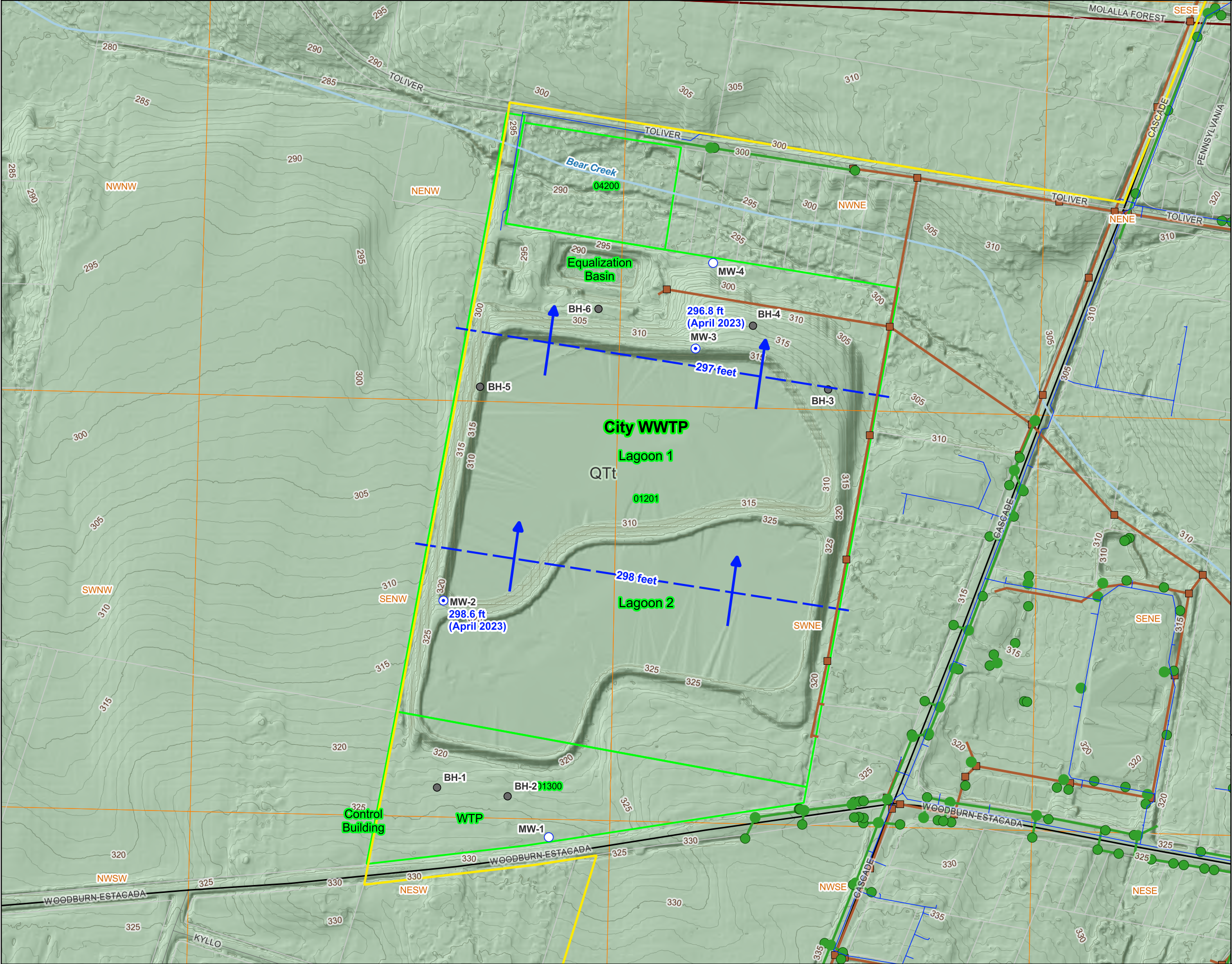


Data Sources: Clackamas County, OWRD, USGS, BLM, ODOT
Date: 4/21/2026

Figure 1
WWTP Site Overview

City of Molalla





LEGEND

City of Molalla

- Urban Growth Boundary (2019)
- Water Mains
- Stormwater System
- Sanitary System
- Sanitary Manholes
- Storm Manholes
- Storm Catch Basins

Wastewater Treatment Plant (WWTP)

- Geotechnical Hole
- Existing Monitoring Well
- Proposed Monitoring Well
- WWTP Parcels
- Estimated Groundwater Elevation (4/2023)

USGS

- Ground Surface Elevation (3DEP Lidar)
- 5 ft
- 1 ft

Watercourse

- Perennial

Transportation

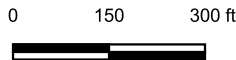
- Highways
- Railroads
- Roads

DOGAMI

- Geologic Formations
- Troutdale Formation (QTt)

PLSS

- Sections
- Quarter Quarters

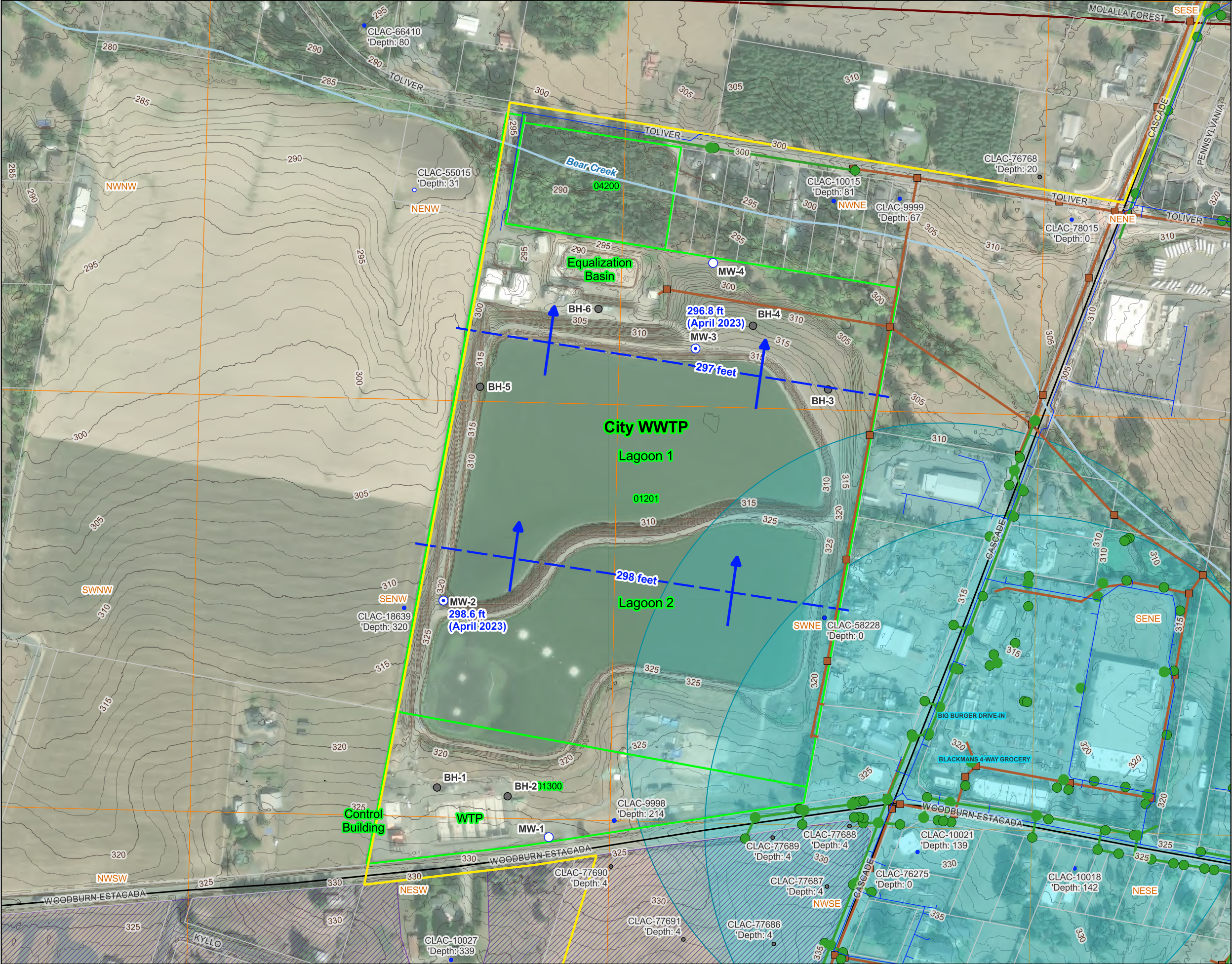


Data Sources: Clackamas County, OWRD, USGS, BLM, ODOT
Date: 4/21/2026

Figure 2
Surficial Geology and
Estimated Groundwater Flow

City of Molalla





LEGEND

City of Molalla

- Urban Growth Boundary (2019)
- Water Mains
- Stormwater System
- Sanitary System
- Sanitary Manholes
- Storm Manholes
- Storm Catch Basins

Wastewater Treatment Plant (WWTP)

- Geotechnical Hole
- Existing Monitoring Well
- Proposed Monitoring Well
- WWTP Parcels
- Estimated Groundwater Elevation (4/2023)

USGS

- Watercourse
- Perennial

Transportation

- Highways
- Railroads
- Roads

OWRD

OWRD Located Well Logs*

- Geotechnical Hole
- Monitoring Well
- Water Well

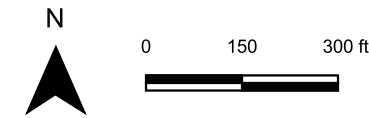
Water Right Place of Use (POU)

- Groundwater Right

OHA

- Drinking Water Source Area (Groundwater, 2 Year Capture Zone)

Notes:
* Some well logs have limited location accuracy and are subsequently mapped by OWRD to the center of a Section or Quarter Quarter (ex. CLAC-9991 and others within WWTP tax lots).

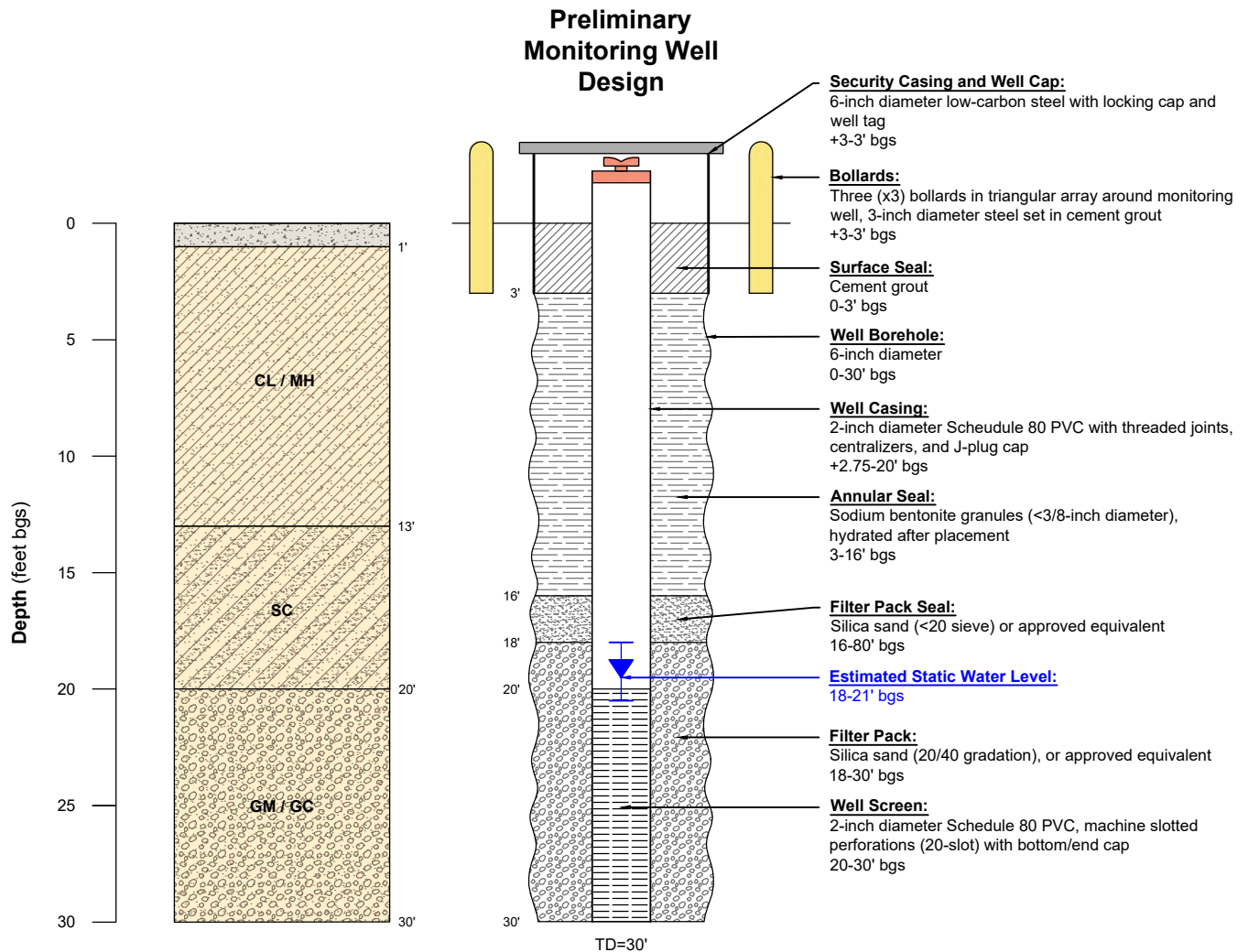


Data Sources: Clackamas County, OWRD, USGS, BLM, ODOT
Date: 4/21/2026

Figure 3
Existing Groundwater Users

City of Molalla





LEGEND

Geology Legend

- = Topsoil / Artificial Fill
- = Silty clay w/ trace sand (CL / MH)
- = Dense clayey sand w/ some gravel (SC)
- = Dense silty gravel w/ some sand (GM / GC)

Figure 4
Monitoring Well Design

City of Molalla



Appendices

Appendix A	Existing WWTP Boring Logs and Well Logs
Appendix B	Existing Water Quality Information, Troutdale Aquifer
Appendix C	Example Field Forms



Appendix A

Existing WWTP Boring Logs and Well Logs

Depth (ft)	Soil / Rock Description and Comments	Log	Elev. Depth	Sample Number and Location	▲ SPT N-Value ● Moisture (%)	Core Recovery (%) RQD (%)	Backfill/ Installations/ Groundwater
1	Medium dense silty GRAVEL (GM); brown, dry, low plasticity silt, fine to coarse subrounded to rounded gravel, (fill).		323.5 0.5				Monument set in concrete
2	Stiff clayey SILT, scattered gravel (MH); grey and iron-stained, moist, medium to high plasticity, coarse angular gravel, (fill).						±2-inch I.D. PVC
3							
4							
5				SS-8-1	▲ 11		Backfilled with bentonite chips
6							
7							
8							
9							
10				SS-8-2	▲ 11		
11							
12							
13							
14							
15	Medium stiff silty CLAY (CL); grey and iron-stained, moist, low to medium plasticity, (fill).		309.0 15.0	SS-8-3	▲ 6		
16							
17							
18			305.5 18.5				
19	Medium dense clayey SAND, some gravel (SC); grey-brown and iron-stained, moist, medium plasticity clay, fine to coarse sand, fine subrounded to rounded gravel, (alluvium).			SS-8-4	▲ 24		Silica sand
20							
21							
22				SS-8-5	▲ 25		
23							
24							
25	Dense gravelly silty SAND (SM); grey-brown and iron-stained, wet, low plasticity silt, fine to coarse sand, fine to coarse subrounded to rounded gravel, (alluvium).		299.0 25.0	SS-8-6	▲ 31		Machine slot screen (0.020)
26							
27			296.5 27.5				
28	Very dense silty GRAVEL, some sand (GM); grey-brown and iron-stained, wet, low plasticity silt, fine to coarse sand, fine to coarse subrounded to rounded gravel, (alluvium).			SS-8-7			
29							
30							
31							
	BOTTOM OF BORING		292.6 31.4				

Project No.: 2201094

Surface Elevation: 324.0 feet (Approx.)

Date of Boring: October 10, 2022

BORING LOG: BH-8**Molalla WWTP Improvements****Molalla, Oregon**

STATE OF OREGON
MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-0395)

10/31/2022

WELL I.D. LABEL# L 146068

START CARD # 1058807

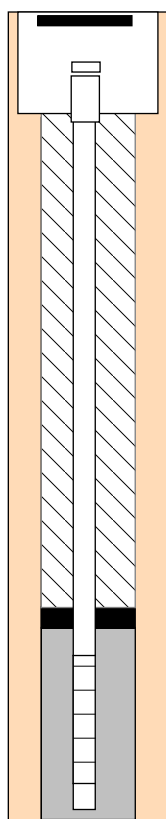
(1) LAND OWNER		Owner Well I.D. <u>MW1</u>	
First Name _____		Last Name _____	
Company <u>CITY OF MOLALLA</u>			
Address <u>117 N MOLOLLA AVE</u>			
City <u>MOLALLA</u>	State <u>OR</u>	Zip <u>97038</u>	

(2) TYPE OF WORK ☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD

☐ Rotary Air ☒ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION		Piezometer Well	☒
Depth of Completed Well	30.00	ft. Special Standard	☐



MONUMENT/VAULT Below Ground

From 0 To 1

BORE HOLE

Diameter 6	From 0	To 30
------------	--------	-------

CASING

Dia. 2 From To 20

Gauge S80 Wld Thrd

Material ☐ Steel ☒ Plastic ☐ ☒

LINER

Dia. _____ From ☐ _____ To _____

Gauge _____ Wld Thrd

Material ☐ Steel ☐ Plastic ☐ ☐

SEAL

From 0 To 1

Material Concrete

Amount 2 Sacks Grout weight

SCREEN
Casing/Liner Casing Material PVC
Diameter 2 From 20 To 30
Slot Size 0.010

From 17	To 30	FILTER Material	SILICA SAND	Size of pack	10/20
---------	-------	--------------------	-------------	--------------	-------

(5) WELL TESTS

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
 Yield gal/min Drawdown Drill stem/Pump depth Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By

Supervising Geologist/Engineer

Water quality concerns?	☐ Yes (describe below)	TDS amount	197	ppm
From	To	Description	Amount	Units

From	To	Description	Amount	Date

(6) LOCATION OF WELL (legal description)

County CLACKAMAS Twp 5.00 S N/S Range 2.00 E E/W WM
Sec 7 SE 1/4 of the NW 1/4 Tax Lot 1201
Tax Map Number _____ Lot _____
Lat _____° _____' _____" or 45.15236389 DMS or DD
Long _____° _____' _____" or -122.61194444 DMS or DD
☐ Street address of well ☒ Nearest address

12424 TOLIVER RD MOLALLA, OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening			
Completed Well	10/10/2022		21

WATER BEARING ZONES

Flowing Artesian? ☐ Dry Hole? ☐

Depth water was first found 21.00

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
10/10/2022	21	30				21

(8) WELL LOG

[illegible]

Date Started 10/10/2022 Completed 10/10/2022

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10702 Date 10/31/2022

Password : (if filing electronically)

Signed CHARLES FOBERT JR (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10702 Date 10/31/2022

Password : (if filing electronically)

Signed CHARLES FOBERT JR (E-filed)

Contact Info (optional) info@westernstatesoil.com

10/31/2022

Comments/Remarks

MW-2

WELL REPORT - Map with location identified
must be attached and shall include an approximate scale and
north arrow

CLAC 77517**10/31/2022****Map of Hole**

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-0395)

10/31/2022

WELL I.D. LABEL# L	146069
--------------------	--------

START CARD # 1058808

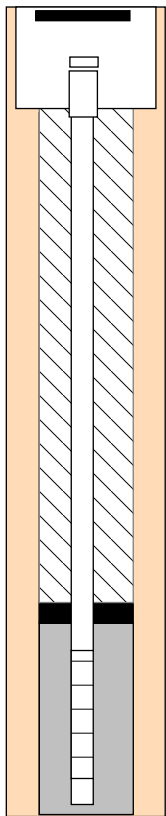
(1) LAND OWNER		Owner Well I.D. <u>MW2</u>	
First Name _____		Last Name _____	
Company <u>CITY OF MOLALLA</u>			
Address <u>117 N MOLOLLA AVE</u>			
City <u>MOLALLA</u>	State <u>OR</u>	Zip <u>97038</u>	

(2) TYPE OF WORK ☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD

☐ Rotary Air ☒ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION Piezometer Well ☒
 Depth of Completed Well 30.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 6 From 0 To 30

CASING

Dia. 2 From ☐ 0 To 20

Gauge S80 Wld Thrd

Material ☐ Steel ☒ Plastic ☐ ☒

LINER

Dia. _____ From ☐ _____ To _____

Gauge _____ Wld Thrd

Material ☐ Steel ☐ Plastic ☐ ☐

SEAL

From 0 To 1

Material Concrete

Amount 2 Sacks Grout weight

SCREEN
Casing/Liner Casing Material PVC
Diameter 2 From 20 To 30
Slot Size 0.010

From 17	To 30	FILTER Material	SILICA SAND	Size of pack	10/20
---------	-------	--------------------	-------------	--------------	-------

(5) WELL TESTS

☐ Pump Yield gal/min	☐ Bailer Drawdown	☐ Air Drill stem/Pump depth	☐ Flowing Artesian Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer

Water quality concerns? ☐ Yes (describe below) TDS amount 197 ppm

From	To	Description	Amount	Units
------	----	-------------	--------	-------

Form	16	Description	Amount	Date

(6) LOCATION OF WELL (legal description)

County CLACKAMAS Twp 5.00 S N/S Range 2.00 E E/W WM
Sec 7 NW 1/4 of the NE 1/4 Tax Lot 1201
Tax Map Number _____ Lot _____
Lat _____° _____' _____" or 45.15460833 DMS or DD
Long _____° _____' _____" or -122.60893333 DMS or DD
☐ Street address of well ☒ Nearest address
12424 TOLIVER RD MOLALLA, OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening			
Completed Well	10/10/2022		22

WATER BEARING ZONES

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
10/10/2022	22	30				22

(8) WELL LOG

[illegible]

Date Started 10/10/2022 Completed 10/10/2022

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10702 Date 10/31/2022
 Password : (if filing electronically) _____
 Signed CHARLES FOBERT JR (E-filed) _____

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10702 Date 10/31/2022
 Password : (if filing electronically) _____
 Signed CHARLES FOBERT JR (E-filed) _____
 Contact Info (optional) info@westernstatesoil.com

10/31/2022

[illegible]

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

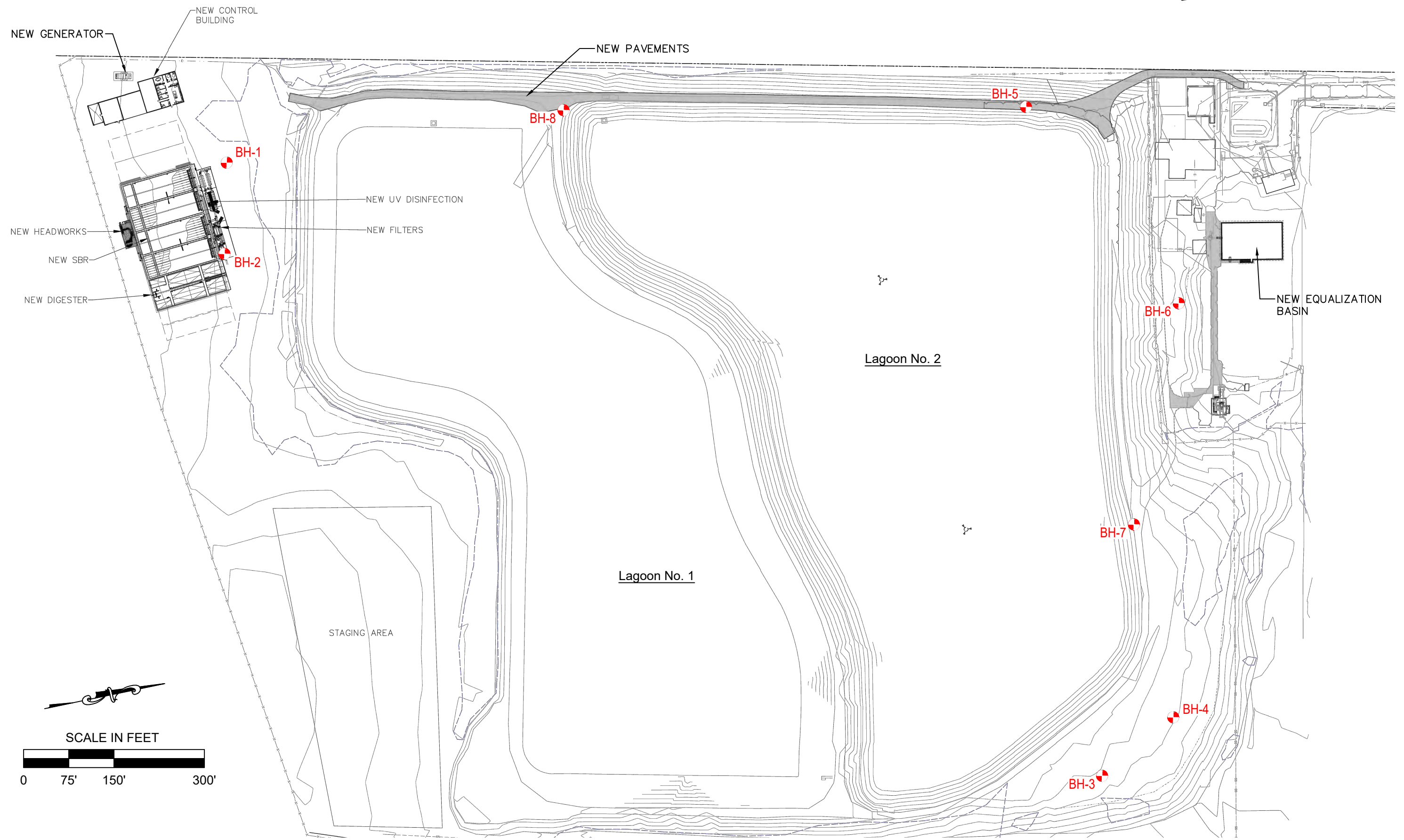
CLAC 77518

10/31/2022

Map of Hole



FILE:FIG 2A (11-1-22).dwg



- NOTES:
1. BOREHOLE LOCATIONS ARE APPROXIMATE.
 2. SEE REPORT FOR A DISCUSSION OF SUBSURFACE CONDITIONS.
 3. BASE MAP WAS PROVIDED BY DYER.



PROJECT NO.
2201094

DATE:
Nov. 14, 2022

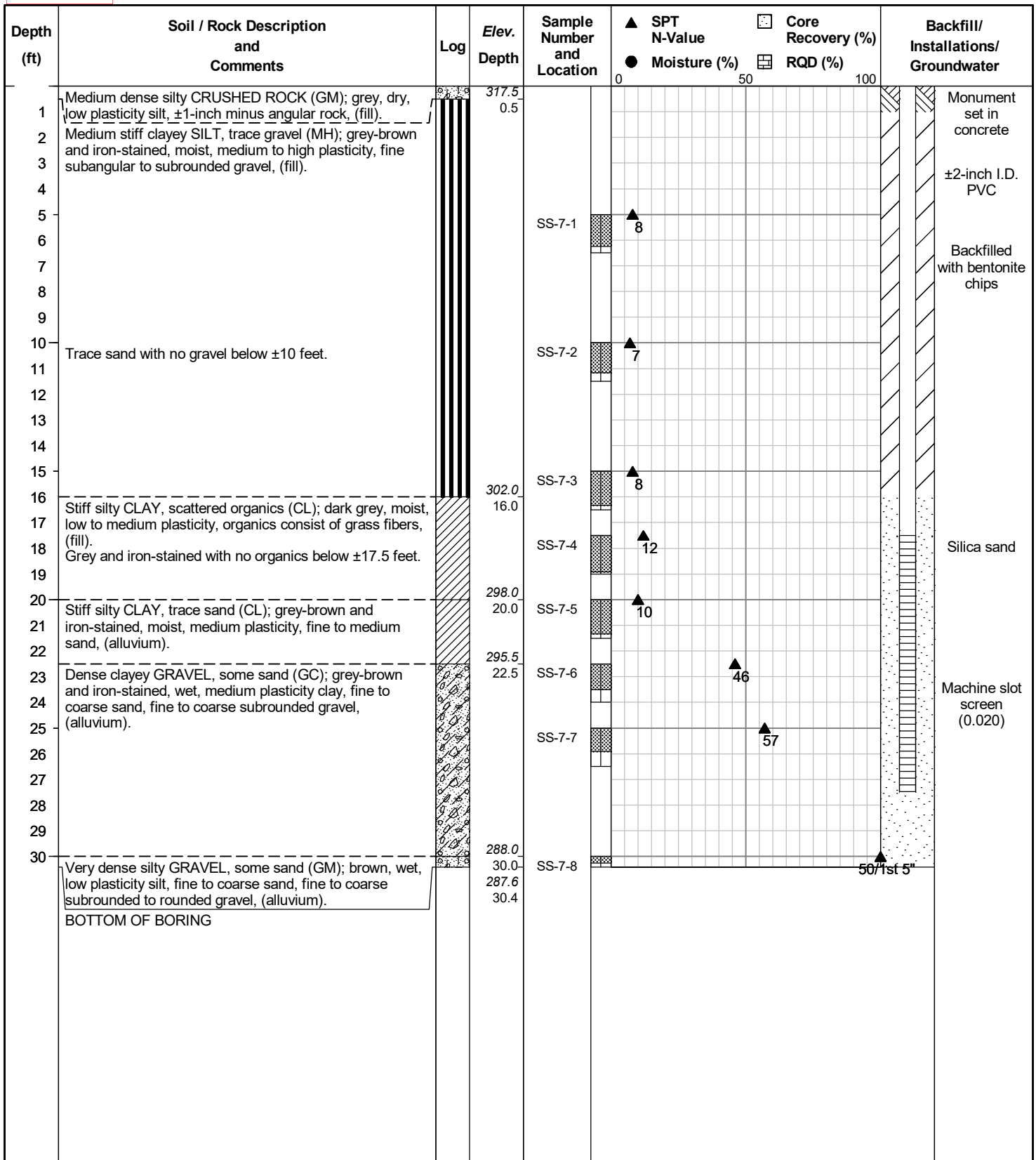
DRAWN BY:
MDM

SITE LAYOUT AND BOREHOLE LOCATIONS

MOLALLA WWTP IMPROVEMENTS
MOLALLA, OREGON

FIGURE NO.

2A



Project No.: 2201094

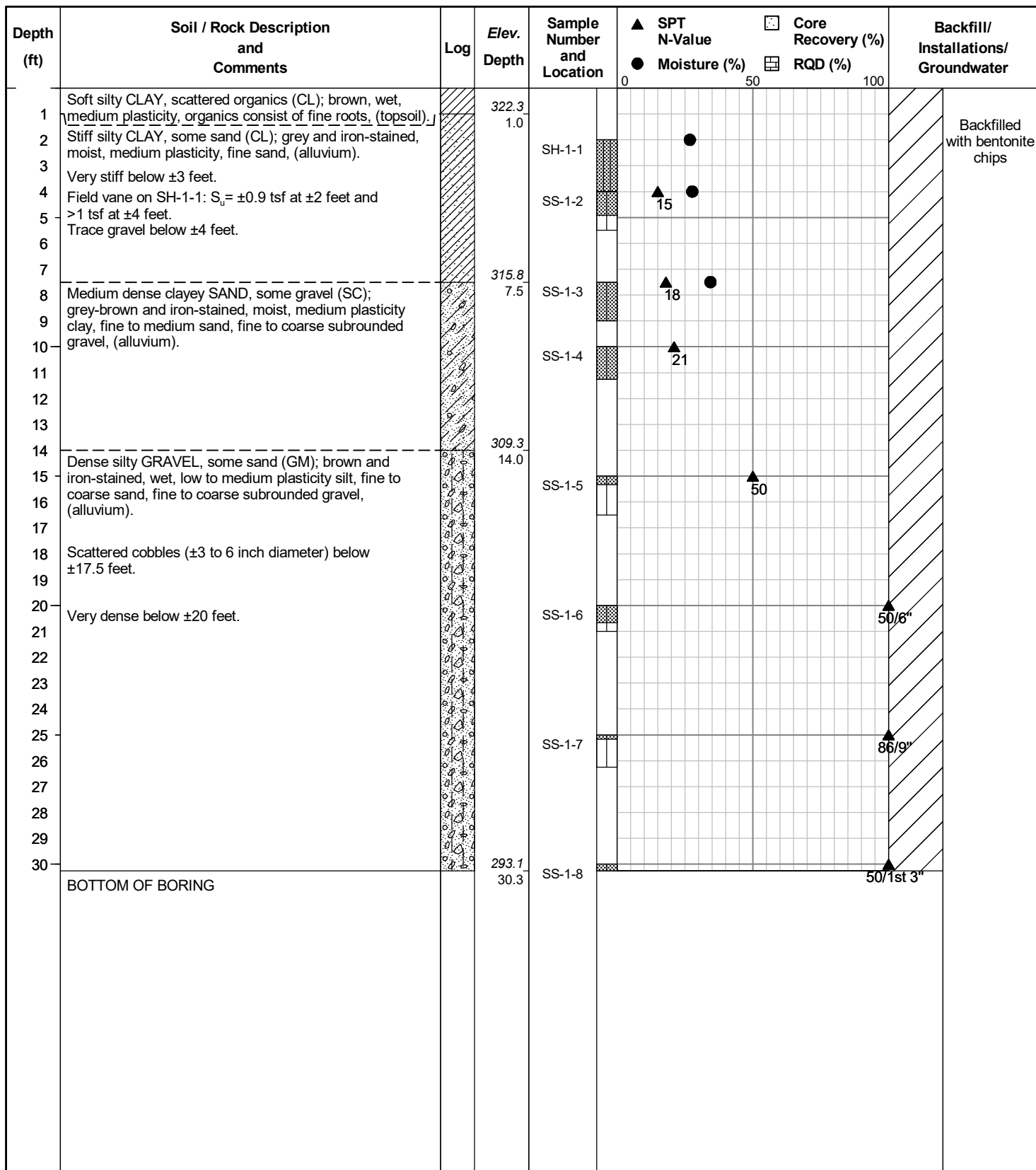
Surface Elevation: 318.0 feet (Approx.)

Date of Boring: October 10, 2022

BORING LOG: BH-7

Molalla WWTP Improvements

Molalla, Oregon



Project No.: 2201094

Surface Elevation: 323.3 feet (Approx.)

Date of Boring: November 23, 2020

BORING LOG: BH-1

Molalla WWTP Improvements

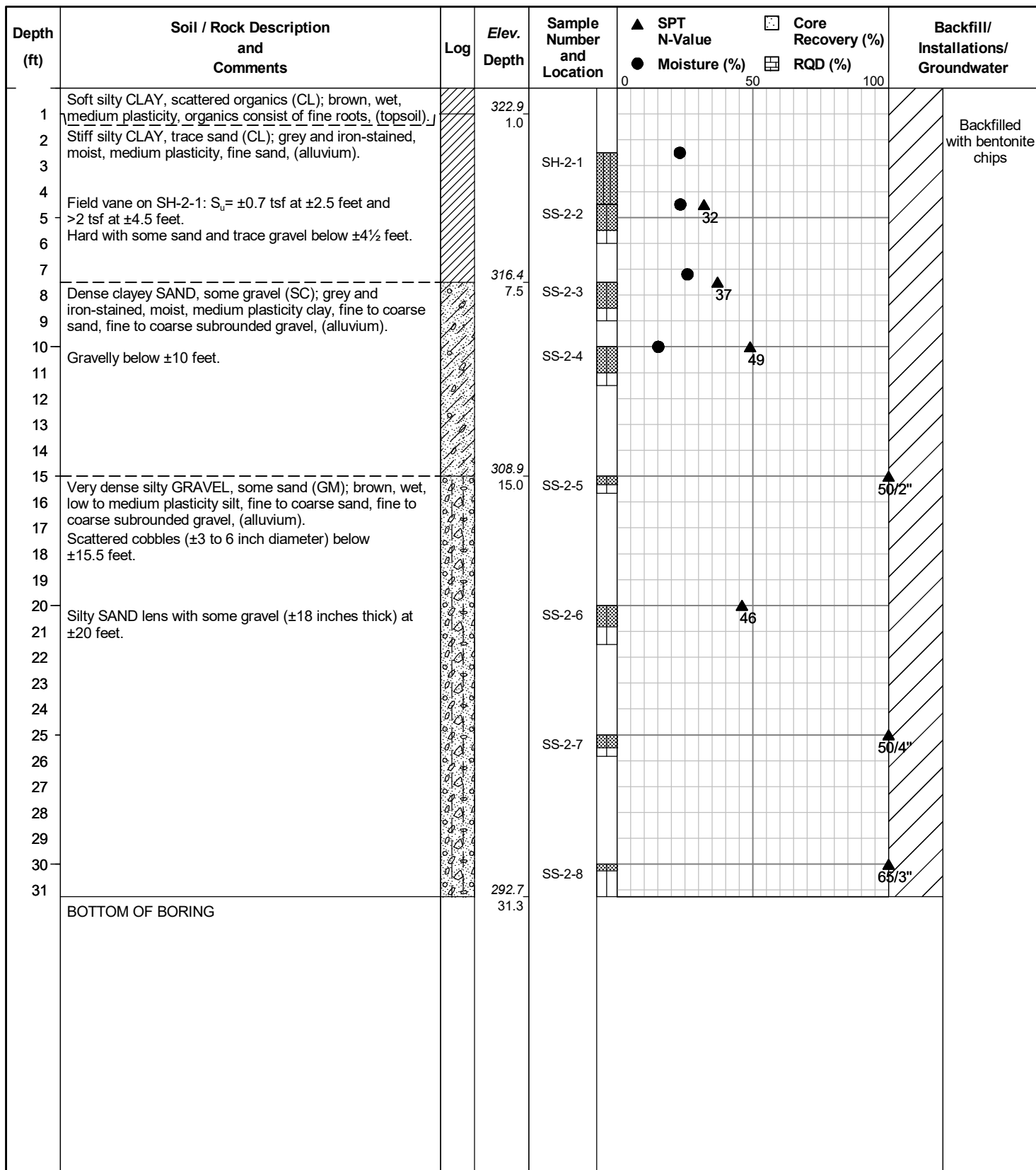
Molalla, Oregon



Foundation Engineering, Inc.
Professional Geotechnical Services

BH-1

Page 1 of 1



Project No.: 2201094

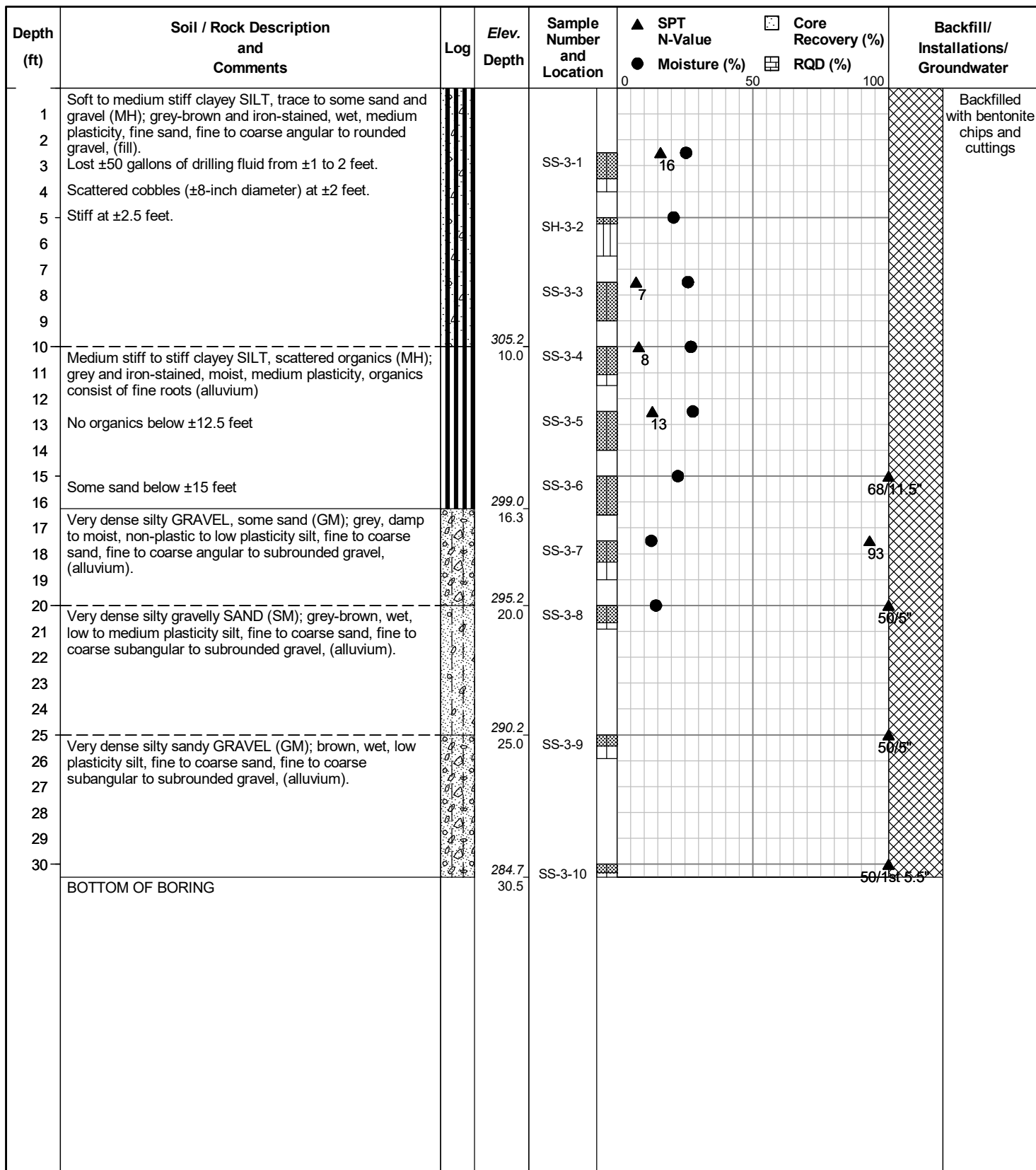
Surface Elevation: 323.9 feet (Approx.)

Date of Boring: November 23, 2020

BORING LOG: BH-2

Molalla WWTP Improvements

Molalla, Oregon



Project No.: 2201094

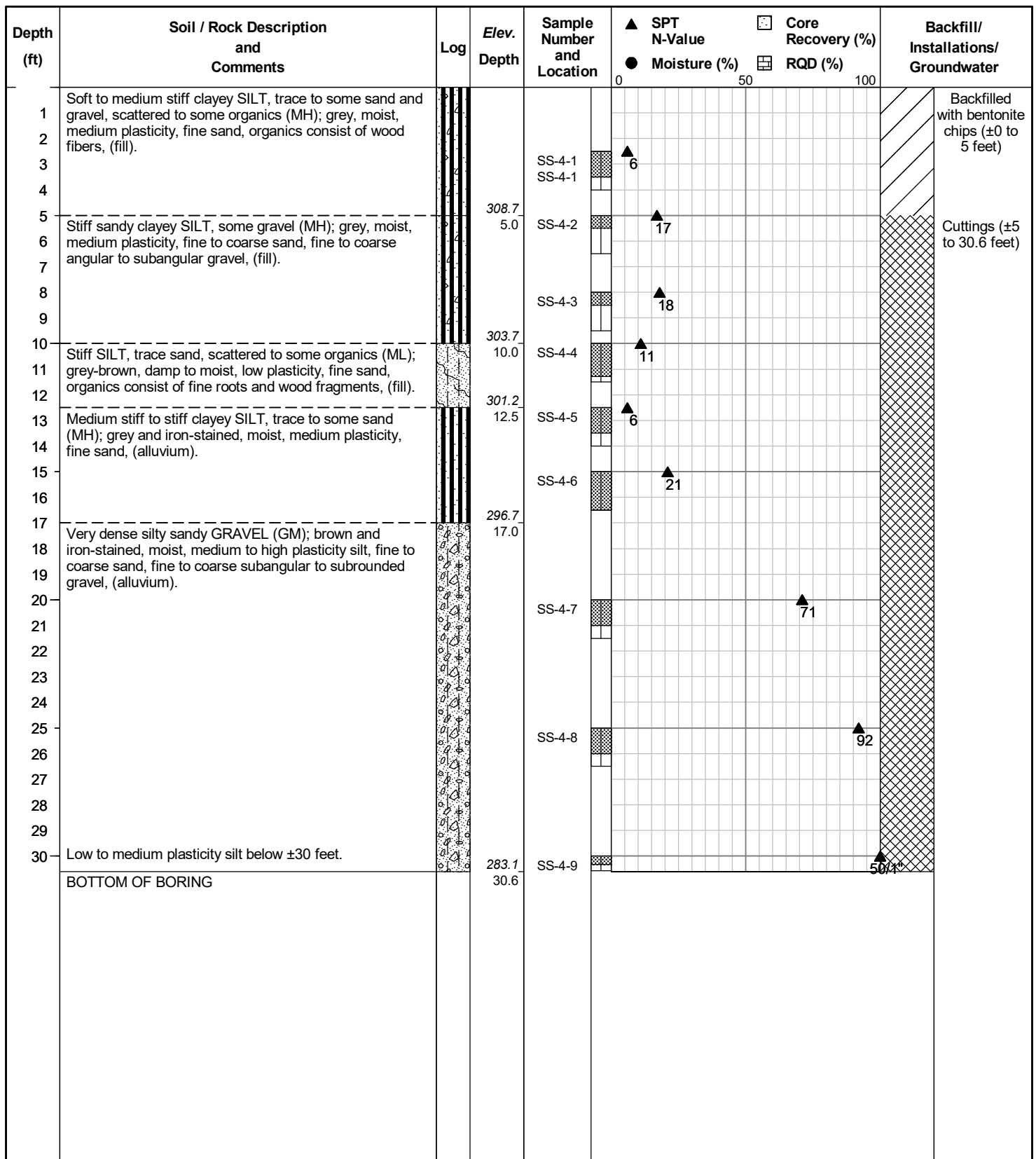
Surface Elevation: 315.2 feet (Approx.)

Date of Boring: December 21, 2020

BORING LOG: BH-3

Molalla WWTP Improvements

Molalla, Oregon



Project No.: 2201094

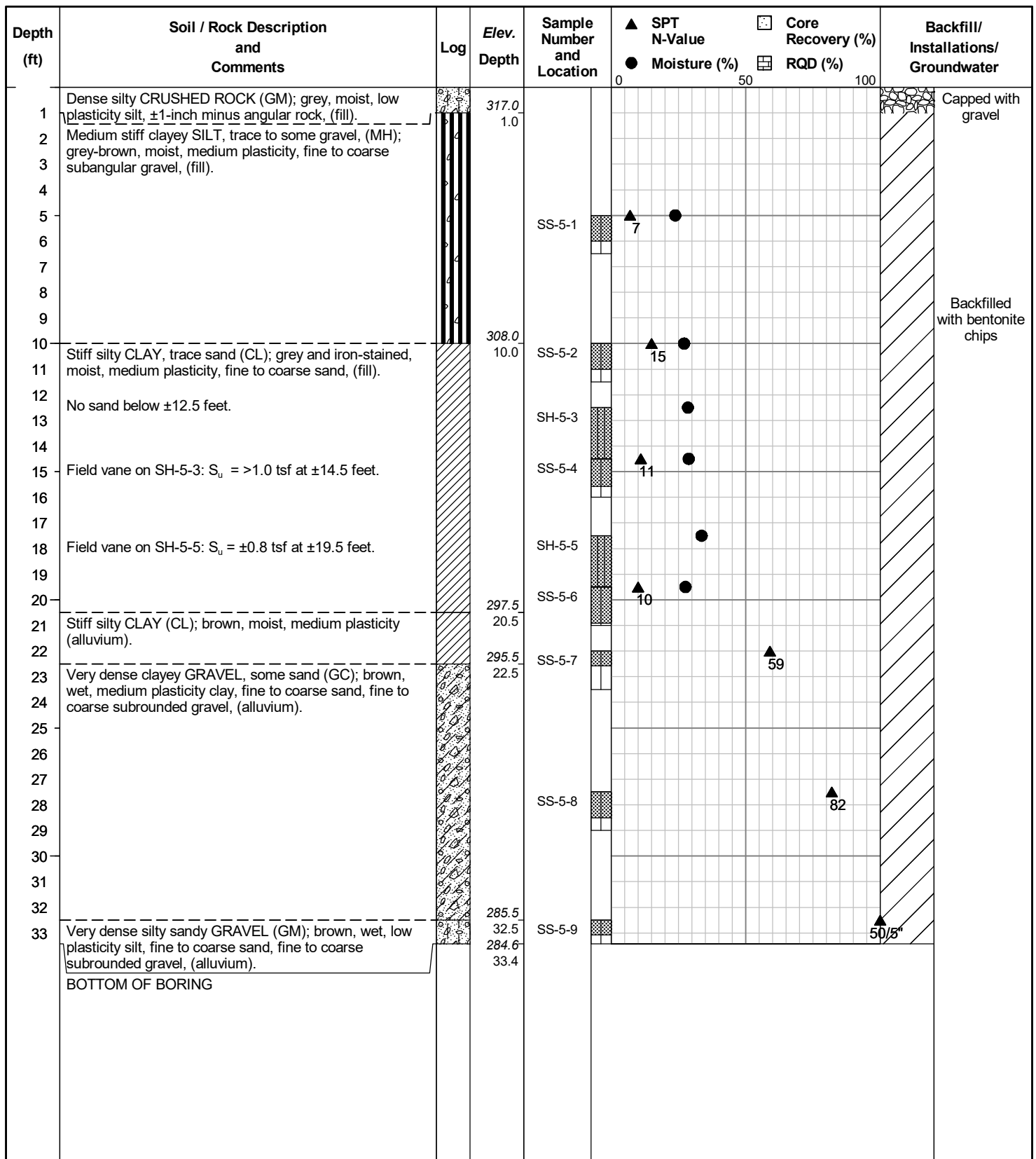
Surface Elevation: 313.7 feet (Approx.)

Date of Boring: December 21, 2020

BORING LOG: BH-4

Molalla WWTP Improvements

Molalla, Oregon



Project No.: 2201094

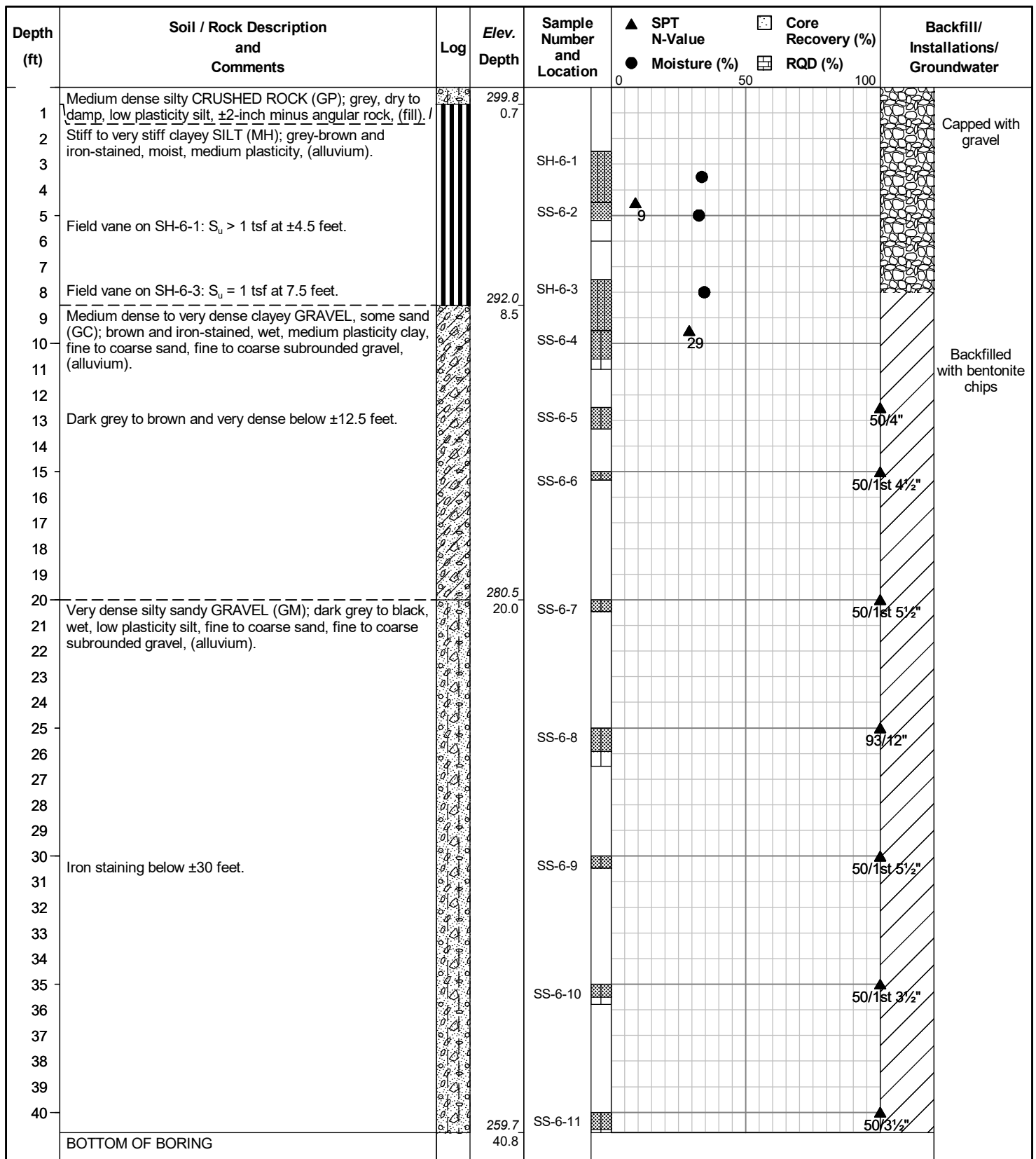
Surface Elevation: 318.0 feet (Approx.)

Date of Boring: February 5, 2021

BORING LOG: BH-5

Molalla WWTP Improvements

Molalla, Oregon



Project No.: 2201094

Surface Elevation: 300.5 feet (Approx.)

Date of Boring: April 23, 2021

BORING LOG: BH-6

Molalla WWTP Improvements

Molalla, Oregon

Appendix B

Existing Water Quality Information, Troutdale Aquifer

CLAC-66410

Fisher's Supply Inc.
 659 SW 1st Ave
 Canby, OR 97013

Phone: 503-263-8557
 Fax: 503-263-8369

Web: www.fisherssupply.com

WATER ANALYSIS IS ONLY AVAILABLE TUESDAY'S AND THURSDAY'S. SAMPLES MUST BE TAKEN THE MORNING OF AND BROUGHT TO FISHER'S SUPPLY NO LATER THAN 11:00 AM THE SAME DAY.

Keep samples as cool as possible. Store in cooler or refrigerator if possible.

PRICING AS OF NOVEMBER 2013

Bacteria - \$50.00

Nitrate - \$40.00

Arsenic Standard 12 Business Days - \$50.00

Arsenic Expedited 7 Business Days - \$75.00

Arsenic Expedited 5 Business Days - \$100.00

Bacteria and Nitrate test results can take up to 5 working days to receive.

Standard Arsenic test results take up to 12 working days to receive. Expedited Arsenic test results are received within 5-7 working days.

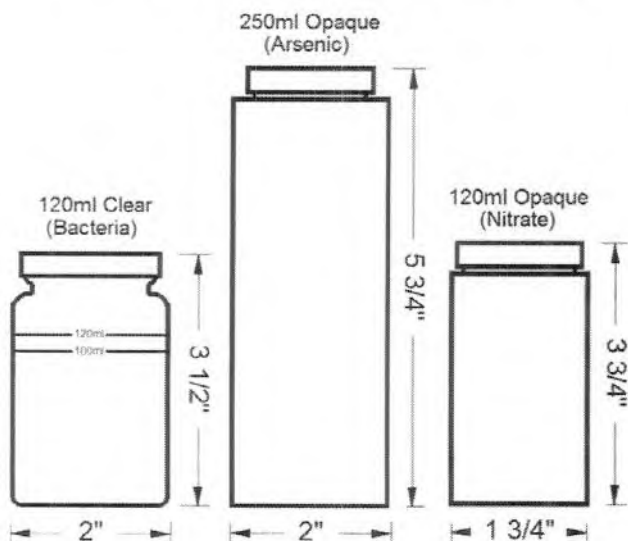
See separate instruction sheet for specific testing procedure. Available from Fisher's Supply or on the "Resources" page of www.fisherssupply.com

Bacteria, Nitrate, and Arsenic tests require their own separate specific test bottles for each. Please label bottles with name and analysis requested.

Bacteria - Clear plastic 120ml Sterile bottle

Nitrate - Opaque plastic 120ml or larger bottle

Arsenic - Opaque plastic 250ml or larger bottle



EDGE
 ANALYTICAL
 LABORATORIES

OR

WATER ANALYSIS

CLIENT INFORMATION

Mail Report To:
 Fisher's Supply Inc.
 659 SW 1st Ave
 Canby, OR 97013

15-27730
 62302

Project: *City of Molalla*

Phone: (503)263-8557

Fax: (503)263-8369

e-mail: cgibson@canby.com

*12381 S. Toliner rd, Molalla
 503-936-4618*

Same as Report ☒

City of Molalla

SAMPLE INFORMATION

Date Collected

Time Collected

Bottle Number

12-29-15

9:22 am

Collected By:

German

Specific *12381 S. Toliner rd, Molalla*

Location: *Hose bib at pressure tank*

☒ Untreated

Chlorine Residual:

☐ Total

☐ Treated

☐ Free

DRINKING WATER

(DEFAULT METHOD: PRESENCE/ABSENCE)

☐ Compliance:

State Regulations for Public Water Systems
 Results will be sent to you and the State

☒ Investigative:

Building Permit, Repairs

☐ Real Estate:

Home Sale

PUBLIC DRINKING WATER SYSTEMS

PWS # 41 _ _ _ _

PWS Name _ _ _ _

☐ Request Special Method:

Requested Analyses

☒ Total Coliform & E. coli

☒ Nitrate

☐ Arsenic (10 working day turn around)

☐ Arsenic (5 working day turn around)

☐ Arsenic (3 working day turn around)

☐ Other: _ _ _ _

Edge Analytical
(800) 755-9295

Bacteria samples must go to:

Portland Lab
 9150 SW Pioneer Ct. Ste W
 Wilsonville OR 97070
 (503) 682-7802

Corporate Lab
 1620 S Walnut St
 Burlington WA 98233

For Laboratory Use Only:

Batch ID

Reference Number

Lab Number

7.0°C



Burlington, WA *Corporate Laboratory (a)*
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA *Microbiology (b)*
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR *Microbiology/Chemistry (c)*
9150 SW Pioneer Ct Ste W - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR *Microbiology/Chemistry (d)*
540 SW Third Street - Corvallis, OR 97333 - 541.753.4946

Bend, OR *Microbiology (e)*
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425



INORGANIC COMPOUNDS (IOC) REPORT

Client Name: Fishers Supply Inc.
659 S.W. 1st Ave.
Canby, OR 97013

System Name:
System ID Number:
Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: 12381 S Toliner Rd, Molalla
County:

Reference Number: 15-27730
Project: City of Molalla

Sample Number: 12381 - hose bib
Lab Number: 15_62302
Collect Date: 12/29/15 09:22
Date Received: 12/29/15
Report Date: 12/30/15
Sampled By: German
Sampler Phone:
Approved by: ajs
Authorized by:

Thanh B Phan
Lab Manager, Portland

EPA#	ANALYTES	RESULTS	UNITS	LRL	MCL	Analyst	Lab Code*	METHOD	Analyzed	COMMENT
1040	EPA Regulated NITRATE-N	1.11	mg/L	0.005	10	cpo	OR100063 c	SM4500-NO3 F	12/29/15	

NOTES:

ND (Not Detected): indicates that the parameter was not detected above the Lower Reporting limit (LRL).

MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; Federal Action Levels are 0.015 mg/L for Lead and 1.3 mg/L for Copper. Sodium has a recommended limit of 20 mg/L. A blank MCL value indicates a level is not currently established.

* Lab Code - lists the laboratory accreditation code plus a letter at the far right to indicate the Edge Analytical lab facility where the analyses was performed.

An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.

These test results meet all the requirements of NELAP, unless otherwise stated in writing, and relate only to these samples. Estimates of uncertainty are not included in this report. If this information is required please contact us at the phone number listed in the report header.

If you have any questions concerning this report contact us at the above phone number.



Burlington, WA *Corporate Laboratory (a)*
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 • 360.757.1400

Bellingham, WA *Microbiology (b)*
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR *Microbiology/Chemistry (c)*
9150 SW Pioneer Ct Ste W - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR *Microbiology/Chemistry (d)*
540 SW Third Street - Corvallis, OR 97333 - 541.753.4946

Bend, OR *Microbiology (e)*
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425

Reference Number: **15-27730**

System ID Number:
System Name:
Sampler Phone:
FAX/Email: **cgibson@canby.com**

Authorized by:

Thanh B Phan
Lab Manager, Portland

Client Name: **Fishers Supply Inc.**
659 S.W. 1st Ave.
Canby, OR 97013

ORLAP #: **OR100063**
Lab Sample #: **15_62302**

Project: **City of Molalla**

Date Collected: **12/29/15 9:22**
Sampled By: **German**
Sample Location: **12381 S Toliner Rd, Molalla**

Sampler Phone Number:
Field ID: **12381 - hose bib**

Sample Type:
Free Chlorine:
Original Sample Date:

Sample Purpose: **Investigative or Other**
Treatment:
Repeat Sample Number:

Date Received: **12/29/15 12:30**
Analysis Start: **12/29/15 16:45** Prep Analyst: **AJS**
Method: **SM9223 B / Colilert-18**
Date Analyzed: **12/30/15 12:45**
Analyst: cpo
Peer Review:

Test Results

PARAMETER	RESULT
TOTAL COLIFORM	Unsatisfactory, Coliform Present
E. Coli	Absent

Sample Invalidation:

☐ Other: _____

Test results relate only to the parameters tested and to the samples as received by the laboratory. Test results meet all requirements of NELAP unless otherwise noted. This report shall not be reproduced, except in full, and with written consent of this laboratory.

If the sample is unsatisfactory you can get information at the health department website.

NOTES:

If the result is Unsatisfactory a repeat sample is required for Public Water Systems. Private individuals should investigate the cause of the unsatisfactory result and resample.
If E. Coli or Fecal Coliform are present in sample do not drink the water until it is properly treated.

OHA Drinking Water Data Online

Chemical Results, Troutdale Aquifer

BIG BURGER DRIVE-IN (PWS 94132, Inactive)

List downloaded on 04/20/2026 from <https://yourwater.oregon.gov/chems.php>

Facility ID	Facility Name	Analyte Group	Analyte Name	Sample Date	Result	Units	Analyte Level Type	Current Analyte Level	Analyte Level Units	Received Date	Sample ID
P-A	EP for WELL	NO3	NITRATE	9/21/2009	1.6	MG/L	MCL	10	MG/L	9/29/2009	90921361-I
EP-A	EP for WELL	NO3	NITRATE	9/22/2008	1.4	MG/L	MCL	10	MG/L	10/16/2008	A80922N1-I
EP-A	EP for WELL	NO3	NITRATE	10/22/2007	1.6	MG/L	MCL	10	MG/L	11/9/2007	A71022I1
EP-A	EP for WELL	NO3	NITRATE	10/23/2006	1.3	MG/L	MCL	10	MG/L	11/7/2006	A61023AC1
EP-A	EP for WELL	NO3	NITRATE	10/26/2005	1.4	MG/L	MCL	10	MG/L	11/10/2005	A51026AD-1
EP-A	EP for WELL	NO3	NITRATE	12/6/2004	1.4	MG/L	MCL	10	MG/L	12/20/2004	A41206O-1
EP-A	EP for WELL	NO3	NITRATE	12/8/2003	1.2	MG/L	MCL	10	MG/L	12/19/2003	A31208M-1
EP-A	EP for WELL	NO3	NITRATE	11/11/2002	1.3	MG/L	MCL	10	MG/L	11/22/2002	A21111H-1

BLACKMANS 4-WAY GROCERY (PWS 94459, CLAC-10021, Active)

List downloaded on 04/20/2026 from <https://yourwater.oregon.gov/chems.php>

Facility ID	Facility Name	Analyte Group	Analyte Name	Sample Date	Result	Units	Analyte Level Type	Current Analyte Level	Analyte Level Units	Received Date	Sample ID
EP-A	EP for WELL	NO3	NITRATE	11/19/2024	0.648	MG/L	MCL	10	MG/L	11/27/2024	24-013106-0001-I
EP-A	EP for WELL	NO3	NITRATE	3/29/2023	0.677	MG/L	MCL	10	MG/L	4/27/2023	23-004264-0001-I
EP-A	EP for WELL	NO3	NITRATE	11/8/2022	0.875	MG/L	MCL	10	MG/L	11/17/2022	22-013743-0001-I
EP-A	EP for WELL	NO3	NITRATE	2/25/2021	0.487	MG/L	MCL	10	MG/L	3/2/2021	210020060001-I
EP-A	EP for WELL	NO3	NITRATE	12/26/2019	ND	MG/L	MCL	10	MG/L	1/10/2020	190157500001-I
EP-A	EP for WELL	NO3	NITRATE	11/29/2018	0.721	MG/L	MCL	10	MG/L	12/10/2018	180109980001-I
EP-A	EP for WELL	NO3	NITRATE	8/10/2017	0.63	MG/L	MCL	10	MG/L	8/25/2017	70810441-I
EP-A	EP for WELL	NO3	NITRATE	6/16/2016	0.72	MG/L	MCL	10	MG/L	7/1/2016	60616561-I
EP-A	EP for WELL	NO3	NITRATE	9/3/2015	0.655	MG/L	MCL	10	MG/L	9/14/2015	50904071-I
EP-A	EP for WELL	NO3	NITRATE	5/22/2014	0.483	MG/L	MCL	10	MG/L	6/4/2014	40522481-I
EP-A	EP for WELL	NO3	NITRATE	5/23/2013	0.319	MG/L	MCL	10	MG/L	6/13/2013	30524031-I
EP-A	EP for WELL	NO3	NITRATE	5/10/2012	0.24	MG/L	MCL	10	MG/L	5/29/2012	20510251-I
EP-A	EP for WELL	NO3	NITRATE	12/15/2011	0.274	MG/L	MCL	10	MG/L	12/23/2011	11216031-I
EP-A	EP for WELL	NO3	NITRATE	12/16/2010	0.39	MG/L	MCL	10	MG/L	1/5/2011	1217051-I
EP-A	EP for WELL	NO3	NITRATE	9/30/2010	0.29	MG/L	MCL	10	MG/L	10/8/2010	930411-I
EP-A	EP for WELL	NO3	NITRATE	7/23/2009	0.39	MG/L	MCL	10	MG/L	8/7/2009	9072414-I
EP-A	EP for WELL	NO3	NITRATE	10/15/2008	0.29	MG/L	MCL	10	MG/L	11/5/2008	A81016F1-I
EP-A	EP for WELL	NO3	NITRATE	8/31/2006	0.7	MG/L	MCL	10	MG/L	9/18/2006	A60831AQ1
EP-A	EP for WELL	NO3	NITRATE	10/27/2005	1.5	MG/L	MCL	10	MG/L	11/8/2005	A51027BC-1
EP-A	EP for WELL	NO3	NITRATE	6/9/2005	1.9	MG/L	MCL	10	MG/L	6/28/2005	A506100-1
EP-A	EP for WELL	NO3	NITRATE	3/10/2005	1.8	MG/L	MCL	10	MG/L	3/29/2005	A50311E-1
EP-A	EP for WELL	NO3	NITRATE	11/26/2003	1.70	MG/L	MCL	10	MG/L	12/4/2003	A31126BE-1
EP-A	EP for WELL	NO3	NITRATE	10/10/2002	2.80	MG/L	MCL	10	MG/L	7/24/2003	A21010BY-1
DIST-A		RT	Total Coliform	7/24/2025	Absent					7/31/2025	25-008431-0001
DIST-A		RT	Total Coliform	4/15/2025	Absent					4/18/2025	25-004028-0001
DIST-A	STORE FRONT HANDWASHING SINK	RT	Total Coliform	1/21/2025	Absent					1/31/2025	25_000699_0001
DIST-A		RT	Total Coliform	11/19/2024	Absent					3/31/2025	24-013106-0002
DIST-A	STOREFRONT HANDWASHING SINK	RT	Total Coliform	8/20/2024	Absent					8/27/2024	24_009152_0001
DIST-A	STOREFRONT COFFEE SINK	RT	Total Coliform	6/24/2024	Absent					7/3/2024	24_006863_0001
DIST-A	HANDWASHING SINK	RT	Total Coliform	2/28/2024	Absent					3/4/2024	24_002244_0001
DIST-A	KITCHEN HANDWASHING SINK	RT	Total Coliform	11/29/2023	Absent					12/1/2023	23_013905_0001
DIST-A	KITCHEN SINK (SMALL)	RT	Total Coliform	7/26/2023	Absent					8/7/2023	23_008805_0001
DIST-A	KITCHEN HAND SINK	RT	Total Coliform	5/24/2023	Absent					5/31/2023	23_006143_0001
DIST-A		RT	Total Coliform	3/29/2023	Absent					4/1/2023	1352-01

TITANIC ICE CO (PWS 94940, CLAC-19126, Active)

List downloaded on 04/20/2026 from <https://yourwater.oregon.gov/chems.php>

Facility ID	Facility Name	Analyte Group	Analyte Name	Sample Date	Result	Units	Analyte Level Type	Current Analyte Level	Analyte Level Units	Received Date	Sample ID
EP-A	EP for WELL	ARS	ARSENIC	12/2/2025	ND	MG/L	MCL	0	MG/L	12/16/2025	5336042-01-I
EP-A	EP for WELL	NO3	NITRATE	12/2/2025	2.29	MG/L	MCL	10	MG/L	12/16/2025	5336042-01-I
EP-A	EP for WELL	NO3	NITRATE	11/26/2024	2.11	MG/L	MCL	10	MG/L	12/31/2024	4331015-01-I
EP-A	EP for WELL	NO3	NITRATE	12/26/2023	1.98	MG/L	MCL	10	MG/L	1/3/2024	3360009-01-I
EP-A	EP for WELL	NO3	NITRATE	12/27/2022	2.19	MG/L	MCL	10	MG/L	1/3/2023	2361021-01-I
EP-A	EP for WELL	NO3	NITRATE	12/21/2021	2.18	MG/L	MCL	10	MG/L	12/27/2021	135501701-I
EP-A	EP for WELL	NO3	NITRATE	9/22/2020	2.04	MG/L	MCL	10	MG/L	9/28/2020	026602201-I
EP-A	EP for WELL	NO3	NITRATE	6/29/2020	2.21	MG/L	MCL	10	MG/L	7/6/2020	018100601-I
EP-A	EP for WELL	NO3	NITRATE	12/26/2019	1.96	MG/L	MCL	10	MG/L	1/3/2020	936002201-I
EP-A	EP for WELL	NO3	NITRATE	9/25/2018	1.84	MG/L	MCL	10	MG/L	9/26/2018	826804801-I
EP-A	EP for WELL	NO3	NITRATE	9/26/2017	2.18	MG/L	MCL	10	MG/L	10/2/2017	726905101-I
EP-A	EP for WELL	NO3	NITRATE	9/27/2016	2.07	MG/L	MCL	10	MG/L	9/30/2016	627104601-I
EP-A	EP for WELL	NO3	NITRATE	12/22/2015	2.29	MG/L	MCL	10	MG/L	12/28/2015	535602301-I
EP-A	EP for WELL	NO3	NITRATE	12/16/2014	2.16	MG/L	MCL	10	MG/L	12/19/2014	435002501-I
EP-A	EP for WELL	NO3	NITRATE	12/3/2013	1.96	MG/L	MCL	10	MG/L	12/6/2013	333702401-I
EP-A	EP for WELL	NO3	NITRATE	11/27/2012	2.50	MG/L	MCL	10	MG/L	12/3/2012	233202001-I
EP-A	EP for WELL	NO3	NITRATE	12/6/2011	2.60	MG/L	MCL	10	MG/L	6/29/2012	134002301-I
EP-A	EP for WELL	NO3	NITRATE	6/15/2010	2.70	MG/L	MCL	10	MG/L	7/13/2010	490129N-I
EP-A	EP for WELL	NO3	NITRATE	4/21/2009	2.50	MG/L	MCL	10	MG/L	5/6/2009	465249N-I
EP-A	EP for WELL	NO3	NITRATE	7/10/2007	2.40	MG/L	MCL	10	MG/L	10/1/2007	429992N
EP-A	EP for WELL	NO3	NITRATE	2/28/2006	2.50	MG/L	MCL	10	MG/L	3/11/2006	403996N
EP-A	EP for WELL	NO3	NITRATE	4/27/2004	2.30	MG/L	MCL	10	MG/L	8/11/2004	367049-I
EP-A	EP for WELL	NO3	NITRATE	12/24/2002	2.10	MG/L	MCL	10	MG/L	4/26/2004	02358/25-I
DIST-A		RT	Total Coliform	3/10/2026	Absent					3/16/2026	6069015-01
DIST-A		RT	Total Coliform	12/2/2025	Absent					12/19/2025	5336046-01
DIST-A	SINK	RT	Total Coliform	9/9/2025	Absent					9/16/2025	5252023-01
DIST-A	SINK	RT	Total Coliform	6/24/2025	Absent					6/27/2025	5175014-01
DIST-A	SINK	RT	Total Coliform	3/11/2025	Absent					3/14/2025	5070037-01
DIST-A	SINK	RT	Total Coliform	11/26/2024	Absent					12/6/2024	4331011-01
DIST-A	SINK	RT	Total Coliform	9/24/2024	Absent					10/7/2024	4268035-01
DIST-A	SINK	RT	Total Coliform	6/18/2024	Absent					6/28/2024	4170028-01
DIST-A	SINK	RT	Total Coliform	3/26/2024	Absent					4/2/2024	4086023-01
DIST-A	SINK	RT	Total Coliform	12/19/2023	Absent					1/5/2024	3353034-01
DIST-A	SINK	RT	Total Coliform	9/26/2023	Absent					9/29/2023	3269014-01
DIST-A	SINK	RT	Total Coliform	6/27/2023	Absent					7/5/2023	3178017-01
DIST-A	SINK	RT	Total Coliform	3/28/2023	Absent					4/3/2023	3087011-01

Appendix C

Example Field Forms

Calibration Log

Date	Operator	Calibration Parameters											Comments	
		DO		SpCond		PH		PH		PH		ORP		
		Standard		Standard		Standard	7.0	Standard	10.0	Standard	4.0	Standard		
		Before		Before		Before		Before		Before		Before		
		After		After		After		After		After		After		
Date	Operator	Calibration Parameters											Comments	
		DO		SpCond		PH		PH		PH		ORP		
		Standard		Standard		Standard	7.0	Standard	10.0	Standard	4.0	Standard		
		Before		Before		Before		Before		Before		Before		
		After		After		After		After		After		After		
Date	Operator	Calibration Parameters											Comments	
		DO		SpCond		PH		PH		PH		ORP		
		Standard		Standard		Standard	7.0	Standard	10.0	Standard	4.0	Standard		
		Before		Before		Before		Before		Before		Before		
		After		After		After		After		After		After		
Date	Operator	Calibration Parameters											Comments	
		DO		SpCond		PH		PH		PH		ORP		
		Standard		Standard		Standard	7.0	Standard	10.0	Standard	4.0	Standard		
		Before		Before		Before		Before		Before		Before		
		After		After		After		After		After		After		
Date	Operator	Calibration Parameters											Comments	
		DO		SpCond		PH		PH		PH		ORP		
		Standard		Standard		Standard	7.0	Standard	10.0	Standard	4.0	Standard		
		Before		Before		Before		Before		Before		Before		
		After		After		After		After		After		After		
Date	Operator	Calibration Parameters											Comments	
		DO		SpCond		PH		PH		PH		ORP		
		Standard		Standard		Standard	7.0	Standard	10.0	Standard	4.0	Standard		
		Before		Before		Before		Before		Before		Before		
		After		After		After		After		After		After		

[illegible]

Field Parameter Measurements

- Ensure that field instruments are cleaned and calibrated prior to each field event
- Field parameters should be stable (<5% variability) prior to collecting sample

[illegible]