

Heilman Farm

AWMP

2017

Rec'd 3/1/17
AWMP# 17004
MA# 174243

Table of Contents

Section 1

Manure Management
AI Outbreak
Crop System
Application Area
Reporting and Records
Mortalities

Section 2

Maps

Section 3

Operation and Maintenance

Section 4

Manure Nutrient Analysis
Nutrient Removal of Forages
Phosphorous Index

Section 5

Soil Sample Results
Soil Survey

Section 6

ORAWM

Section 7

NPDES Permit

Section 8

Manure Application Rates for Forage Production
Calculating Manure Nutrient Application Rates
Post Harvest Nitrate Testing

Farm Contact Information: Ed and Lisa Heilman
12616 S. Spangler Road
Oregon City, OR 97045
503-632-7718

Physical Location: 12616 S. Spangler Road
Oregon City, OR 97045

Animal Feeding Operation: Medium CAFO
Type and Size: 112,500 Broilers and 100 Beef Cattle

Owner/Operator

As the owner/operator of this AWMP, I, as the decision maker, have been involved in the planning process and agree that the items/practices listed in each element of this AWMP are needed. I understand that I am responsible for keeping all the necessary records associated with the implementation of this AWMP.

Signature:  Date: 2-10-17
Name: Ed or Lisa Heilman

The broiler operation is owned and operated by **Ed and Lisa Heilman** is located at **12616 S. Spangler Road, Oregon City, Oregon 97045**. The operation is a broiler chicken facility in Clackamas County. The permitted animal numbers are 112,500 broilers and 100 beef cattle. The facility is in full operation year round. Chicks are received from the hatchery in broods up to 112,500 for the 40 to 48 day grow out period. There are typically 6 grow out periods per year. The average weight per chicken estimated for manure volume is 3 pounds. The finished weight is 5 to 8 pounds per chicken. All manure and litter is collected and spread on pasture or sold to outside parties.

Fifty beef cows are kept on site all year, grazing 100% of the time. Each year about 50 calves are kept on site, confined for a very minimal time during calving and grazed approximately 6 months. After this they are taken to market to be sold as beef cattle.

Manure Management

Manure Collection Methods

The chickens are raised in 5 poultry houses, which are designed for loose housing using cedar shavings or fir microfiber for bedding. All manure is contained within the houses while the chickens are at the facilities. Between each grow the buildings are cleaned out using a Lewis poultry house decaking machine. The waste is then stored in a 45,000ft³ roofed structure until it can be spread on the fields or exported.

No substantial manure quantities are collected from the beef cows or calves. The small amount collected while in confinement or around the hay troughs will be spread on the pastures or stored under cover. ORAWM estimates 30 days of storage.

Manure Storage Facilities and Transfer

The manure storage on site includes the 5 chicken houses and a 45,000ft³ roofed structure. During the 45-day grow out period the manure is kept in the chicken houses. Between grow outs the houses are cleaned and the manure is stored until it can be spread on the pasture/hay ground. If saturated or frozen conditions exist the operators utilize the covered storage until the manure can be spread. Manure transfer activities are conducted in such a way as to minimize spillage of manure and litter outside of the poultry houses and manure storage barn. All transfer areas are cleaned up frequently.

Avian Influenza Outbreak

In case of an Avian Influenza outbreak in the state of Oregon, all animal mortalities will be disposed of in a manner that will comply with the Avian Influenza surveillance and Response Plan for domestic birds developed by the Oregon Department of Agriculture.

All animal mortalities effected (directly or indirectly) by Avian Influenza will be composted in existing chicken growing barns (fryer birds). The composting process will be done under the direction and in cooperation with the ODA divisions of Natural Resources and Animal Health and Identification. The composed manure/mortalities will be handled as manure and in a manner that complies with my current AWMP.

Disposal of the animal mortalities is in compliance with the Confined Animal Feeding Operation Permit and the approved AWMP for this facility.

Crop System

The land base consists of 212.3 acres of hay/pasture. Soils will be sampled at the one (1) foot level every five (5) years for nitrogen, phosphorous, and potassium. The pasture is estimated to yield 2-4 ton/acre on a 100% dry matter basis.

Land Base

Field Number	Acres	Crop	N Removed (lbs/acre)	P ₂ O ₅ Removed (lbs/acre)	Total N Removed (lbs)	Total P ₂ O ₅ Removed (lbs)
Keizer	9	Hay/Pasture	192	64	1,728	576
Jog	3	Hay/Pasture	192	64	576	192
#3 House	4	Hay/Pasture	192	64	768	256
Machine	7.3	Hay/Pasture	192	64	1,402	467
30 Acre	9	Hay/Pasture	192	64	1,728	576
Pat's	12	Hay/Pasture	192	64	2,304	768
Cindy's	10	Hay/Pasture	192	64	1,920	640
Lenigar's Back	10	Hay/Pasture	192	64	1,920	640
Lenigar's Front	5.5	Hay/Pasture	192	64	1,056	352
Rod Henry's	7.5	Hay/Pasture	192	64	1,440	480
Pearson's	29	Hay/Pasture	192	64	5,568	1,856
Back 80	60	Hay/Pasture	96	32	5,760	1,920
Ed Booder	46	Hay/Pasture	96	32	4,416	1,472
Total	212.3			Total	30,586	10,195

Manure Storage-

Storage Type:	Capacity	Estimated Storage Period
Solid Storage	45,000ft ³	30

Nutrient Balance-

Nutrients Generated:	N Generated (lbs) After losses	P₂O₅ Generated (lbs.) after losses
Solid Manure	49,353	69,100
Liquid Manure	0	0
Grazing	4,951	3,405
Total	54,304	72,505

Exported Nutrients	N Exported (lbs) after losses	P₂O₅ Exported (lbs.) after losses
Solid Manure	25,000	33,380
Liquid Manure	0	0
Grazing	0	0
Total	25,000	33,380

Crop Nutrient Removal	N Utilized (lbs)	P₂O₅ Utilized (lbs)
Total	30,586	10,195

Net Nutrients:	Nutrients Generated after losses (lbs)	Nutrients Removed by Crop and Exported after losses (lbs)	Net Nutrient Balance after losses (lbs)
Nitrogen	54,304	55,586	-1,282
P ₂ O ₅	72,505	43,575	28,930

System Losses:	Nutrients Generated (lbs)	Nutrients Remaining after Losses (lbs)	Nutrients Lost in System (lbs)
Nitrogen (N)	110,536	54,304	56,232
Phosphate (P ₂ O ₅)	72,505	72,505	0

Application Area

Application

The manure and irrigation application systems will be calibrated to agronomic applications of manure and processed wastewater. No applications of manure are to be applied in the setback areas. The phosphorous runoff rating for each of the farm fields is based on the Western Oregon Phosphorus Index. Wastewater, solid manure and commercial fertilizer for any field with a low or medium runoff rating can be applied on a nitrogen basis. No manure applications to fields with a "high" phosphorus rating. No applications of manure or commercial fertilizer containing phosphorus are to be made on a field with a "very high" phosphorus runoff rating.

General Considerations for Making Manure Applications

Manure applications may be made at any time of the year provided certain factors have been considered. However, the overriding factor one should use in considering whether or not to apply nutrients to a crop, irrespective of the nutrient source, is the agronomic need of the crop at the time of application. The following guidelines are to be considered once the decision has been made to make a manure application:

- **Manure applications may be done** as long as you can comply with all permit conditions. Based on crop nutrient uptake patterns, manure applications should stop when the crop is done growing for the year and before the first significant rainfall event that is expected to result in saturated soils or surface runoff.
- **Fields that are subsurface tile drained require additional precautions** when manure is applied. Any pre-application tillage should leave as much residue as possible on the soil surface. Water control structures installed in subsurface drainage systems should be managed to prevent discharge of manure and wastewater during periods of application.
- **Calibrate application equipment** to ensure uniform distribution and agronomic application rates.
- **Maintain setbacks for manure application from any surface waters.** The management goal is to allow no manure to enter surface waters at any time. The following table shows minimum setback requirements for manure applications:

Manure Type	Application Equipment	Seasons	
		Wet	Dry
Solid	Spreader	70 feet	35 feet

Note:

- a. Setbacks are the distance between open waterways and manure application area.
- b. Setback requirements will generally increase for manures which are applied aerially (such as a traveling big gun) versus manures applied lower to the ground (such as a splash bar) due to potential for drift from wind or splashing.

- **Record applications, transfers or exports of nutrients (manure and fertilizer)** and maintain them for 5 years. The CAFO Recordkeeping Calendar or other methods can be used to satisfy permit requirements for record keeping.

Considerations For Dry Season Manure Applications:

Apply wastewater and solids containing manure at agronomic rates using the following guidelines:

- Apply to land being prepared for crops and till manure into soil within 3 days of application if possible or apply to actively growing crops such as grass, clover or alfalfa.
- ***Do not apply*** during rainfall events that are expected to result in saturated soils or surface runoff.
- ***Maintain the setback buffer distances*** when making applications of liquids or solids containing manure.
- ***Record applications, transfers or exports*** of nutrients (manure and fertilizer) and maintain them for 5 years.

Considerations For Wet Season Manure Applications:

Only apply manure during this time period if the following guidelines CAN be met. Call the ODA CAFO Program at (503) 986-4700 for guidance if a manure application is needed and the following guidelines CAN NOT be met:

- Apply manure only to actively growing crops such as grass, clover or alfalfa.
- Minimize application rates by using the maximum travel rates for the application equipment.
- ***Maintain the setback buffer distance*** when making applications of liquids or solids containing manure.
- ***Do not apply*** during rainfall events that are expected to result in saturated soils or surface runoff.
- ***Do not apply*** to saturated or flooded soils. It is recommended that application(s) be limited to soils (areas) where the flooding frequency class rating is None, Very Rare, to Rare.
- ***Applications of wastewater or solids containing manure to frozen soils should be avoided.*** Do the following if an application of wastewater or solids containing manure is to be made to frozen soils:
 - Apply only enough wastewater or solids containing manure to address storage limitations until suitable soil conditions for application are available.
 - Minimize applications to 5 wet tons per acre or less of solids containing manure and 6,788 gallons (0.25 inches) per acre or less of wastewater.
 - Apply to alternating strips to reduce the risk of contaminated runoff reaching water sources.
 - Apply to fields of established hay, pasture, or fields containing at least 90% cover and are the furthest from open water sources.

- Runoff control systems such as earthen dikes must be in place where applications will be made to fields with slopes greater than 5%.
- **Record applications, transfers or exports** of nutrients (manure and fertilizer) and maintain them for at least 5 years.
- **Do not apply** manure or commercial fertilizer to fields receiving applications unless the nutrients applied in the manure are less than the annual application of nutrients.

Reporting & Records

Manure Application/Export

All manure application and export records will include the quantity of manure or wastewater. Records will be maintained and kept for five (5) years.

Reporting

All discharges must be reported to the Oregon Department of Agriculture within 24 hours (Salem 503-986-4699).

Animal Mortality

Having dead animals sent to an acceptable disposal site is the best method to deal with animal mortalities. A list of disposal sites can be found on the internet at <http://www.deq.state.or.us/wmc/solwaste/disposal.html>. Under no circumstances are animal mortalities to be disposed of in any type of liquid manure storage facility.

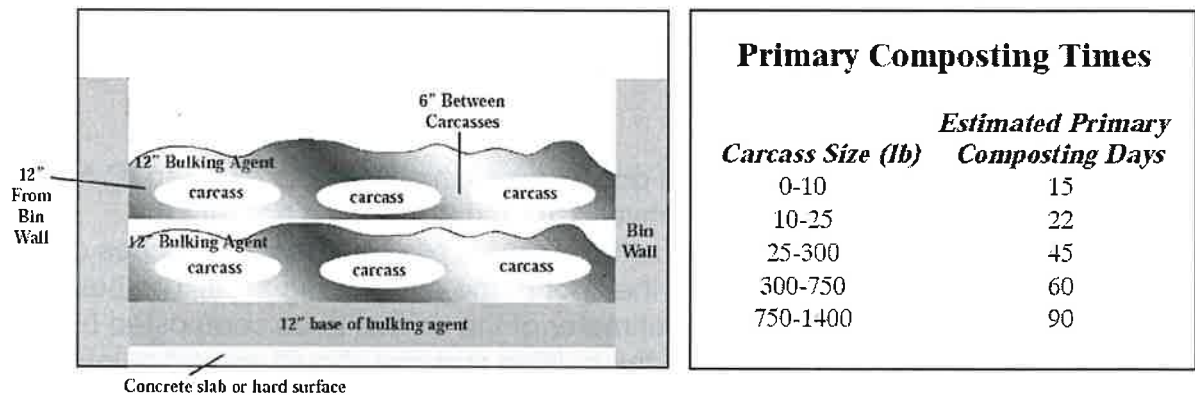
Rapid composting of dead animals occurs when the carbon to nitrogen (C:N) ratio of the compost mix ranges between 10 and 20 to 1. To achieve the recommended C:N ratio, build the initial compost pile by placing 18 inches of sawdust or other bulking agent on the floor of the composting area. The bulking agent should extend beyond the perimeter of the animal to be composted by at least 2 feet. If using a compost bin the bulking material should extend at least 1 foot beyond the perimeter of the animal being composted. Using a bulking agent such as sawdust will absorb any liquids as the animal decomposes during the composting process.

Once the bulking agent has been placed on the floor of the composting area, place the animal carcass on top. To decrease composting time and prevent bloating the body cavity should be cut open. Cover the carcass with 1 to 3 feet of separated manure solids or other material that has a moisture content between 30 to 60 percent and a C:N ratio of not more than 30 to 1. Use 1 foot of material for small carcasses and 3 feet for large carcasses such as cattle. Be careful not to add material that is too wet as it will hinder the composting process and cause

odors. Small animals can be layered in a compost pile by placing 12 inches of the bulking agent between layers as shown in the figure below. Be sure the total height of the compost pile does not exceed 7 feet in height as it may spontaneously combust causing a fire.

The first heating or primary composting cycle will take approximately 15 to 90 days depending on the size of the animal being composted. Refer to the table below for estimated primary composting times. Check pile temperature using thermometer probe on a daily basis. The pile temperature should be checked at multiple points around the compost pile and at a point approximately 3 feet into the pile. The temperature of the compost pile should reach 130 degrees Fahrenheit (F) within a few days. Temperatures should peak between 130 and 150 degrees F in 3 to 4 days. When the temperature of the compost pile falls below 130 degrees F, the compost needs to be aerated by turning or other means. Be sure carcasses remain covered with the bulking agent after being aerated. It is important to maintain a temperature above 130 degrees F for at least 7 days during the primary composting cycle as failure to do so may result in the incomplete destruction of pathogens and can cause fly and odor problems. After aerating the compost pile, the secondary composting times will be similar to the first.

After aerating the compost pile by turning or other means, be sure to check the moisture content and add water if necessary being careful not to add too much water. The compost pile should feel moist to the touch but you should not be able to squeeze any water out of it.



Odors given off by the composting operation is a good indicator of how the compost operation is proceeding. Foul odors may mean that the process has turned from aerobic to anaerobic. Anaerobic conditions are the result of insufficient oxygen in the compost. This may be caused by excessive moisture in the compost or the need for turning or aerating of the compost pile.

After the composting process is finished, it may be used as a bulking agent for a new compost pile. A rule of thumb is to use 50 percent of the composted material for a bulking agent but you may want to use more or less depending on how

degraded the bulking agent is in the finished compost. Using finished compost in a new compost pile reduces the amount of bulking agent needed for the new pile and provides microbial inoculants to get the composting process started.

Finished compost can also be applied to crop and pasture land fields for utilization of the nutrients and organics in the composted material. The nutrient content of the composted material should be determined and application equipment calibrated to ensure nutrients contained in the composted material are not over applied.

As an alternative one of the following methods may be used:

Natural Disposal- To allow nature to take its course the dead animal needs to be transported to a location at least $\frac{1}{2}$ mile from any off-farm dwelling and at least $\frac{1}{4}$ mile from any water way in accordance with ORS 601.140. Once this criteria is met the carcass can be left to degrade naturally with the help of scavengers.

Landfill- Dead animals may be transported to a permitted landfill that accepts animal carcasses for disposal. Be sure to call the chosen landfill first to insure a landfill will accept your animal carcasses. Refer to the website given previously for permitted landfills to call. Contact the landfill operator and the DEQ at (800) 452-4011 if the landfill you would like to use is not a permitted facility to see if an exception may be granted for the disposal of animal carcasses.

Incineration- Dead animals may be burned as a method of disposal and as a method to control diseases. Contact your DEQ at (800) 452-4011 for guidance on incineration of animal carcasses.

Burial- Dead animals may be buried as a method of disposal. Large animals such as an adult cow will require a hole approximately 2 feet by 7 feet by 8 feet deep. Be sure to select a site that doesn't have a water table to insure the bottom of the hole will be dry. The animal carcass should be covered with hydrated lime and covered with at least 4 feet of soil mounded 2 feet above the natural ground line to allow for settling as the carcass decomposes. Burial sites should be located at least 500 feet down slope from surface waters or wells.



Our Model 360 in the Lower Tom shed by House #2.

We use 1 bucket of cedar shavings, 1 bucket of manure to 1 bucket of mortality. The end product is mixed with the manure in the shed and spread upon the fields. We get on wheel barrel full of compost with each turn of the ecodrum.



- Molded from corrosion-free polyethylene for longevity
- Control system is automated and easy to use
- Forced air exhaust
- Supported by heavy-duty drive
- Powered by a 1hp 220v motor for low energy cost
- Stainless steel temperature probe
- Quick latch door
- Automatically discharges compost every rotation

- What is compost?

According to the EPA, compost is organic material that can be used as a soil amendment or as a medium to grow plants. It is created by combining organic wastes in proper ratios with bulking agents (e.g., wood shavings) to accelerate the breakdown of organic materials. More mature compost includes the production of high temperatures of at least 131F to destroy pathogens and weed seeds that natural decomposition does not destroy.

- What is In-Vessel composting?

Composting is a natural biological process, carried out under controlled aerobic (oxygen) conditions, where various microorganisms including bacteria and fungi break down organic matter into simpler substances. In in-vessel composting, organic materials are fed into a drum where the environmental conditions (including temperature, moisture and aeration) are closely controlled. The Ecodrum™ has a motor to turn the drum daily for proper aeration, and conversion of organic material to compost can take as little as a few weeks. The Ecodrum™ draws air through the compost drum to create higher temperatures and speed up the composting process.

- What inputs are required by the Ecodrum™ composting process?

The Ecodrum™ requires a 220V outlet in order to run the 1hp motor. Bulking is required in order to achieve a good finished product. Suggested bulking materials are wood shavings and peanut hulls. Other bulking materials may be used but a representative should be contacted in this case.

- Does the Ecodrum™ compost in cold weather?

Yes Ecodrum™ can be used in cold weather. We recommend sheltering the Ecodrum™ in areas where high wind chill, snow and freezing rain are present during the winter months. Also, a higher ratio of bulking material to organics may be required in these areas.

- What smells are produced by the Ecodrum™ composting process?

Aerobic hot composting processes such as the Ecodrum™ produce very little odor.

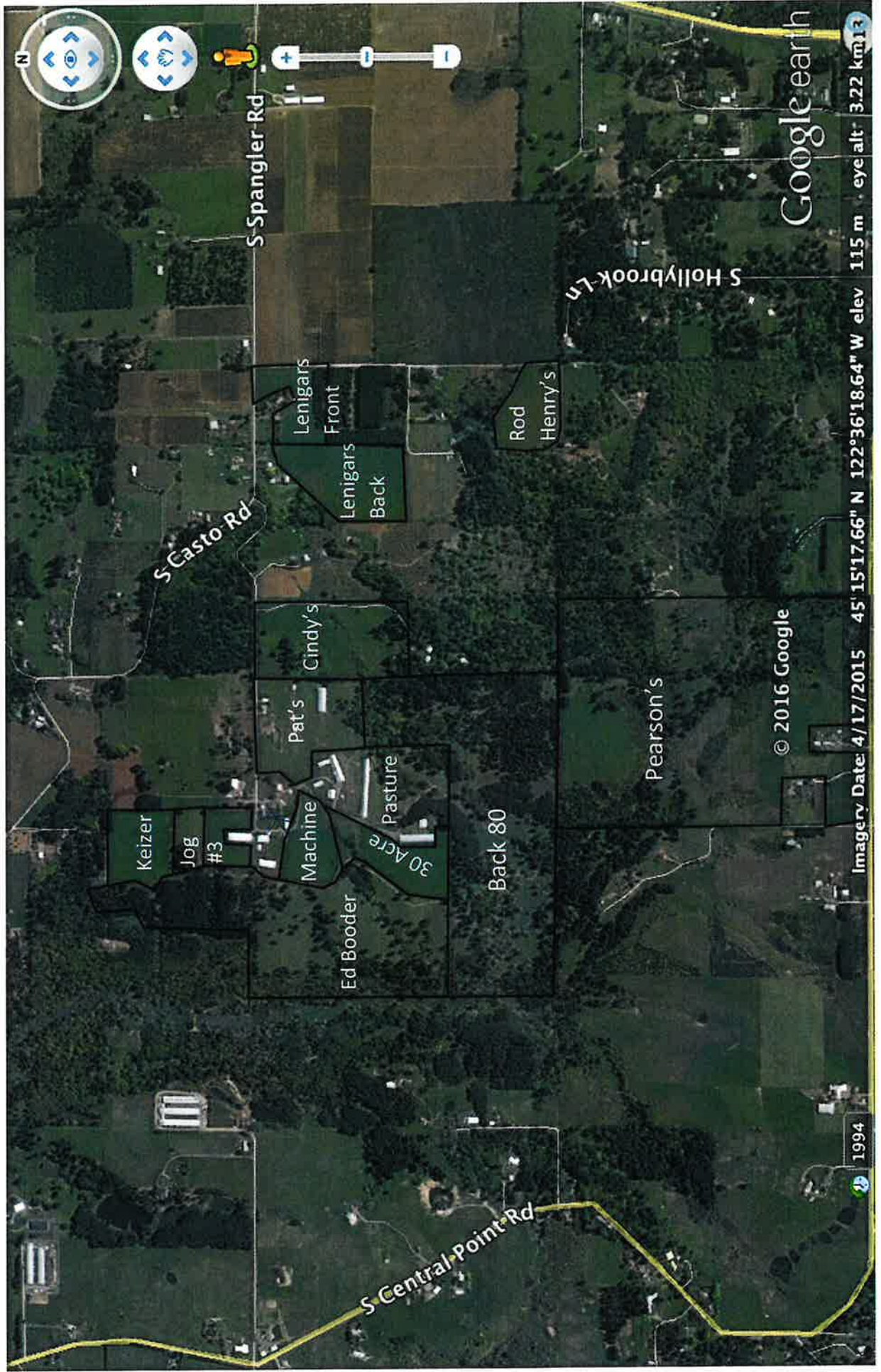
- How long does the Ecodrum™ composting process take?

It takes as little as 2 weeks to compost mortalities.



copied from website

Heilman Farm



LAND Application

Leased 15+ acres
LAND Application

Lease 10 acres
Spangler Lease 15+ acres

#3
15,000 Broiler Chickens
NO runoff

12621 house

Spangler Rd

Shed

Storage + Cows

Storage

12616 our house

12650 house

12700 house

hayshed

machine shed

Barn

LAND Application

LAND Application 5 acres

cow feeder

manure storage shed

#2 18,800 Chickens
NO runoff

Storage SHED

LAND Application

LAND Application

#5 Broiler House

NO runoff
#1
23,500 Chickens

road

road

#4 Broiler house

LAND Application

LAND Application

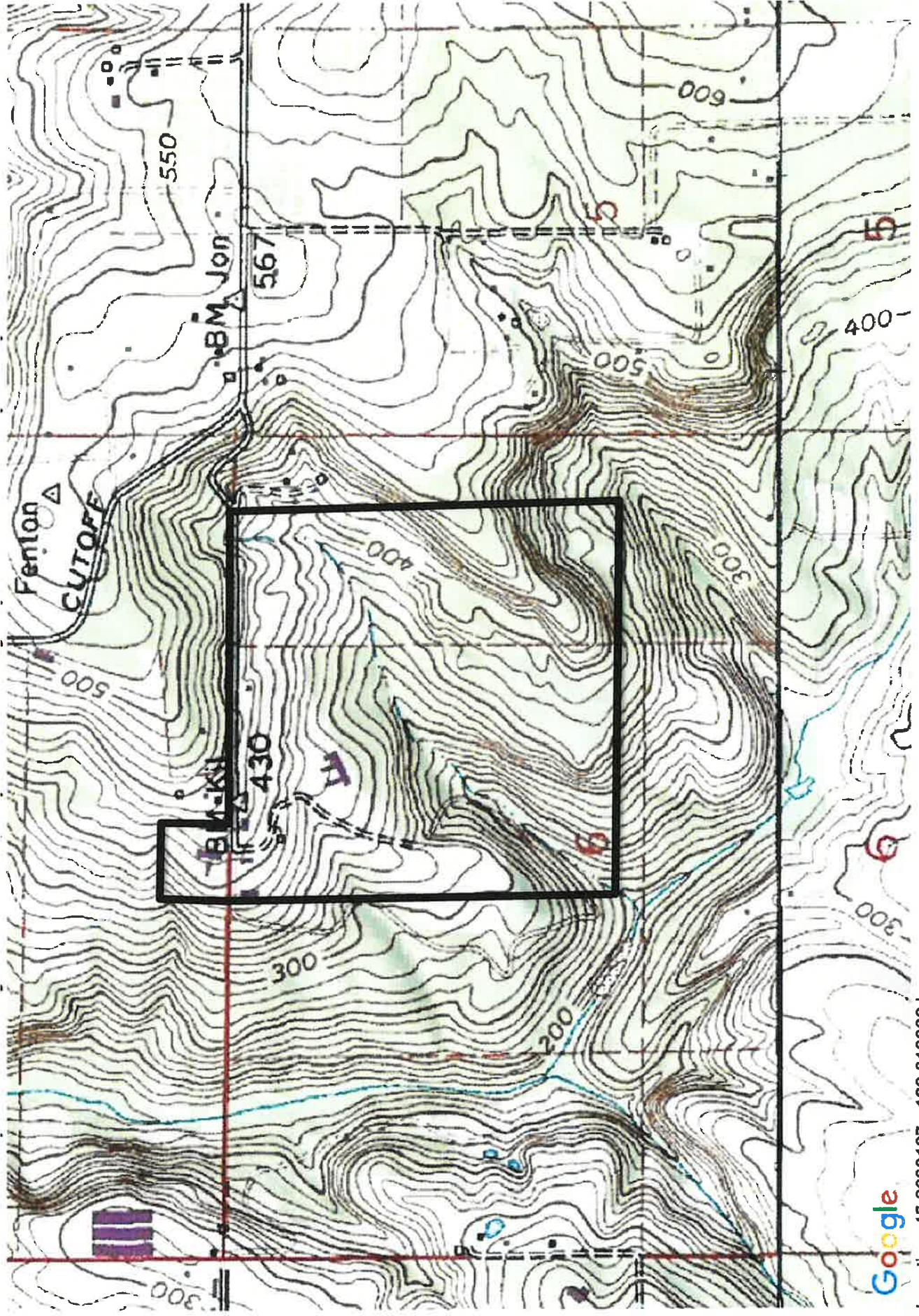
Property line

Creek

Creek

Creek at very back of property

Heilman Farm



Operation and Maintenance

Solids Storage Facility

Emptying of the solids storage facilities should begin in the spring and continue through the spring and summer months as weather conditions permit. To function properly and have the greatest management flexibility, the solids storage facilities must be as empty as possible in the fall before the fall and winter weather begins.

Periodically inspect concrete and asphalt slabs, walls and curbs and repair or replace broken sections as needed. Cleanup any spillage of manure and organics from outside of the solids storage area and place them back in the solids storage facility.

Maintain all fences, railings, and/or warning signs to provide warning and/or prevent unauthorized human or livestock entry. Immediately repair vandalism, vehicular or livestock damage to the structure, earthen areas surrounding the structure, or any appurtenances.

Building Roofs

Inspect building roofs annually as a minimum. Repair and/or replace all rusted sections and secure loose sections as needed. Immediately replace all broken trusses, rafters, beams, poles as needed. Immediately determining the cause and necessary modifications(s) to prevent reoccurring structural failure is essential.

Composting Facility

Take a representative sample of the raw compost mixture and have a laboratory determine the moisture content pH, and the carbon and nitrogen content.

The carbon to nitrogen ratio should range between 25 and 40 to 1. Make adjustments as needed to the ingredients of the raw compost mixture as necessary to achieve a carbon to nitrogen ratio within the acceptable range.

The moisture content should be between 40 and 60 percent. Add water or drier material to adjust the moisture content. Care must be taken to see that the carbon to nitrogen ratio of the mix is still in the 25 – 40 to 1 range after adjusting the moisture content.

The pH preferably should range between 6.5 and 8 however composting may be achieved between a pH of 5.5 and 9.0.

Check pile temperature using thermometer probe on a daily basis. The pile temperature should be checked at a point one-third the distance for the outside of the pile to center of the mass. Initially it will take approximately 2 to 3 days for

the compost to get above 105 degrees F. Compost temperatures should peak between 130 and 140 degrees F in 5 and 7 days. When the temperature of the compost material falls below 110 degrees F the compost needs to be aerated by turning or other means. Failure to achieve the desired temperatures may result in the incomplete destruction of pathogens and weed seeds and can cause fly and odor problems.

Odors given off by the composting operation is a good indicator of how the compost operation is proceeding. Foul odors may mean that the process has turned from aerobic to anaerobic. Anaerobic conditions are the result of insufficient oxygen in the compost. This may be caused by excessive moisture in the compost or the need for turning or aerating of the compost material.

For a well-managed windrow or static pile composting operation, the composting time during the summer months should range from 14 days to a month. To ensure finished compost, observe that the composted material has little or no trace of the original raw material and has little odor. The material should be black to brown in color. Particle size should be consistent and soil-like in texture.

All materials that are not considered feedstock for the composting process (i.e. plastic ear tags, plastic gloves, etc...) are to be collected and transported to a permitted landfill by a garbage collection service or other means. It is anticipated that there will be no other material that will require offsite disposal.

Periodically inspect concrete and asphalt slabs, walls and curbs and repair or replace broken sections as needed. Cleanup any spillage of composted material from outside of the composting area and place them back in the composting facility.

Maintain all fences, railings, and/or warning signs to provide warning and/or prevent unauthorized human or livestock entry. Immediately repair vandalism, vehicular or livestock damage to the structure, earthen areas surrounding the structure, or any appurtenances.

Fences

Do not allow livestock access to open watercourses and drainage ways. Provide off stream watering facilities where possible and limit access to designated watering areas.

Inspect fences periodically and repair or replace broken or decayed posts and tighten sagging wire as needed. Broken wire can be spliced or replaced. Replace broken or missing insulators on electric fences as needed and repair or replace inoperative electric fence controllers.

Insure gates and other appurtenances are in good working order. Replace or repair components as needed.

Livestock Watering Facilities

Check all above ground connections, valves, gates, rodent guards, inlets and outlets to make sure they are functioning properly. Check troughs and tanks for leaks or cracks and repair or replace immediately, if necessary.

Make certain the area adjacent to the trough is well protected with gravel, paving, or good cover. Be sure that the outlet pipe has a free outlet and is not causing any serious erosion problems. Check periodically to see if debris has fallen into the trough or tank which may restrict inflow or planned functions of the outflow system.

Clean the entire system periodically and remove moss, algae growth, and/or sludge. Chemicals such as copper sulfate and chlorine can be used to prevent moss and algae growth. Local rules and regulations are to be followed when using chemicals to make sure they are safe for animals.

Where necessary maintain coverings and insulation to prevent damage from freezing.

Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

Immediately repair any vandalism, vehicular or livestock damage.

Pipelines

Flush pipelines used for liquid waste applications with clean water following waste application, or as needed, to prevent particle buildup.

Drain the pipeline and components in areas that are subject to freezing. If parts of the pipeline cannot be drained, a non-toxic antifreeze solution may be added.

Check to make sure all valves and air vents are set at the proper operating condition so they can provide protection to the pipeline. Inspect pipelines for sign of failure. Inspect risers and valves periodically for leaks or worn gaskets. Repair or replace pipeline, risers and valves as needed.

Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activities.

Pumps

Operate and maintain pumps in accordance with good judgment and manufacturer's manuals and recommendations.

Drain liquid manure from pumps during cold weather to prevent freezing. If parts of the system cannot be drained, a non-toxic antifreeze solution may be added.

Inspect pumps periodically and remove debris wrapped around shafts and impellers. Maintain foot valves and check valves for proper operation.

For proper operation of electric motors and controls, maintain lubrication for all bearings, keep electric panel free from obstructions and debris. Maintain electrical safety devices, assure all electrical contacts are tight, and lock main electrical switch to "OFF" position during non-use season. Maintain adequate shade and ventilation for pump motors.

For proper operation of pumps, maintain lubrication for all bearings and pump shafts, assure belts are adjusted properly, maintain safety covering devices on open shafts and belt drives, check to make sure all safety valves and devices are set at proper operating conditions so they may provide protection to the pump and power unit. For centrifugal pumps, periodically measure tolerance between pump impeller and pump casing (i.e. wearing) and replace wear ring as needed to help restore new pump operating characteristics.

Use portable pressure gauge (preferably a liquid filled gauge) to monitor pump performance.

Operate and maintain agitators in accordance with the manufacturer's manual and recommendations. Inspect all plumbing annually as a minimum.

Replace, tighten, or repair broken or loose connections and lines as needed.

Wells

Protect the area immediately surrounding the well from being damaged by agriculture machinery, vehicles, or livestock.

All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.

Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

Check metal surfaces for rust and other damage especially sections in contact with earthfill and other materials. Repair or replace damaged section and apply paint as a protective covering.

Keep all surface water from entering or accumulating at the immediate vicinity of the well site.

Immediately repair any vandalism, vehicular, or livestock damage.

Chemical Handling Checklist

The following measures shall be taken to prevent chemicals from contaminating process water or storm water storage and treatment systems:

1. Make sure all chemicals are stored in proper containers. Expired chemicals and empty containers are to be properly disposed of in accordance with state and federal regulations. Pesticides and associate refuse are to be disposed of in accordance with the FIFRA label.
2. Chemical storage areas are to be self-contained with no drains or other pathways that will allow spilled chemicals to exit the storage area.
3. Chemical storage areas are to be covered to prevent chemical contact with rain or snow.
4. Emergency procedures and equipment are to be in place to contain and clean up chemical spills.
5. Chemical handling and equipment wash areas are to be designed and constructed to prevent contamination of surface waters, waste water, and storm water storage and treatment systems.

DATE: September 30, 2016
 REPORT: M 6791
 CLIENT: HEILMAN FARMS
 SOURCE:
 SAMPLED: ELISA HEILMAN
 TYPE: MANURE (SOLID)



**AgSource
 Laboratories**

A Subsidiary of Cooperative Resources International
 323 6th St. • P.O. Box 1350 • Umatilla, OR 97882
 Phone 541-922-4884 • Toll-Free 800-537-1129 • Fax 541-922-5496
 umatilla@agsource.com • www.agsource.com

MANURE ANALYSIS REPORT

LAB NO.	SAMPLE I.D.	UNIT	Total N	P2O5	K2O	Total S	NH4-N	pH	Mn	Cu	Fe	Soluble Salts	Moisture	Solids
8239	MANURE	As Rec'd %	2.850	2.170	2.301	0.544	0.150	8	0.028	0.023	0.049	0.687	16.86	83.14
		As Rec'd #/T	57.000	43.399	46.016	10.874	3.000		0.556	0.462	0.982	13.747		



DATE: March 24, 2014
 REPORT: M 3559
 CLIENT: HEILMAN, ELISA
 SOURCE:
 SAMPLED:
 TYPE: MANURE (SOLID)

MANURE ANALYSIS REPORT

LAB NO.	SAMPLE I.D.	UNIT	Total N	P2O5	K2O	Soluble	
						Salts	Moisture Solids
4726	MANURE HEILMAN FARMS	As Rec'd %	2.520	2.521	3.650	1.73	36.68
		As Rec'd #/T	50.400	50.411	72.999	34.650	63.32

AMOUNT OF MANURE TO APPLY FOR CROPS GROWN

The timing and frequency of applications of wastewater and solids containing manure for utilization by crops shown in the table below are based on information provided in Oregon State University Extension publications listed in Section 5.

The formulas for determining the total nutrient application rate per unit yield for each crop shown in the table below are as follows:

Total N to apply in pounds = N in pounds per yield unit from the table for the crop grown X percent (%) dry matter (DM) of harvested crop/100 X planned or measured yield per yield unit

Total P₂O₅ to apply in pounds = P in pounds per yield unit from the table for the crop grown X 2.291 P₂O₅/P X percent (%) dry matter (DM) of harvested crop/100 X planned or measured yield per yield unit

Total K₂O to apply in pounds = K in pounds per yield unit from the table for the crop grown X 1.205 K₂O/K X percent (%) dry matter (DM) of harvested crop/100 X planned or measured yield per yield unit

The following table shows the crops that may be grown on this farm:

FRUIT OR VEGETABLES	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/yield unit)		
				N	P	K
Beans, dry edible	cwt	100	100	3.13	0.45	0.85
Blueberries	ton	2000	100	2.14	0.20	3.54
Caneberries	ton	2000	100	11.43	7.42	11.43
Corn, Sweet	ton	2000	100	17.80	4.8	11.6
Mixed Vegetables & Fruit	ton	2000	100	8.33	2.08	10.20
Onions	cwt	100	100	0.30	0.06	0.22
Orchard, Fruit	ton	2000	100	13.00	2.00	16.00
Pea, edible	ton	2000	100	73.60	8.00	18.00
Potatoes	ton	2000	100	6.60	1.20	10.33

GRAIN, SEED OR OIL CROPS	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/field unit)		
				N	P	K
Barley	bushels	48	100	0.87	0.16	0.21
Beets, sugar	ton	2000	100	4.00	0.60	2.78
Canola	ton	2000	100	70.00	12.00	18.00
Corn, grain shelled	bushels	56	100	0.90	0.16	0.22
Crimson Clover seed	lb	1	100	0.05	0.01	0.02
Fescue Seed, Straw Removed	cwt	100	100	10.03	1.08	8.33
Fescue, seed (Fine or Tail)	lb	1	100	0.02	0.00	0.00
Grass Seed	cwt	100	100	1.60	0.20	0.40
Grass Seed, Straw Removed	ton	2000	100	33.90	5.50	34.40
Oats, grain	bushels	32	100	0.62	0.11	0.16
Orchardgrass seed	lb	1	100	0.016	0.002	0.004
Peppermint for Oil	ton	2000	100	4.20	1.80	2.80
Peppermint for Oil, Leaves and Stems Removed	ton	2000	100	87.2	36.8	57.8
Pumpkins	ton	2000	100	4.00	1.40	6.60
Red Clover seed	lb	1	100	0.05	0.01	0.02
Ryegrass Seed	cwt	100	100	1.60	0.20	0.40
Ryegrass, Perennial Seed	lb	1	100	0.02	0.002	0.004
Wheat, Soft White for grain	bushels	60	100	1.00	0.24	0.21
Wheat, Soft White Straw Removed	ton	2000	100	43.40	8.90	20.90
Wheat, Hard Red for grain	bushels	60	100	1.60	0.37	0.31
Wheat, Soft White Straw Removed	ton	2000	100	83.40	17.10	37.10

HAY AND PASTURE CROPS	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/field unit)		
				N	P	K
Alfalfa, Hay	ton	2000	100	64.00	8.00	42.00
Alta Fescue Hay/Pasture	ton	2000	100	33.00	6.90	37.60
Grass Legume Hay/Pasture	ton	2000	100	33.90	5.50	34.40
Meadow Fescue Hay/Pasture	ton	2000	100	41.60	8.80	47.40
Oats Hay/Pasture	ton	2000	100	60.00	10.20	14.80
Orchardgrass Hay/Pasture	ton	2000	100	53.20	8.60	18.60
Perennial Hay/Pasture (Low Intensity)	ton	2000	100	32.00	6.00	38.00
Perennial Hay/Pasture (Low-Med Intensity)	ton	2000	100	38.00	6.00	38.00
Perennial Hay/Pasture (Medium Intensity)	ton	2000	100	48.00	7.00	38.00
Perennial Hay/Pasture (Med- High Intensity)	ton	2000	100	58.00	8.00	40.00
Perennial Hay/Pasture (High Intensity)	ton	2000	100	64.00	8.00	40.00
Ryegrass Hay	ton	2000	100	33.40	5.40	28.40
Ryegrass, Perennial Pasture	ton	2000	100	58.00	8.00	48.00
Tall Fescue Hay/Pasture	ton	2000	100	39.40	4.00	40.00

SILAGE AND HAYLAGE CROPS	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/field unit)		
				N	P	K
Corn for Silage	ton	2000	100	7.50	1.20	6.00
Crimson Clover forage	ton	2000	100	40.00	4.41	32.98
Field Pea, Forage	ton	2000	100	73.60	8.00	18.00
Oat haylage	ton	2000	100	60.00	10.20	14.80
Oats & Peas/ Green Beans	ton	2000	100	32.03	5.58	18.65
Red Clover forage	ton	2000	100	40.00	4.41	32.98
Ryegrass Haylage	ton	2000	100	50.00	8.00	42.67
Sorghum-Sudan Haylage	ton	2000	100	54.33	6.33	58.00
Triticale Haylage	ton	2000	100	49.00	6.80	11.40
Wheatgrass Hay/Pasture	ton	2000	100	28.40	5.40	53.60

	OTHER CROPS	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/field unit)		
					N	P	K
	Hops, Cones	bale	200	100	9.00	0.96	5.00
	Natural Area (Trees and Grass)	ton	2000	100	10.52	1.56	9.20
	Nursery Stock	ton	2000	100	8.33	2.08	10.20

PHOSPHORUS INDEX WORKSHEET - WESTERN OREGON

Producer: Heilman Farm County: Clackamas Tract No. _____ Field No(s): Pearson Date: 9/30/16
 Soil Map Unit(s): 36B, 36C, 70B Soil Test P: 6 ppm Lab. Method: Bray Sample Depth: 12"
 Crop Rotation: Pasture Nutrient Application Method(s) Solids Spreader

Planner: _____ Notes: _____

TRANSPORT FACTORS	Factor Weight	PHOSPHORUS LOSS RATING						Weighted Rating Value	
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned	
Annual Soil Erosion - (T/ac/yr) for the year(s) of the manure application.	1.50	< 1 (0)	1 - 3 (1.5)	4 - 6 (3.0)	7 - 15 (6.0)	> 15 (12.0)	0	0	
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation	Application rate < infiltration rate OR No visible runoff at field borders	Application rate = infiltration rate OR Little to no visible runoff at field borders	Application rate > infiltration rate OR Visible runoff at field borders	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present.	0	0	
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	8	8	
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	0	0	
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 - 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 - 299 feet OR buffer 10 - 19 ft. wide next to surface waters (1.5)	100 - 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	0	0	
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141 - 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0	
Transport Factors Subtotal (TFS)							8	8	

Tract _____ Fields _____		PHOSPHORUS LOSS RATING					Weighted Rating Value		
SOURCE FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned	
Soil Test P - ppm (Bray P1)	1.00	(Soil Test P - 40) x 0.10	(6 - 40) x 0.10 = 0 ppm	Assign 0 points if Soil Test P < 40			0		
Commercial P Fertilizer Application Rate	1.00	lbs/ac P ₂ O ₅ x 0.02 = 0						0	
Commercial P Fertilizer Application Method	1.00	None Applied	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September	Incorporated within 5 days of application from October through February OR Surface applied March through August	Incorporated more than 5 days after application OR Surface applied September through October	Surface applied November through February	0		
			(0)	(1.0)	(2.0)	(4.0)	(8.0)	0	
Organic P Source Application Rate	1.00	lbs/ac P ₂ O ₅ x 0.02 = 187						3.74	
Organic P Source Application Method	1.00	None Applied	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September	Incorporated within 5 days of application from October through February OR Surface applied March through August	Incorporated more than 5 days after application OR Surface applied September through October	Surface applied November through February	4		
			(0)	(1.0)	(2.0)	(4.0)	(8.0)	4	

	Current	Planned
Transport Factors Subtotal (TFS)	8	
Source Factors Subtotal (SFS)	7.74	
Total Rating Value (TFS + SFS)	15.74	
Site Vulnerability Class	Medium	

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 - 25.0	Medium
25.1 - 50.0	High
> 50.0	Very High

PHOSPHORUS INDEX WORKSHEET - WESTERN OREGON

Producer: Heilman Farm County: Clackamas Tract No. _____ Field No(s): Leigars Date: 9/30/16
 Soil Map Unit(s): 45B Soil Test P: 20 ppm Lab. Method: Bray Sample Depth: 12"
 Crop Rotation: Pasture Nutrient Application Method(s) Solids Spreader

Planner: _____ Notes: _____

PHOSPHORUS LOSS RATING							Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Annual Soil Erosion - (T/ac/yr) for the year(s) of the manure application.	1.50	< 1 (0)	1 - 3 (1.5)	4 - 6 (3.0)	7 - 15 (6.0)	> 15 (12.0)	<u>0</u>	_____
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation	Application rate < infiltration rate OR No visible runoff at field borders	Application rate = infiltration rate OR Little to no visible runoff at field borders	Application rate > infiltration rate OR Visible runoff at field borders	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present.	<u>0</u>	_____
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	<u>1</u>	_____
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	<u>0</u>	_____
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters	300 - 500 feet OR buffer 20 - 30 ft. wide next to surface waters	200 - 299 feet OR buffer 10 - 19 ft. wide next to surface waters	100 - 199 feet AND buffer < 10 ft. wide next to surface waters	< 100 feet AND No buffer next to surface waters	<u>0</u>	_____
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141 - 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	<u>0</u>	_____
Transport Factors Subtotal (TFS)							1	_____

Tract _____ Fields _____		PHOSPHORUS LOSS RATING						Weighted Rating Value	
SOURCE FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned	
Soil Test P – ppm (Bray P1)	1.00	$(\text{Soil Test P} - 40) \times 0.10$ (<u>20</u> - 40) $\times 0.10 =$ <u>0</u> ppm Assign 0 points if Soil Test P < 40 Soil Test P						<u>0</u>	<u>0</u>
Commercial P Fertilizer Application Rate	1.00	$\text{lbs/ac P}_2\text{O}_5 \times 0.02$ <u>0</u> $\times 0.02 =$ <u>0</u>						<u>0</u>	<u>0</u>
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied through August through October (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	<u>0</u>	<u>0</u>	
Organic P Source Application Rate	1.00	$\text{lbs/ac P}_2\text{O}_5 \times 0.02$ <u>187</u> $\times 0.02 =$ <u>3.74</u>						<u>3.74</u>	<u>0</u>
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied through August through October (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	<u>4</u>	<u>0</u>	

	Current	Planned
Transport Factors Subtotal (TFS)	<u>2</u>	
Source Factors Subtotal (SFS)	<u>7.74</u>	
Total Rating Value (TFS + SFS)	<u>9.74</u>	
Site Vulnerability Class	<u>Low</u>	

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 – 25.0	Medium
25.1 – 50.0	High
> 50.0	Very High

PHOSPHORUS INDEX WORKSHEET - WESTERN OREGON

Producer: Heilman Farm County: Clatsop Tract No. _____ Field No(s): Cindy's Date: 09/29/17
 Soil Map Unit(s): 36G Soil Test P: 11 ppm Lab. Method: Bray Sample Depth: 12"
 Crop Rotation: Pasture Nutrient Application Method(s) Solid Manure Spreader

Planner: _____ Notes: _____

TRANSPORT FACTORS	Factor Weight	PHOSPHORUS LOSS RATING						Weighted Rating Value	
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned	
Annual Soil Erosion - (T/ac/yr) for the year(s) of the manure application.	1.50	< 1 (0)	1 - 3 (1.5)	4 - 6 (3.0)	7 - 15 (6.0)	> 15 (12.0)	0	0	
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation	Application rate < infiltration rate OR No visible runoff at field borders	Application rate = infiltration rate OR Little to no visible runoff at field borders	Application rate > infiltration rate OR Visible runoff at field borders	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present.	0	0	
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	4	0	
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	0	0	
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters	300 - 500 feet OR buffer 20 - 30 ft. wide next to surface waters	200 - 299 feet OR buffer 10 - 19 ft. wide next to surface waters	100 - 199 feet AND buffer < 10 ft. wide next to surface waters	< 100 feet AND No buffer next to surface waters	0	0	
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141 - 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0	
Transport Factors Subtotal (TFS)							4		

Tract _____ Fields _____		PHOSPHORUS LOSS RATING					Weighted Rating Value			
SOURCE FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned		
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) x 0.10	(<u>11</u> – 40) x 0.10 = <u>0</u> ppm	Assign 0 points if Soil Test P < 40					<u>0</u>	<u>0</u>
Commercial P Fertilizer Application Rate	1.00	lbs/ac P ₂ O ₅ x 0.02 = <u>0</u> x 0.02 = <u>0</u>							<u>0</u>	<u>0</u>
Commercial P Fertilizer Application Method	1.00	None Applied	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September	Incorporated within 5 days of application from October through February OR Surface applied March through August	Incorporated more than 5 days after application OR Surface applied September through October	Surface applied November through February	<u>0</u>	<u>0</u>		
		(0)	(1.0)	(2.0)	(4.0)	(8.0)	<u>0</u>	<u>0</u>		
Organic P Source Application Rate	1.00	lbs/ac P ₂ O ₅ x 0.02 = <u>187</u> x 0.02 = <u>3.74</u>							<u>3.74</u>	<u>3.74</u>
Organic P Source Application Method	1.00	None Applied	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September	Incorporated within 5 days of application from October through February OR Surface applied March through August	Incorporated more than 5 days after application OR Surface applied September through October	Surface applied November through February	<u>4</u>	<u>4</u>		
		(0)	(1.0)	(2.0)	(4.0)	(8.0)	<u>4</u>	<u>4</u>		

	Current	Planned
Transport Factors Subtotal (TFS)	<u>4</u>	
Source Factors Subtotal (SFS)	<u>7.74</u>	
Total Rating Value (TFS + SFS)	<u>11.74</u>	
Site Vulnerability Class	<u>Low</u>	

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 – 25.0	Medium
25.1 – 50.0	High
> 50.0	Very High

PHOSPHORUS INDEX WORKSHEET - WESTERN OREGON

Producer: Heilman Farm County: Clackamas Tract No. _____ Field No(s): 30AcreField Date: 9/29/16

Soil Map Unit(s): 36B Soil Test P: 308 ppm Lab. Method: Bray Sample Depth: 12"

Crop Rotation: Pasture Nutrient Application Method(s): Solids Spreader

Planner: _____ Notes: _____

TRANSPORT FACTORS	Factor Weight	PHOSPHORUS LOSS RATING						Weighted Rating Value	
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned	
Annual Soil Erosion - (T/ac/yr) for the year(s) of the manure application.	1.50	< 1 (0)	1 - 3 (1.5) Application rate < infiltration rate OR No visible runoff at field borders	4 - 6 (3.0) Application rate = infiltration rate OR Little to no visible runoff at field borders	7 - 15 (6.0) Application rate > infiltration rate OR Visible runoff at field borders	> 15 (12.0) Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present.	0	0	
Soil Erosion from Sprinkler Irrigation	0.75	(0) No sprinkler irrigation	(0.75) Very low or low	(1.5) Medium	(3.0) High	(6.0) Very High	0	2	
Runoff Class	1.00	(0) Negligible	(1.0) Very low or low	(2.0) Medium	(4.0) High	(8.0) Very High	0	2	
Flooding Frequency Class	0.75	(0) None or very rare	(0.75) Rare	(1.5) Occasional	(3.0) Frequent	(6.0) Very Frequent	0	0	
Distance to Perennial Surface Waters / Buffer Widths	0.75	(0) > 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters	(0.75) 300 - 500 feet OR buffer 20 - 30 ft. wide next to surface waters	(1.5) 200 - 299 feet OR buffer 10 - 19 ft. wide next to surface waters	(3.0) 100 - 199 feet AND buffer < 10 ft. wide next to surface waters	(6.0) < 100 feet AND No buffer next to surface waters	0	0	
Subsurface Drainage	0.50	(0) No Tile Drains	(0.5) Tile drains present Soil Test P (Bray P1) < 60 ppm	(1.0) Tile drains present Soil Test P (Bray P1) 61 - 140 ppm	(2.0) Tile drains present Soil Test P (Bray P1) 141 - 190 ppm	(4.0) Tile drains present Soil Test P (Bray P1) > 190 ppm	0	0	
Transport Factors Subtotal (TFS)							2	2	

Tract _____ Fields _____		PHOSPHORUS LOSS RATING					Weighted Rating Value		
SOURCE FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned	
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) x 0.10 = <u>308</u> - 40 x 0.10 = <u>26.8</u> Assign 0 points if Soil Test P < 40 ppm						<u>26.8</u>	_____
Commercial P Fertilizer Application Rate	1.00	lbs/ac P ₂ O ₅ x 0.02 = <u>0</u> x 0.02 = <u>0</u>						<u>0</u>	_____
Commercial P Fertilizer Application Method	1.00	None Applied	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September	Incorporated within 5 days of application from October through February OR Surface applied March through August	Incorporated more than 5 days after application OR Surface applied September through October	Surface applied November through February	<u>0</u>	_____	
		(0)	(1.0)	(2.0)	(4.0)	(8.0)	<u>0</u>	_____	
Organic P Source Application Rate	1.00	lbs/ac P ₂ O ₅ x 0.02 = <u>0</u> x 0.02 = <u>0</u>						<u>0</u>	_____
Organic P Source Application Method	1.00	None Applied	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September	Incorporated within 5 days of application from October through February OR Surface applied March through August	Incorporated more than 5 days after application OR Surface applied September through October	Surface applied November through February	<u>0</u>	_____	
		(0)	(1.0)	(2.0)	(4.0)	(8.0)	<u>0</u>	_____	

	Current	Planned
Transport Factors Subtotal (TFS)	<u>2</u>	_____
Source Factors Subtotal (SFS)	<u>26.8</u>	_____
Total Rating Value (TFS + SFS)	<u>28.8</u>	_____
Site Vulnerability Class	High	_____

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 – 25.0	Medium
25.1 – 50.0	High
> 50.0	Very High

PHOSPHORUS INDEX WORKSHEET - WESTERN OREGON

Producer: Heilman Farms County: Clackamas Tract No. _____ Field No(s). Machine Date: 9/30/16
 Soil Map Unit(s): 36C Soil Test P: 122 ppm Lab. Method: Bray Sample Depth: 12"
 Crop Rotation: Pasture Nutrient Application Method(s) Solids Spreader

Planner: _____ Notes: _____

PHOSPHORUS LOSS RATING							Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Annual Soil Erosion - (T/ac/yr) for the year(s) of the manure application.	1.50	< 1 (0)	1 - 3 (1.5)	4 - 6 (3.0)	7 - 15 (6.0)	> 15 (12.0)	0	_____
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0	_____
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	8	_____
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	0	_____
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 - 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 - 299 feet OR buffer 10 - 19 ft. wide next to surface waters (1.5)	100 - 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	0	_____
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141 - 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	_____
Transport Factors Subtotal (TFS)							8	_____

Tract	Fields	PHOSPHORUS LOSS RATING					Weighted Rating Value	
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) × 0.10	(<u>122</u> – 40) × 0.10 = <u>8.2</u> ppm	Assign 0 points if Soil Test P < 40			<u>8.2</u>	
Commercial P Fertilizer Application Rate	1.00	lbs/ac P ₂ O ₅ × 0.02	<u>0</u> × 0.02 = <u>0</u> lbs/ac P ₂ O ₅				<u>0</u>	
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	<u>0</u>	
Organic P Source Application Rate	1.00	lbs/ac P ₂ O ₅ × 0.02	<u>187</u> × 0.02 = <u>3.74</u> lbs/ac P ₂ O ₅				<u>3.74</u>	
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	<u>2</u>	

	Current	Planned
Transport Factors Subtotal (TFS)	<u>8</u>	
Source Factors Subtotal (SFS)	<u>13.94</u>	
Total Rating Value (TFS + SFS)	<u>21.94</u>	
Site Vulnerability Class	<u>Medium</u>	

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 – 25.0	Medium
25.1 – 50.0	High
> 50.0	Very High

PHOSPHORUS INDEX WORKSHEET - WESTERN OREGON

Producer: Heilman Farms County: Clackamas Tract No. Keizer Jog #3 Date: 9/30/16
 Soil Map Unit(s): 45C, 24C Soil Test P: 101 ppm Lab. Method: Bray Sample Depth: 12"
 Crop Rotation: Pasture Nutrient Application Method(s) Solid Spreader

Planner: _____ Notes: _____

PHOSPHORUS LOSS RATING							Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Annual Soil Erosion -- (T/ac/yr) for the year(s) of the manure application.	1.50	< 1 (0)	1 - 3 (1.5)	4 - 6 (3.0)	7 - 15 (6.0)	> 15 (12.0)	1	
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0	
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	2	
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	0	
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 - 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 - 299 feet OR buffer 10 - 19 ft. wide next to surface waters (1.5)	100 - 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	0	
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141 - 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	
Transport Factors Subtotal (TFS)							3	

Tract _____ Fields _____		PHOSPHORUS LOSS RATING					Weighted Rating Value	
SOURCE FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) x 0.10	(101 – 40) x 0.10 = 6.1 ppm			Assign 0 points if Soil Test P < 40	6.1	
Commercial P Fertilizer Application Rate	1.00		lbs/ac P ₂ O ₅ x 0.02	0		0 x 0.02 = 0	0	
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	0	
Organic P Source Application Rate	1.00		lbs/ac P ₂ O ₅ x 0.02	187		187 x 0.02 = 3.74	3.74	
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	4	

	Current	Planned
Transport Factors Subtotal (TFS)	3	
Source Factors Subtotal (SFS)	13.84	
Total Rating Value (TFS + SFS)	16.84	
Site Vulnerability Class	Medium	

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 – 25.0	Medium
25.1 – 50.0	High
> 50.0	Very High

PHOSPHORUS INDEX WORKSHEET - WESTERN OREGON

Producer: Heilman Farm County: Clackamas Tract No. Back 80 Date: 9/30/16

Soil Map Unit(s): 70D Soil Test P: 115 ppm Lab. Method: Bray Sample Depth: 12"

Crop Rotation: Pasture Nutrient Application Method(s) Solid Manure Spreader

Planner: _____ Notes: _____

PHOSPHORUS LOSS RATING							Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned
Annual Soil Erosion - (T/ac/yr) for the year(s) of the manure application.	1.50	< 1 (0)	1 - 3 (1.5)	4 - 6 (3.0)	7 - 15 (6.0)	> 15 (12.0)	0	
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0	
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	8	
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	0	
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 - 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 - 299 feet OR buffer 10 - 19 ft. wide next to surface waters (1.5)	100 - 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	0	
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141 - 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	
Transport Factors Subtotal (TFS)							8	

SOURCE FACTORS	Factor Weight	PHOSPHORUS LOSS RATING						Weighted Rating Value		
		None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Current	Planned		
Soil Test P - ppm (Bray P1)	1.00	(Soil Test P - 40) x 0.10	(115 - 40) x 0.10 = 7.5 ppm				Assign 0 points if Soil Test P < 40	7.5		
Commercial P Fertilizer Application Rate	1.00		lbs/ac P ₂ O ₅ x 0.02					0		
Commercial P Fertilizer Application Method	1.00	None Applied	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September	(1.0)	Incorporated within 5 days of application from October through February OR Surface applied through August	(2.0)	Incorporated more than 5 days after application OR Surface applied September through October	(4.0)	Surface applied November through February	(8.0)
									0	
Organic P Source Application Rate	1.00		lbs/ac P ₂ O ₅ x 0.02					3.74		
Organic P Source Application Method	1.00	None Applied	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September	(1.0)	Incorporated within 5 days of application from October through February OR Surface applied through August	(2.0)	Incorporated more than 5 days after application OR Surface applied September through October	(4.0)	Surface applied November through February	(8.0)
									4	

	Current	Planned
Transport Factors Subtotal (TFS)	8	
Source Factors Subtotal (SFS)	15.24	
Total Rating Value (TFS + SFS)	23.24	
Site Vulnerability Class	Medium	

Total Rating Value TFS + SFS	Site Vulnerability Class
< 13.0	Low
13.0 - 25.0	Medium
25.1 - 50.0	High
> 50.0	Very High

Submitted by: **UMH00114**
HEILMAN FARMS
12616 S SPANGLER RD
OREGON CITY, OREGON 97045-9527

323 Sixth Street
 Umatilla, OR
 Tel: 541-922-4600
 umatilla@agsource.com

Soil Analysis

Laboratory Sample #
AW60802 - AW60809

Date Received
29-Sep-2016

Date Reported
30-Sep-2016

Information Sheet No.
S2408

Field:

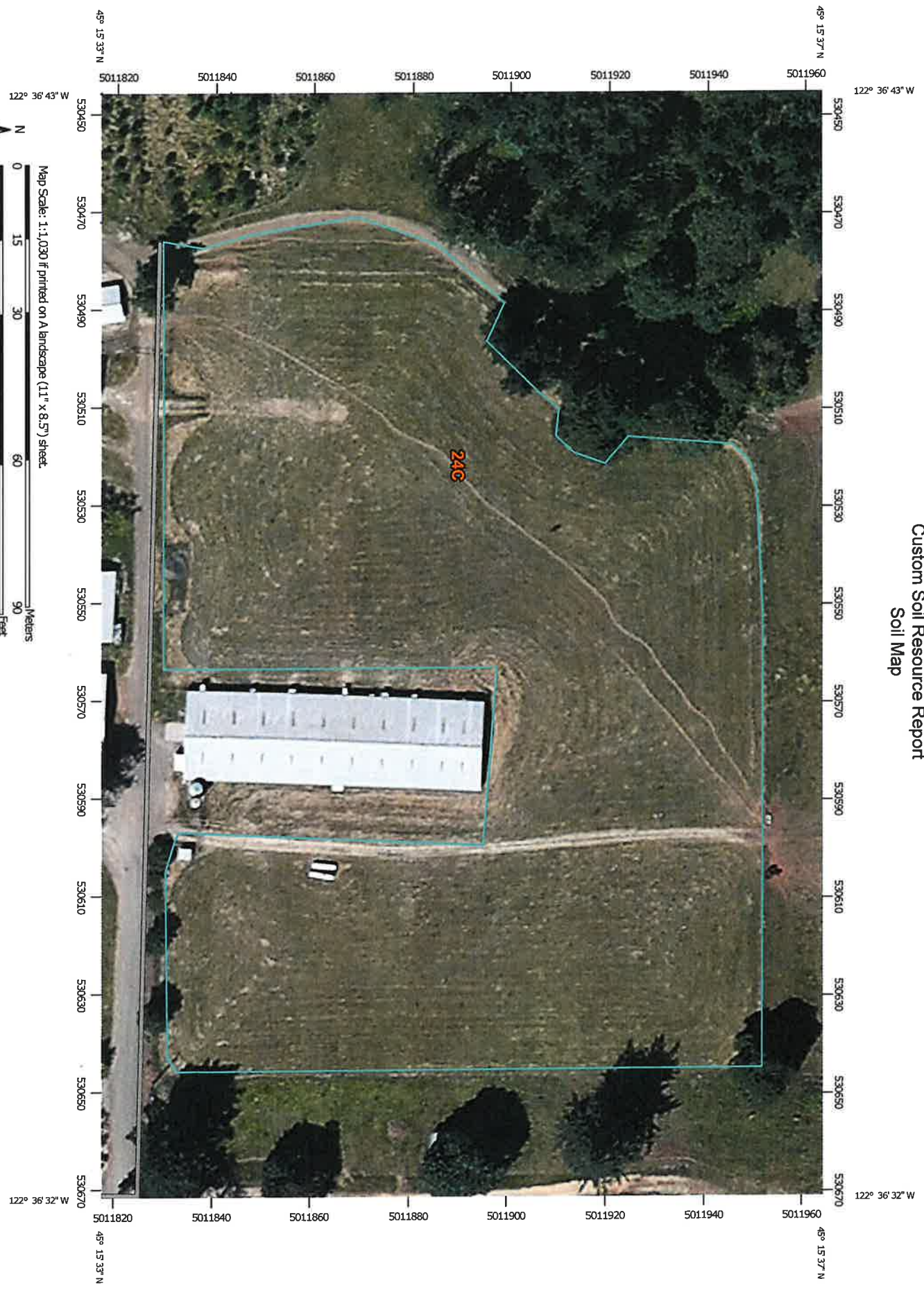
Crop:

Sampled: **29-Sep-2016**

Lab No.	Sample Id	Sample Depth	pH	BpH	SS mmhos	OM %	Ex Carb	Bray P ppm	Olsen P ppm	Ammonium Acetate			NO3 N lb/a	NH4 N lb/a	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Al ppm	Cl ppm	Est. CEC	Base Saturation				
										K meq	Ca meq	Na meq												H %	K %	Mg %	Ca %	Na %
AW60808	3 HOUSE KEIZER		5.6	6.2	0.1	3.2	NONE	101			340	2.2	7.6	0.11	56	16	42.2	0.5	3.5	37	3.5	61	19.9	45.3	4.4	11.3	38.5	0.6
AW60806	30 ACER FIELD = #5 house		5.6	6.1	0.2	4.8	NONE	308			382	2.2	9.1	0.13	117	21	28.7	0.7	11.9	65	12.1	159	22.4	44.6	4.4	9.8	40.6	0.6
AW60802	CINDY'S		5.3	6.0	0.1	2.8	NONE	11			247	1.8	6.2	0.11	42	33	32.8	0.3	1.5	46	1.5	56	19.7	55.8	3.2	9.2	31.3	0.6
AW60809	ED-BOODER		5.6	6.2	0.1	2.7	NONE	223			394	1.4	6.6	0.08	40	13	17.7	0.4	2.8	25	2.4	98	18.2	49.5	5.6	8.0	36.5	0.5
AW60803	LENIGAR BACK		5.5	6.1	0.1	4.1	NONE	20			212	1.2	5.8	0.10	42	21	62.0	0.6	2.2	33	3.2	40	17.6	56.9	3.1	6.7	32.7	0.6
AW60807	MACHUNE SHED		5.6	6.3	0.1	2.6	NONE	122			381	3.7	10.4	0.15	45	17	25.8	0.4	6.5	17	4.5	79	23.2	34.4	4.2	16.0	44.7	0.7
AW60805	PD&B WIRE GATE Back 80		5.3	5.5	0.1	3.2	NONE	115			238	2.7	8.4	0.14	58	20	33.4	0.5	5.8	39	6.1	190	27.9	57.4	2.2	9.9	30.0	0.5
AW60804	PEARSONS		5.1	6.0	0.1	1.2	NONE	6			168	2.2	4.6	0.16	31	18	45.2	0.2	1.2	31	1.5	46	18.4	59.9	2.4	11.8	25.1	0.9

#3 House

Custom Soil Resource Report Soil Map



Map Scale: 1:1,030 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge UTM: UTM Zone 10N WGS84

MAP LEGEND

	Area of Interest (AOI)		Spot Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
	Special Point Features		Water Features
	Blowout		Streams and Canals
	Borrow Pit		Transportation
	Clay Spot		+++
	Closed Depression		Rails
	Gravel Pit		Interstate Highways
	Gravelly Spot		US Routes
	Landfill		Major Roads
	Lava Flow		Local Roads
	Marsh or swamp		Background
	Mine or Quarry		Aerial Photography
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
24C	Cottrell silty clay loam, 8 to 15 percent slopes	4.0	100.0%
Totals for Area of Interest		4.0	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.

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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.

Clackamas County Area, Oregon

24C—Cottrell silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223w
Elevation: 300 to 900 feet
Mean annual precipitation: 45 to 80 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cottrell and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cottrell

Setting

Landform: Terraces, hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve, riser
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Old alluvium

Typical profile

H1 - 0 to 24 inches: silty clay loam
H2 - 24 to 55 inches: silty clay
H3 - 55 to 86 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes
(G002XY004OR)

Minor Components

Borges

Percent of map unit: 4 percent
Landform: Depressions on terraces, hillslopes
Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Base slope, tread

Down-slope shape: Linear

Across-slope shape: Linear

Other vegetative classification: Poorly Drained (G002XY006OR)

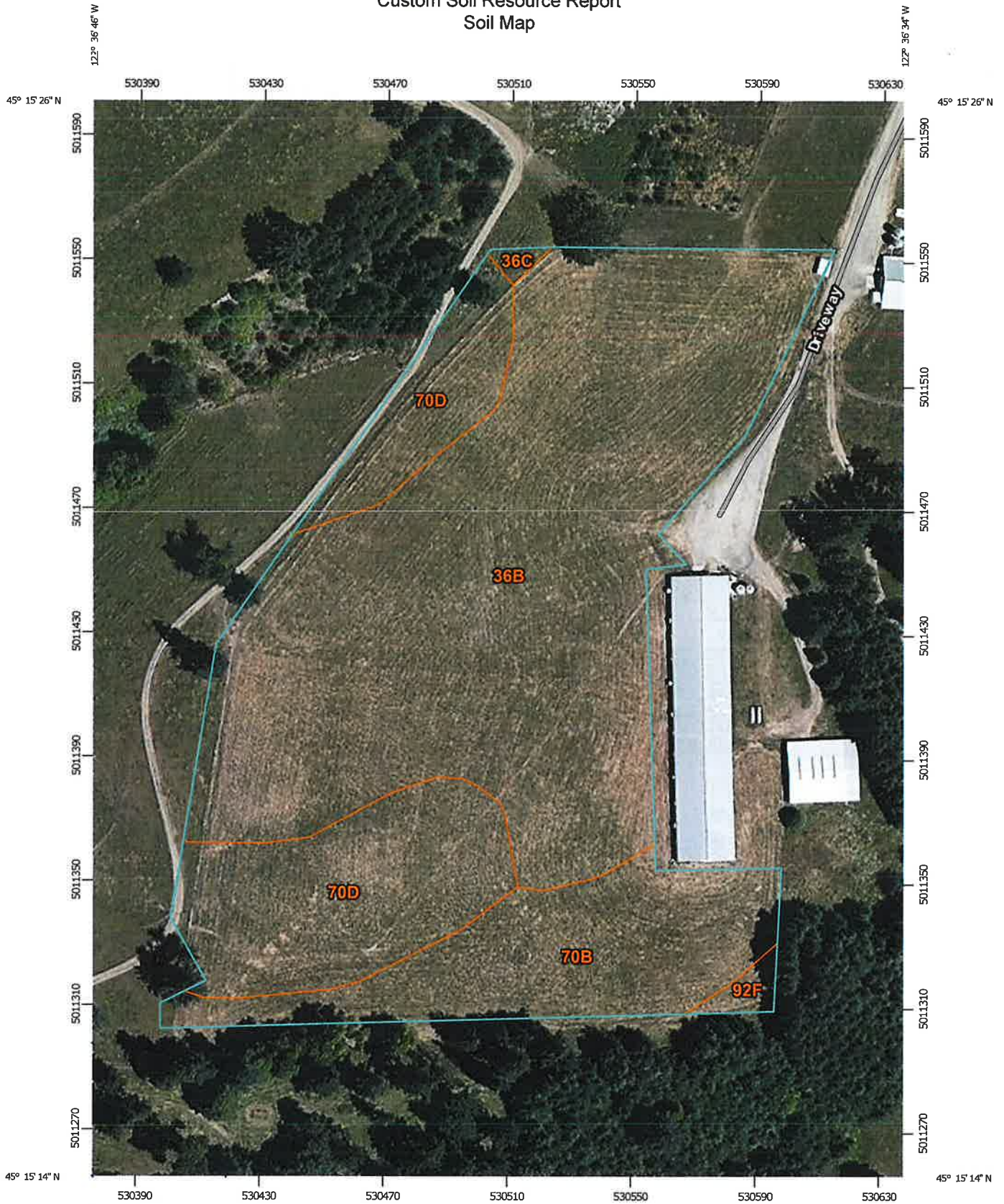
Custom Soil Resource Report

Physical Soil Properties--Clackamas County Area, Oregon

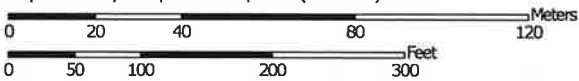
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
24C--Cottrell silty clay loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Cottrell	0-24	-20-	-49-	27-31- 35	1.30-1.40- 1.50	4.00-9.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	3.0- 3.5- 4.0	.32	.32	5	6	48
	24-55	- 7-	-48-	40-45- 50	1.20-1.25- 1.30	1.40-3.00-4.00	0.15-0.16-0.1 7	3.0- 4.5- 5.9	0.5- 1.8- 3.0	.28	.28			
	55-86	- 8-	-55-	30-38- 45	1.30-1.35- 1.40	1.40-3.00-4.00	0.15-0.18-0.2 1	3.0- 4.5- 5.9	0.0- 0.3- 0.5	.37	.37			

#5 House (30 Acre Field)

Custom Soil Resource Report Soil Map






























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



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

 Area of Interest (AOI)	 Area of Interest (AOI)	 Spoil Area
Soils	 Soil Map Unit Polygons	 Stony Spot
 Soil Map Unit Lines	 Soil Map Unit Points	 Very Stony Spot
Special Point Features	 Blowout	 Wet Spot
 Borrow Pit	 Clay Spot	 Other
 Closed Depression	 Gravel Pit	 Special Line Features
 Gravelly Spot	 Landfill	Water Features
 Lava Flow	 Marsh or swamp	 Streams and Canals
 Mine or Quarry	 Miscellaneous Water	Transportation
 Perennial Water	 Rock Outcrop	 Rails
 Rock Outcrop	 Saline Spot	 Interstate Highways
 Sandy Spot	 Severely Eroded Spot	 US Routes
 Sinkhole	 Slide or Slip	 Major Roads
 Sodic Spot		 Local Roads
		 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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
36B	Hardscrabble silt loam, 2 to 7 percent slopes	5.5	62.3%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	0.0	0.4%
70B	Powell silt loam, 0 to 8 percent slopes	1.4	15.7%
70D	Powell silt loam, 15 to 30 percent slopes	1.8	20.9%
92F	Xerochrepts and Haploxerolls, very steep	0.1	0.8%
Totals for Area of Interest		8.8	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.

Custom Soil Resource Report

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.

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

Clackamas County Area, Oregon

36B—Hardscrabble silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 224j
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Foothlope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluvium
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

70B—Powell silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 226l
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 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

Powell and similar soils: 80 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 15 to 23 inches to fragipan
Natural 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 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

Minor Components

Delena

Percent of map unit: 4 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

Aquepts

Percent of map unit: 2 percent
Landform: Depressions

70D—Powell silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 226n
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 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

Powell and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 15 to 23 inches to fragipan
Natural 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 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Custom Soil Resource Report

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: D

Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)

Minor Components

Delena

Percent of map unit: 4 percent

Landform: Terraces, hillslopes

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Interfluve, riser

Down-slope shape: Linear

Across-slope shape: Linear

Other vegetative classification: Poorly Drained (G002XY006OR)

92F—Xerochrepts and Haploxeroils, very steep

Map Unit Setting

National map unit symbol: 2281

Elevation: 50 to 1,000 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: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 50 percent

Haploxeroils and similar soils: 35 percent

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

Description of Xerochrepts

Setting

Landform: Terraces

Landform position (three-dimensional): Riser

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 8 inches: silt loam

H2 - 8 to 48 inches: gravelly clay loam

H3 - 48 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent

Depth to restrictive feature: More than 80 inches

Natural 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: About 36 to 72 inches

Custom Soil Resource Report

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Description of Haploxerolls

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 60 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 1.98 in/hr)
Depth to water table: About 36 to 48 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
36B— Hardscrabble silt loam, 2 to 7 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
Hardscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	2.0-4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1	6.0- 7.5- 8.9	0.0-0.3- 0.5	.24	.24			
36C— Hardscrabble silt loam, 7 to 20 percent slopes														
Hardscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	2.0-4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1	6.0- 7.5- 8.9	0.0-0.3- 0.5	.24	.24			
70B—Powell silt loam, 0 to 8 percent slopes														
Powell	0-7	-11-	-67-	20-22- 24	1.15-1.20- 1.25	4.00-9.00-14.00	0.21-0.23-0.2	0.0- 1.5- 2.9	4.0-5.0- 6.0	.43	.43	3	6	48
	7-15	-10-	-68-	18-23- 27	1.10-1.23- 1.35	4.00-9.00-14.00	0.19-0.21-0.2	0.0- 1.5- 2.9	1.0-2.5- 4.0	.49	.49			
	15-60	-9-	-67-	18-24- 30	1.60-1.63- 1.65	0.42-0.91-1.40	0.09-0.11-0.1	0.0- 1.5- 2.9	0.1-0.6- 1.0	.55	.55			

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon











































Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
70D—Powell silt loam, 15 to 30 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Powell	0-7	-11-	-67-	20-22- 24	1.15-1.20-1.25	4.00-9.00-14.00	0.21-0.23-0.25	0.0-1.5-2.9	4.0-5.0-6.0	.43	.43	3	6	48
	7-15	-10-	-68-	18-23- 27	1.10-1.23-1.35	4.00-9.00-14.00	0.19-0.21-0.23	0.0-1.5-2.9	1.0-2.5-4.0	.49	.49			
	15-60	-9-	-67-	18-24- 30	1.60-1.63-1.65	0.42-0.91-1.40	0.09-0.11-0.12	0.0-1.5-2.9	0.1-0.6-1.0	.55	.55			
92F—Xerochrepts and Haploxerolls, very steep														
Xerochrepts	0-8	-25-	-53-	18-23- 27	1.10-1.25-1.40	4.00-9.00-14.00	0.16-0.19-0.21	0.0-1.5-2.9	2.0-3.5-5.0	.37	.37	4	6	48
	8-48	-36-	-39-	20-25- 30	1.10-1.25-1.40	1.40-8.00-14.00	0.11-0.13-0.15	3.0-4.5-5.9	0.5-0.8-1.0	.20	.32			
	48-60	-35-	-34-	27-31- 35	1.20-1.30-1.40	1.40-3.00-4.00	0.09-0.11-0.12	3.0-4.5-5.9	0.0-0.3-0.5	.10	.32			
Haploxerolls	0-12	-24-	-51-	15-25- 35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	5.0-7.0-9.0	.32	.32	5	6	48
	12-60	-39-	-37-	15-25- 35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	0.5-1.3-2.0	.32	.32			

Fields # 1 and 2
(Pearsons Front)

Custom Soil source Report
Soil Map



MAP LEGEND

	Area of Interest (AOI)		Spill Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
	Special Point Features		Water Features
	Blowout		Streams and Canals
	Borrow Pit		Transportation
	Clay Spot		+++ Rails
	Closed Depression		Interstate Highways
	Gravel Pit		US Routes
	Gravelly Spot		Major Roads
	Landfill		Local Roads
	Lava Flow		Background
	Marsh or swamp		Aerial Photography
	Mine or Quarry		
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: Web Mercator (EPSG:3857)

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 Survey Area Data: Version 10, Sep 18, 2015

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Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
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Totals for Area of Interest		3.1	100.0%

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Custom Soil Resource Report

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

Clackamas County Area, Oregon

36B—Hardscrabble silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 224j
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Foothlope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

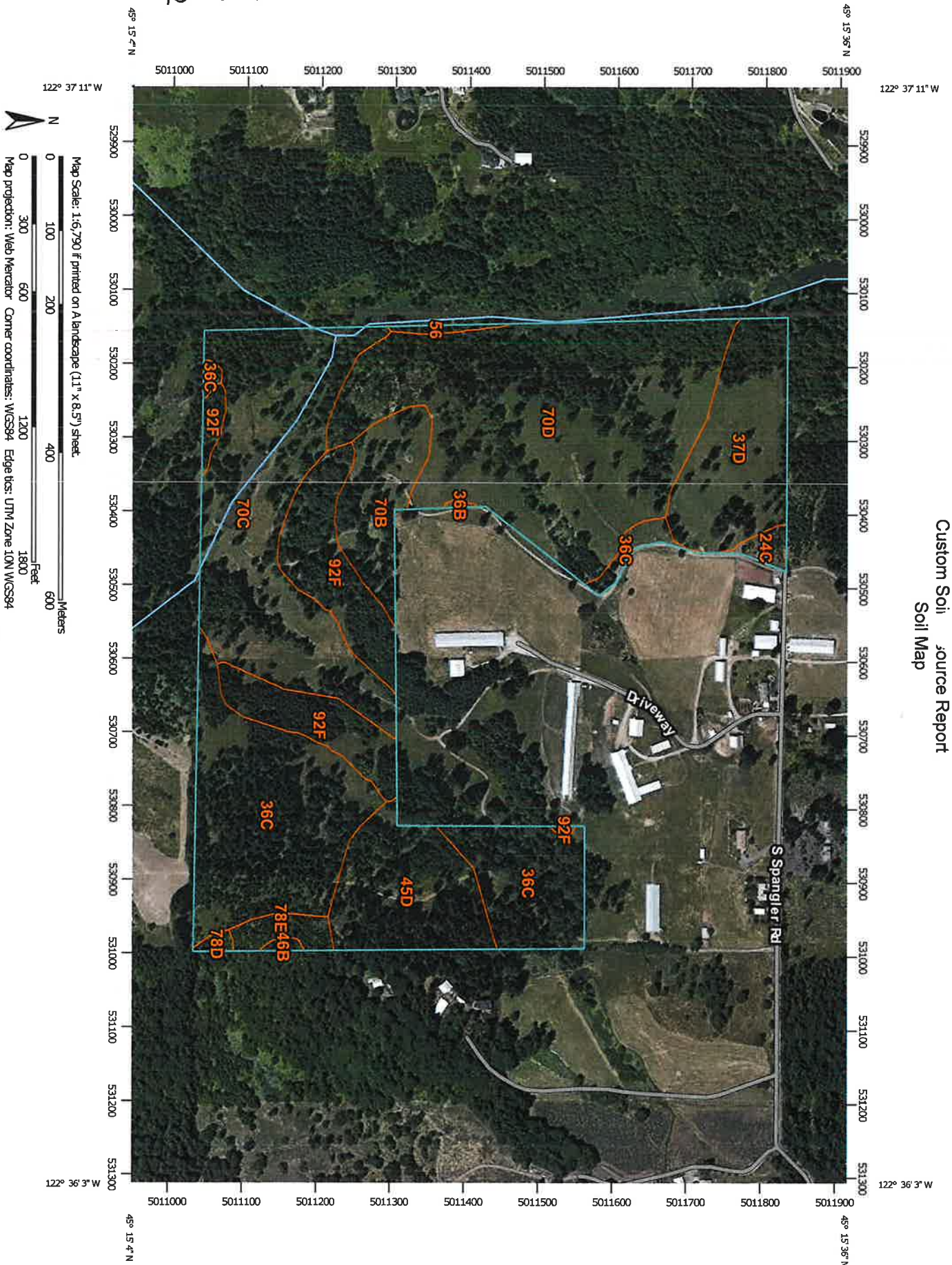
Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon






















Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kt	T		
36B— Hardscrabble silt loam, 2 to 7 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Hardscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	2.0- 4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1 6	6.0- 7.5- 8.9	0.0- 0.3- 0.5	.24	.24			

Back 80

Custom Soil Source Report
Soil Map



MAP LEGEND

 Area of Interest (AOI)	 Area of Interest (AOI)	 Spoil Area
Soils	 Soil Map Unit Polygons	 Stony Spot
 Soil Map Unit Lines	 Very Stony Spot	 Wet Spot
 Soil Map Unit Points	 Other	 Special Line Features
Special Point Features	 Special Line Features	Water Features
 Blowout	 Streams and Canals	Transportation
 Borrow Pit	 Rails	 Interstate Highways
 Clay Spot	 US Routes	 Major Roads
 Closed Depression	 Local Roads	 Background
 Gravel Pit	 Aerial Photography	
 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		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
24C	Cottrell silty clay loam, 8 to 15 percent slopes	0.7	0.6%
36B	Hardscrabble silt loam, 2 to 7 percent slopes	0.1	0.1%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	21.7	20.5%
37D	Helvetia silt loam, 15 to 30 percent slopes	9.0	8.5%
45D	Jory silty clay loam, 15 to 30 percent slopes	8.0	7.5%
46B	Jory stony silt loam, 3 to 8 percent slopes	0.2	0.2%
56	McBee silty clay loam	0.3	0.3%
70B	Powell silt loam, 0 to 8 percent slopes	5.1	4.8%
70C	Powell silt loam, 8 to 15 percent slopes	19.6	18.5%
70D	Powell silt loam, 15 to 30 percent slopes	29.5	27.9%
78D	Saum silt loam, 15 to 30 percent slopes	0.3	0.3%
78E	Saum silt loam, 30 to 60 percent slopes	1.3	1.3%
92F	Xerochrepts and Haploxerolls, very steep	10.2	9.6%
Totals for Area of Interest		105.9	100.0%

Map Unit Descriptions

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

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

Custom Soil Resource Report

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

Custom Soil Resource Report

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.

Clackamas County Area, Oregon

24C—Cottrell silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223w

Elevation: 300 to 900 feet

Mean annual precipitation: 45 to 80 inches

Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 140 to 200 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Cottrell and similar soils: 85 percent

Minor components: 4 percent

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

Description of Cottrell

Setting

Landform: Terraces, hillslopes

Landform position (two-dimensional): Summit, footslope

Landform position (three-dimensional): Base slope, interfluvium, riser

Down-slope shape: Linear, concave

Across-slope shape: Linear

Parent material: Old alluvium

Typical profile

H1 - 0 to 24 inches: silty clay loam

H2 - 24 to 55 inches: silty clay

H3 - 55 to 86 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent

Depth to restrictive feature: More than 80 inches

Natural 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 24 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C

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

Minor Components

Borges

Percent of map unit: 4 percent

Landform: Depressions on terraces, hillslopes

Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

36B—Hardscrabble silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 224j
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluvium
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

37D—Helvetia silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 224n
Elevation: 250 to 500 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

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

Description of Helvetia

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed old alluvium

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 21 inches: silty clay loam
H3 - 21 to 40 inches: silty clay
H4 - 40 to 60 inches: silty clay loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural 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 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained >15% Slopes
(G002XY003OR)

45D—Jory silty clay loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 224z
Elevation: 250 to 1,200 feet
Mean annual precipitation: 50 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

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

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluvium
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

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

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)

46B—Jory stony silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2251
Elevation: 250 to 1,200 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

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

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

H1 - 0 to 8 inches: stony silt loam
H2 - 8 to 48 inches: stony silty clay
H3 - 48 to 60 inches: stony silty clay

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

56—McBee silty clay loam

Map Unit Setting

National map unit symbol: 225t
Elevation: 50 to 1,200 feet
Mean annual precipitation: 40 to 60 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

Mcbee and similar soils: 85 percent
Minor components: 4 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 15 inches: silty clay loam
H2 - 15 to 48 inches: silty clay loam
H3 - 48 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural 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 24 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 11.6 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes
(G002XY004OR)

Minor Components

Wapato

Percent of map unit: 3 percent
Landform: Flood plains

Custom Soil Resource Report

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains

70B—Powell silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2261
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 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

Powell and similar soils: 80 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 15 to 23 inches to fragipan
Natural 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 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Custom Soil Resource Report

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

Minor Components

Delena

Percent of map unit: 4 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

Aquepts

Percent of map unit: 2 percent
Landform: Depressions

70C—Powell silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 226m
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Famland classification: Farmland of statewide importance

Map Unit Composition

Powell and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 15 to 23 inches to fragipan

Custom Soil Resource Report

Natural 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 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

Minor Components

Delena

Percent of map unit: 3 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Foothlope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

70D—Powell silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 226n
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 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

Powell and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam

Custom Soil Resource Report

H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 15 to 23 inches to fragipan
Natural 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 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)

Minor Components

Delena

Percent of map unit: 4 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

78D—Saum silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2273
Elevation: 250 to 800 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

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope

Custom Soil Resource Report

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural 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 storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)

78E—Saum silt loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2274
Elevation: 250 to 800 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: Not prime farmland

Map Unit Composition

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam

Custom Soil Resource Report

H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural 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 storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C

92F—Xerochrepts and Haploxerolls, very steep

Map Unit Setting

National map unit symbol: 2281
Elevation: 50 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Famland classification: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 50 percent
Haploxerolls and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerochrepts

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 48 inches: gravelly clay loam
H3 - 48 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Custom Soil Resource Report

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

Depth to water table: About 36 to 72 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

Description of Haploxerolls

Setting

Landform: Terraces

Landform position (three-dimensional): Riser

Down-slope shape: Concave

Across-slope shape: Linear

Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 12 inches: silt loam

H2 - 12 to 60 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)

Depth to water table: About 36 to 48 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
24C—Cottrell silty clay loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Cottrell	0-24	-20-	-49-	27-31- 35	1.30-1.40- 1.50	4.00-9.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	3.0- 3.5- 4.0	.32	.32	5	6	48
	24-55	-7-	-48-	40-45- 50	1.20-1.25- 1.30	1.40-3.00-4.00	0.15-0.16-0.1 7	3.0- 4.5- 5.9	0.5- 1.8- 3.0	.28	.28			
	55-86	-8-	-55-	30-38- 45	1.30-1.35- 1.40	1.40-3.00-4.00	0.15-0.18-0.2 1	3.0- 4.5- 5.9	0.0- 0.3- 0.5	.37	.37			
36B— Handscrabble silt loam, 2 to 7 percent slopes														
Handscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	2.0- 4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1 6	6.0- 7.5- 8.9	0.0- 0.3- 0.5	.24	.24			

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kt	T		
36C— Handscrabble silt loam, 7 to 20 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Handscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	2.0- 4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1	6.0- 7.5- 8.9	0.0- 0.3- 0.5	.24	.24			
37D—Helvetia silt loam, 15 to 30 percent slopes														
Helvetia	0-14	-27-	-54-	15-20- 25	1.10-1.20- 1.30	4.00-9.00-14.00	0.19-0.20-0.2	0.0- 1.5- 2.9	2.0- 3.0- 4.0	.37	.37	5	6	48
	14-21	-20-	-49-	27-31- 35	1.10-1.20- 1.30	4.00-9.00-14.00	0.19-0.20-0.2	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.37	.37			
	21-40	-8-	-50-	35-43- 50	1.20-1.30- 1.40	1.40-3.00-4.00	0.15-0.17-0.1	3.0- 4.5- 5.9	0.5- 0.8- 1.0	.32	.32			
	40-60	-18-	-52-	25-30- 35	1.20-1.30- 1.40	1.40-3.00-4.00	0.19-0.20-0.2	3.0- 4.5- 5.9	0.0- 0.3- 0.5	.43	.43			
45D—Jory silty clay loam, 15 to 30 percent slopes														
Jory	0-13	-19-	-48-	27-34- 40	1.20-1.25- 1.30	4.00-9.00-14.00	0.18-0.20-0.2	0.0- 1.5- 2.9	3.0- 4.5- 6.0	.32	.32	5	6	48
	13-60	-3-	-45-	45-53- 60	1.30-1.40- 1.50	1.40-3.00-4.00	0.15-0.16-0.1	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.24	.24			

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
46B—Joy stony silt loam, 3 to 8 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Joy	0-8	-25-	-52-	20-24- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.13-0.16-0.1 8	0.0-1.5-2.9	2.0-3.0- 4.0	.20	.37	5	7	38
	8-48	-5-	-45-	45-50- 55	1.30-1.40- 1.50	1.40-3.00-4.00	0.11-0.13-0.1 5	3.0-4.5-5.9	1.0-2.0- 3.0	.15	.24			
	48-60	-5-	-45-	45-50- 55	1.30-1.40- 1.50	1.40-3.00-4.00	0.11-0.13-0.1 5	3.0-4.5-5.9	0.5-0.8- 1.0	.15	.24			
56—McBee silty clay loam														
McBee	0-15	-7-	-62-	27-31- 35	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0-4.5-5.9	3.0-4.5- 6.0	.24	.24	5	6	48
	15-48	-7-	-62-	27-31- 35	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0-4.5-5.9	1.0-2.5- 4.0	.37	.37			
	48-60	-31-	-33-	27-36- 45	1.20-1.30- 1.40	1.40-2.70-4.00	0.13-0.17-0.2 1	3.0-4.5-5.9	0.5-0.8- 1.0	.32	.32			
70B—Powell silt loam, 0 to 8 percent slopes														
Powell	0-7	-11-	-67-	20-22- 24	1.15-1.20- 1.25	4.00-9.00-14.00	0.21-0.23-0.2 5	0.0-1.5-2.9	4.0-5.0- 6.0	.43	.43	3	6	48
	7-15	-10-	-68-	18-23- 27	1.10-1.23- 1.35	4.00-9.00-14.00	0.19-0.21-0.2 3	0.0-1.5-2.9	1.0-2.5- 4.0	.49	.49			
	15-60	-9-	-67-	18-24- 30	1.60-1.63- 1.65	0.42-0.91-1.40	0.09-0.11-0.1 2	0.0-1.5-2.9	0.1-0.6- 1.0	.55	.55			

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kt	T		
70C—Powell silt loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Powell	0-7	-11-	-67-	20-22-24	1.15-1.20-1.25	4.00-9.00-14.00	0.21-0.23-0.25	0.0-1.5-2.9	4.0-5.0-6.0	.43	.43	3	6	48
	7-15	-10-	-68-	18-23-27	1.10-1.23-1.35	4.00-9.00-14.00	0.19-0.21-0.23	0.0-1.5-2.9	1.0-2.5-4.0	.49	.49			
	15-60	-9-	-67-	18-24-30	1.60-1.63-1.65	0.42-0.91-1.40	0.09-0.11-0.12	0.0-1.5-2.9	0.1-0.6-1.0	.55	.55			
70D—Powell silt loam, 15 to 30 percent slopes														
Powell	0-7	-11-	-67-	20-22-24	1.15-1.20-1.25	4.00-9.00-14.00	0.21-0.23-0.25	0.0-1.5-2.9	4.0-5.0-6.0	.43	.43	3	6	48
	7-15	-10-	-68-	18-23-27	1.10-1.23-1.35	4.00-9.00-14.00	0.19-0.21-0.23	0.0-1.5-2.9	1.0-2.5-4.0	.49	.49			
	15-60	-9-	-67-	18-24-30	1.60-1.63-1.65	0.42-0.91-1.40	0.09-0.11-0.12	0.0-1.5-2.9	0.1-0.6-1.0	.55	.55			
78D—Saum silt loam, 15 to 30 percent slopes														
Saum	0-8	-24-	-52-	20-24-27	1.20-1.30-1.40	4.00-9.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	2.0-3.0-4.0	.32	.32	3	6	48
	8-26	-17-	-48-	30-35-40	1.30-1.40-1.50	4.00-9.00-14.00	0.18-0.19-0.20	3.0-4.5-5.9	1.0-2.0-3.0	.32	.32			
	26-50	-7-	-51-	35-43-50	1.30-1.40-1.50	1.40-3.00-4.00	0.12-0.14-0.15	3.0-4.5-5.9	0.5-0.8-1.0	.15	.32			
50-54	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon

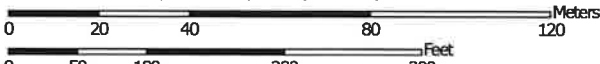
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
78E—Saum silt loam, 30 to 60 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
Saum	0-8	-24-	-52-	20-24- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	2.0-3.0- 4.0	.32	.32	3	6	48
	8-26	-17-	-48-	30-35- 40	1.30-1.40- 1.50	4.00-9.00-14.00	0.18-0.19-0.2 0	3.0- 4.5- 5.9	1.0- 2.0- 3.0	.32	.32			
	26-50	-7-	-51-	35-43- 50	1.30-1.40- 1.50	1.40-3.00-4.00	0.12-0.14-0.1 5	3.0- 4.5- 5.9	0.5- 0.8- 1.0	.15	.32			
92F— Xerochrepts and Haploxerolls, very steep	50-54	—	—	—	—	—	—	—	—					
Xerochrepts	0-8	-25-	-53-	18-23- 27	1.10-1.25- 1.40	4.00-9.00-14.00	0.16-0.19-0.2 1	0.0- 1.5- 2.9	2.0-3.5- 5.0	.37	.37	4	6	48
	8-48	-36-	-39-	20-25- 30	1.10-1.25- 1.40	1.40-8.00-14.00	0.11-0.13-0.1 5	3.0- 4.5- 5.9	0.5- 0.8- 1.0	.20	.32			
	48-60	-35-	-34-	27-31- 35	1.20-1.30- 1.40	1.40-3.00-4.00	0.09-0.11-0.1 2	3.0- 4.5- 5.9	0.0- 0.3- 0.5	.10	.32			
Haploxerolls	0-12	-24-	-51-	15-25- 35	1.10-1.35- 1.60	1.40-8.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	5.0- 7.0- 9.0	.32	.32	5	6	48
	12-60	-39-	-37-	15-25- 35	1.10-1.35- 1.60	1.40-8.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.32	.32			

Cindy's

Custom Soil Resource Report
Soil Map










































Map Scale: 1:1,610 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

	Area of Interest (AOI)		Spoil Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features			
	Blowout		Water Features
	Borrow Pit		Streams and Canals
	Clay Spot	Transportation	
	Closed Depression		Rails
	Gravel Pit		Interstate Highways
	Gravelly Spot		US Routes
	Landfill		Major Roads
	Lava Flow		Local Roads
	Marsh or swamp		Background
	Mine or Quarry		Aerial Photography
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
24C	Cottrell silty clay loam, 8 to 15 percent slopes	3.3	32.1%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	7.0	67.6%
45D	Jory silty clay loam, 15 to 30 percent slopes	0.0	0.3%
Totals for Area of Interest		10.3	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

Custom Soil Resource Report

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.

Clackamas County Area, Oregon

24C—Cottrell silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223w
Elevation: 300 to 900 feet
Mean annual precipitation: 45 to 80 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cottrell and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cottrell

Setting

Landform: Terraces, hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve, riser
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Old alluvium

Typical profile

H1 - 0 to 24 inches: silty clay loam
H2 - 24 to 55 inches: silty clay
H3 - 55 to 86 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)

Minor Components

Borges

Percent of map unit: 4 percent
Landform: Depressions on terraces, hillslopes
Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

45D—Jory silty clay loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 224z
Elevation: 250 to 1,200 feet
Mean annual precipitation: 50 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

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

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

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

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)

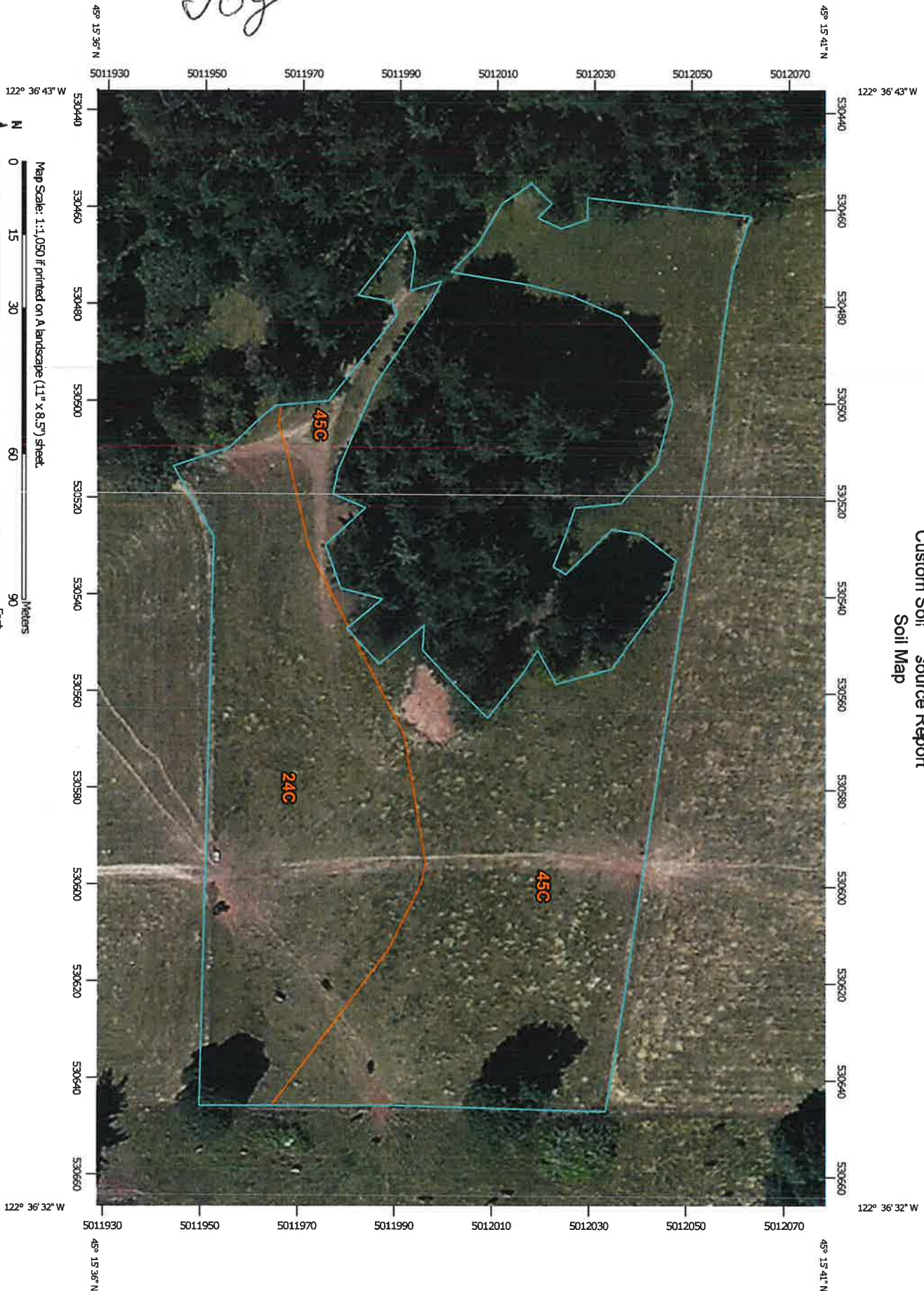
Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
24C—Cottrell silty clay loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Cottrell	0-24	-20-	-49-	27-31-35	1.30-1.40-1.50	4.00-9.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	3.0-3.5-4.0	.32	.32	5	6	48
	24-55	-7-	-48-	40-45-50	1.20-1.25-1.30	1.40-3.00-4.00	0.15-0.16-0.17	3.0-4.5-5.9	0.5-1.8-3.0	.28	.28			
36C—Hardscrabble silt loam, 7 to 20 percent slopes	55-86	-8-	-55-	30-38-45	1.30-1.35-1.40	1.40-3.00-4.00	0.15-0.18-0.21	3.0-4.5-5.9	0.0-0.3-0.5	.37	.37			
	0-8	-24-	-51-	22-25-27	1.20-1.30-1.40	4.00-9.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	2.0-4.0-6.0	.37	.37	3	6	48
Hardscrabble	8-14	-20-	-53-	25-28-30	1.20-1.30-1.40	4.00-9.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	0.5-1.3-2.0	.49	.49			
	14-60	-17-	-28-	50-55-60	1.10-1.20-1.30	0.01-0.20-0.42	0.11-0.14-0.16	6.0-7.5-8.9	0.0-0.3-0.5	.24	.24			
45D—Joy silty clay loam, 15 to 30 percent slopes														
Joy	0-13	-19-	-48-	27-34-40	1.20-1.25-1.30	4.00-9.00-14.00	0.18-0.20-0.21	0.0-1.5-2.9	3.0-4.5-6.0	.32	.32	5	6	48
	13-60	-3-	-45-	45-53-60	1.30-1.40-1.50	1.40-3.00-4.00	0.15-0.16-0.17	3.0-4.5-5.9	0.5-1.3-2.0	.24	.24			

Jog







































Custom Soil source Report
Soil Map



Map Scale: 1:1,050 if printed on a landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

 Area of Interest (AOI)	 Area of Interest (AOI)	 Spoil Area
Soils	 Soil Map Unit Polygons	 Stony Spot
 Soil Map Unit Lines	 Soil Map Unit Polygons	 Very Stony Spot
 Soil Map Unit Points	 Soil Map Unit Polygons	 Wet Spot
Special Point Features	 Blowout	 Other
 Borrow Pit	 Clay Spot	Special Line Features
 Closed Depression	 Gravel Pit	Water Features
 Gravelly Spot	 Landfill	 Streams and Canals
 Lava Flow	 Marsh or swamp	Transportation
 Mine or Quarry	 Miscellaneous Water	 Rails
 Perennial Water	 Rock Outcrop	 Interstate Highways
 Saline Spot	 Sandy Spot	 US Routes
 Severely Eroded Spot	 Sinkhole	 Major Roads
 Slide or Slip	 Sodicy Spot	 Local Roads
		 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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
24C	Cottrell silty clay loam, 8 to 15 percent slopes	1.1	37.1%
45C	Jory silty clay loam, 8 to 15 percent slopes	1.8	62.9%
Totals for Area of Interest		2.9	100.0%

Map Unit Descriptions

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

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

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

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

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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.

Clackamas County Area, Oregon

24C—Cottrell silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223w
Elevation: 300 to 900 feet
Mean annual precipitation: 45 to 80 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cottrell and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cottrell

Setting

Landform: Terraces, hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve, riser
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Old alluvium

Typical profile

H1 - 0 to 24 inches: silty clay loam
H2 - 24 to 55 inches: silty clay
H3 - 55 to 86 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes
(G002XY004OR)

Minor Components

Borges

Percent of map unit: 4 percent
Landform: Depressions on terraces, hillslopes
Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

45C—Jory silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 224y
Elevation: 250 to 1,200 feet
Mean annual precipitation: 50 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

Jory and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

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

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

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Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
24C—Cottrell silty clay loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Cottrell	0-24	-20-	-49-	27-31- 35	1.30-1.40- 1.50	4.00-9.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	3.0- 3.5- 4.0	.32	.32	5	6	48
	24-55	- 7-	-48-	40-45- 50	1.20-1.25- 1.30	1.40-3.00-4.00	0.15-0.16-0.1 7	3.0- 4.5- 5.9	0.5- 1.8- 3.0	.28	.28			
	55-86	- 8-	-55-	30-38- 45	1.30-1.35- 1.40	1.40-3.00-4.00	0.15-0.18-0.2 1	3.0- 4.5- 5.9	0.0- 0.3- 0.5	.37	.37			
45C—Jory silty clay loam, 8 to 15 percent slopes														
Jory	0-13	-19-	-48-	27-34 40	1.20-1.25- 1.30	4.00-9.00-14.00	0.18-0.20-0.2 1	0.0- 1.5- 2.9	3.0- 4.5- 6.0	.32	.32	5	6	48
	13-60	- 3-	-45-	45-53- 60	1.30-1.40- 1.50	1.40-3.00-4.00	0.15-0.16-0.1 7	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.24	.24			

Keizer

Custom Soil Resource Report
Soil Map



122° 36' 46" W

122° 36' 46" W

122° 36' 30" W

122° 36' 30" W

49° 15' 39" N

49° 15' 46" N

49° 15' 39" N

49° 15' 46" N

5012030 5012060 5012090 5012120 5012150 5012180 5012210 5012240







530390 530420 530450 530480 530510 530540 530570 530600 530630 530660 530690

Map Scale: 1:1,530 if printed on A landscape (11" x 8.5") sheet.

0 50 100 200 300 Feet
0 20 40 80 120 Meters

Map projection: Web Mercator Corner coordinates: WGS84 Edge bias: UTM Zone 10N WGS84

MAP LEGEND

-  Area of Interest (AOI)
-  Area of Interest (AOI)
- Soils**
-  Soil Map Unit Polygons
-  Soil Map Unit Lines
-  Soil Map Unit Points
- Special Point Features**
-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Spoil Area
-  Stony Spot
-  Vary Stony Spot
-  Wet Spot
-  Other
-  Special Line Features
- Water Features**
-  Streams and Canals
- Transportation**
-  Ralls
-  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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
23C	Cornelius silt loam, 8 to 15 percent slopes	0.2	2.8%
37D	Helvetia silt loam, 15 to 30 percent slopes	1.6	18.7%
45C	Jory silty clay loam, 8 to 15 percent slopes	6.8	78.5%
Totals for Area of Interest		8.7	100.0%

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments

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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.

Clackamas County Area, Oregon

23C—Cornelius silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223s
Elevation: 250 to 1,400 feet
Mean annual precipitation: 40 to 60 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

Cornelius and similar soils: 80 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cornelius

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 34 inches: silty clay loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 30 to 40 inches to fragipan
Natural 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 27 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes
(G002XY004OR)

Minor Components

Delena

Percent of map unit: 4 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope

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Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

37D—Helvetia silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 224n
Elevation: 250 to 500 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

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

Description of Helvetia

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed old alluvium

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 21 inches: silty clay loam
H3 - 21 to 40 inches: silty clay
H4 - 40 to 60 inches: silty clay loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural 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 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained >15% Slopes (G002XY003OR)

45C—Jory silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 224y
Elevation: 250 to 1,200 feet
Mean annual precipitation: 50 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

Jory and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluvium
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

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

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: High (about 10.1 inches)

Interpretive groups

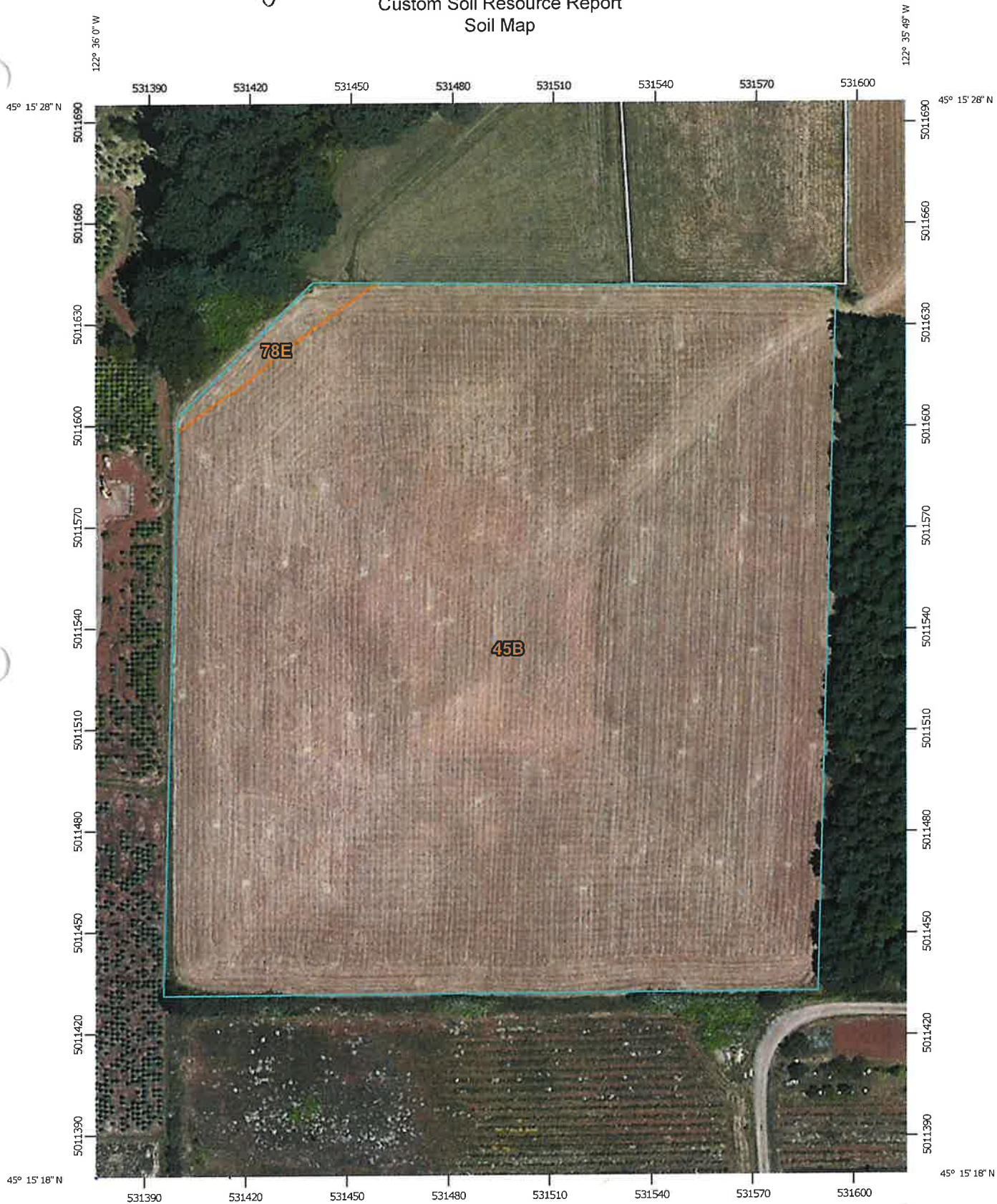
Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

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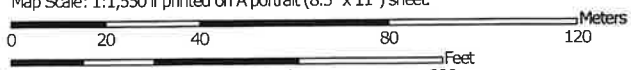
Physical Soil Properties--Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
23C--Cornellus silt loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Cornellus	0-16	-11-	-69-	15-20- 25	1.20-1.25- 1.30	4.00-9.00-14.00	0.20-0.22-0.2 3	0.0- 1.5- 2.9	1.0-3.0- 5.0	.37	.37	4	6	48
	16-34	-7-	-62-	27-31- 35	1.25-1.33- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.5-0.8- 1.0	.43	.43			
	34-60	-9-	-66-	15-25- 35	1.55-1.60- 1.65	0.42-0.91-1.40	0.04-0.05-0.0 6	0.0- 1.5- 2.9	0.0-0.3- 0.5	.55	.55			
37D--Helvetia silt loam, 15 to 30 percent slopes														
Helvetia	0-14	-27-	-54-	15-20- 25	1.10-1.20- 1.30	4.00-9.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	2.0-3.0- 4.0	.37	.37	5	6	48
	14-21	-20-	-49-	27-31- 35	1.10-1.20- 1.30	4.00-9.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	1.0-2.0- 3.0	.37	.37			
	21-40	-8-	-50-	35-43- 50	1.20-1.30- 1.40	1.40-3.00-4.00	0.15-0.17-0.1 8	3.0- 4.5- 5.9	0.5-0.8- 1.0	.32	.32			
	40-60	-18-	-52-	25-30- 35	1.20-1.30- 1.40	1.40-3.00-4.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.0-0.3- 0.5	.43	.43			
45C--Jory silty clay loam, 8 to 15 percent slopes														
Jory	0-13	-19-	-48-	27-34- 40	1.20-1.25- 1.30	4.00-9.00-14.00	0.18-0.20-0.2 1	0.0- 1.5- 2.9	3.0-4.5- 6.0	.32	.32	5	6	48
	13-60	-3-	-45-	45-53- 60	1.30-1.40- 1.50	1.40-3.00-4.00	0.15-0.16-0.1 7	3.0- 4.5- 5.9	0.5-1.3- 2.0	.24	.24			

Lenigar #1 (Back)

Custom Soil Resource Report Soil Map















Map Scale: 1:1,550 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge ties: UTM Zone 10N WGS84

MAP LEGEND

	Area of Interest (AOI)		Spoil Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features			
	Blowout	Water Features	
	Borrow Pit		Streams and Canals
	Clay Spot	Transportation	
	Closed Depression		Rails
	Gravel Pit		Interstate Highways
	Gravelly Spot		US Routes
	Landfill		Major Roads
	Lava Flow		Local Roads
	Marsh or swamp		Background
	Mine or Quarry	Aerial Photography	
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres In AOI	Percent of AOI
45B	Jory silty clay loam, 2 to 8 percent slopes	9.8	98.8%
78E	Saum silt loam, 30 to 60 percent slopes	0.1	1.2%
Totals for Area of Interest		9.9	100.0%

Map Unit Descriptions

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

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

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

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

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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.

Clackamas County Area, Oregon

45B—Jory silty clay loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 224x
Elevation: 250 to 1,200 feet
Mean annual precipitation: 50 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

Jory and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluvium
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

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

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

78E—Saum silt loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2274

Custom Soil Resource Report

Elevation: 250 to 800 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: Not prime farmland

Map Unit Composition

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Foothlope, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural 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 storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon



















Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
45B—Jory silty clay loam, 2 to 8 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Jory	0-13	-19-	-48-	27-34-40	1.20-1.25-1.30	4.00-9.00-14.00	0.18-0.20-0.21	0.0-1.5-2.9	3.0-4.5-6.0	.32	.32	5	6	48
78E—Saum silt loam, 30 to 60 percent slopes	13-60	-3-	-45-	45-53-60	1.30-1.40-1.50	1.40-3.00-4.00	0.15-0.16-0.17	3.0-4.5-5.9	0.5-1.3-2.0	.24	.24			
Saum	0-8	-24-	-52-	20-24-27	1.20-1.30-1.40	4.00-9.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	2.0-3.0-4.0	.32	.32	3	6	48
	8-26	-17-	-48-	30-35-40	1.30-1.40-1.50	4.00-9.00-14.00	0.18-0.19-0.20	3.0-4.5-5.9	1.0-2.0-3.0	.32	.32			
	26-50	-7-	-51-	35-43-50	1.30-1.40-1.50	1.40-3.00-4.00	0.12-0.14-0.15	3.0-4.5-5.9	0.5-0.8-1.0	.15	.32			
	50-54	—	—	—	—	—	—	—	—					

Lenigaris #2 (Front)

Custom Soil Resource Report Soil Map



MAP LEGEND

	Area of Interest (AOI)		Spoil Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features			
	Blowout	Water Features	
	Borrow Pit		Streams and Canals
	Clay Spot	Transportation	
	Closed Depression		Rails
	Gravel Pit		Interstate Highways
	Gravelly Spot		US Routes
	Landfill		Major Roads
	Lava Flow		Local Roads
	Marsh or swamp		Background
	Mine or Quarry	Aerial Photography	
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
45B	Jory silty clay loam, 2 to 8 percent slopes	5.3	100.0%
Totals for Area of Interest		5.3	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.

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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.

Clackamas County Area, Oregon

45B—Jory silty clay loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 224x
Elevation: 250 to 1,200 feet
Mean annual precipitation: 50 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

Jory and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

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

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

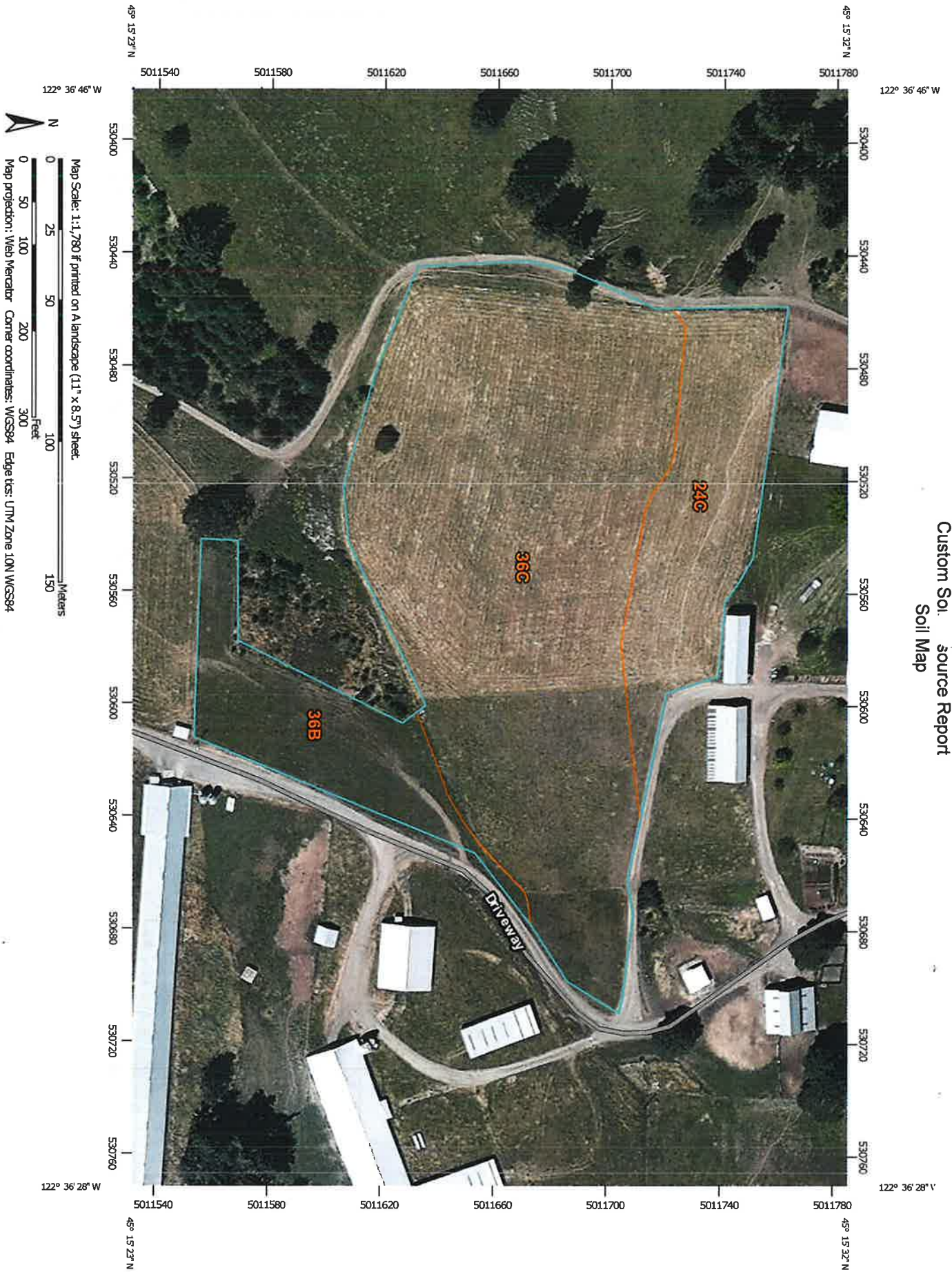
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Physical Soil Properties—Clackamas County Area, Oregon


























Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
45B—Jory silty clay loam, 2 to 8 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Jory	0-13	-19-	-48-	27-34- 40	1.20-1.25- 1.30	4.00-9.00-14.00	0.18-0.20-0.2 1	0.0- 1.5- 2.9	3.0- 4.5- 6.0	.32	.32	5	6	48
	13-60	-3-	-45-	45-53- 60	1.30-1.40- 1.50	1.40-3.00-4.00	0.15-0.16-0.1 7	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.24	.24			

Machine Shed

Custom Soil Source Report Soil Map



MAP LEGEND

	Area of Interest (AOI)		Spill Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features			
	Blowout		Water Features
	Borrow Pit		Transportation
	Clay Spot		+++
	Closed Depression		Major Roads
	Gravel Pit		Local Roads
	Gravelly Spot		Background
	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		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
24C	Cottrell silty clay loam, 8 to 15 percent slopes	1.3	17.7%
36B	Hardscrabble silt loam, 2 to 7 percent slopes	1.0	13.7%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	5.0	68.7%
Totals for Area of Interest		7.3	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

Custom Soil Resource Report

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.

Clackamas County Area, Oregon

24C—Cottrell silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223w
Elevation: 300 to 900 feet
Mean annual precipitation: 45 to 80 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cottrell and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cottrell

Setting

Landform: Terraces, hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve, riser
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Old alluvium

Typical profile

H1 - 0 to 24 inches: silty clay loam
H2 - 24 to 55 inches: silty clay
H3 - 55 to 86 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)

Minor Components

Borges

Percent of map unit: 4 percent
Landform: Depressions on terraces, hillslopes
Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

36B—Hardscrabble silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 224j
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluvium
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

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Physical Soil Properties--Clackamas County Area, Oregon

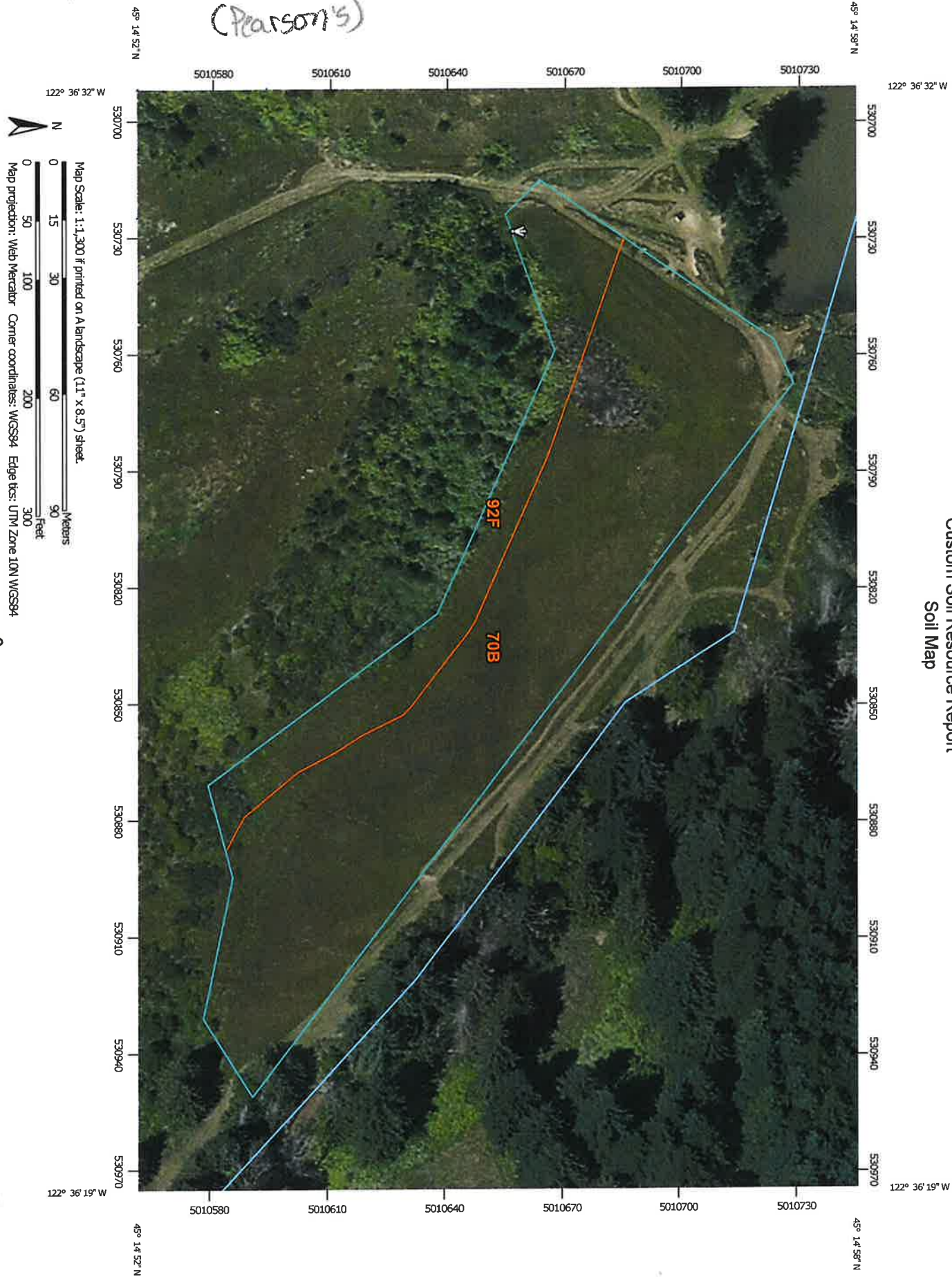
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
24C--Cottrell silty clay loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Cottrell	0-24	-20-	-49-	27-31- 35	1.30-1.40-1.50	4.00-9.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	3.0-3.5-4.0	.32	.32	5	6	48
	24-55	-7-	-48-	40-45- 50	1.20-1.25-1.30	1.40-3.00-4.00	0.15-0.16-0.17	3.0-4.5-5.9	0.5-1.8-3.0	.28	.28			
36B--Handscrabble silt loam, 2 to 7 percent slopes	55-86	-8-	-55-	30-38- 45	1.30-1.35-1.40	1.40-3.00-4.00	0.15-0.18-0.21	3.0-4.5-5.9	0.0-0.3-0.5	.37	.37			
	0-8	-24-	-51-	22-25- 27	1.20-1.30-1.40	4.00-9.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	2.0-4.0-6.0	.37	.37	3	6	48
Handscrabble	8-14	-20-	-53-	25-28- 30	1.20-1.30-1.40	4.00-9.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	0.5-1.3-2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20-1.30	0.01-0.20-0.42	0.11-0.14-0.16	6.0-7.5-8.9	0.0-0.3-0.5	.24	.24			

Custom Soil Resource Report


Physical Soil Properties--Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kt	T		
36C-- Handscrabble silt loam, 7 to 20 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Handscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	2.0- 4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1	6.0- 7.5- 8.9	0.0-0.3- 0.5	.24	.24			

Middle
(Pearson's)

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Soil Map



MAP LEGEND

	Area of Interest (AOI)		Spoil Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
	Special Point Features		Water Features
	Blowout		Streams and Canals
	Borrow Pit		Transportation
	Clay Spot		+++ Falls
	Closed Depression		Interstate Highways
	Gravel Pit		US Routes
	Gravelly Spot		Major Roads
	Landfill		Local Roads
	Lava Flow		Background
	Marsh or swamp		Aerial Photography
	Mine or Quarry		
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

MAP INFORMATION

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

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
70B	Powell silt loam, 0 to 8 percent slopes	2.1	77.8%
92F	Xerochrepts and Haploxerolls, very steep	0.6	22.2%
Totals for Area of Interest		2.7	100.0%

Map Unit Descriptions

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

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

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

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

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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.

Clackamas County Area, Oregon

70B—Powell silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 226l
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 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

Powell and similar soils: 80 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 15 to 23 inches to fragipan
Natural 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 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

Minor Components

Delena

Percent of map unit: 4 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear

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Across-slope shape: Linear

Other vegetative classification: Poorly Drained (G002XY006OR)

Aquepts

Percent of map unit: 2 percent

Landform: Depressions

92F—Xerochrepts and Haploxerolls, very steep

Map Unit Setting

National map unit symbol: 2281

Elevation: 50 to 1,000 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: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 50 percent

Haploxerolls and similar soils: 35 percent

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

Description of Xerochrepts

Setting

Landform: Terraces

Landform position (three-dimensional): Riser

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 8 inches: silt loam

H2 - 8 to 48 inches: gravelly clay loam

H3 - 48 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent

Depth to restrictive feature: More than 80 inches

Natural 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: About 36 to 72 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

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Description of Haploxerolls

Setting

Landform: Terraces

Landform position (three-dimensional): Riser

Down-slope shape: Concave

Across-slope shape: Linear

Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 12 inches: silt loam

H2 - 12 to 60 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 1.98 in/hr)

Depth to water table: About 36 to 48 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

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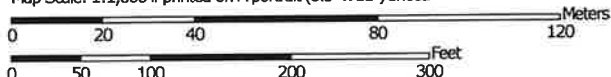
Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
70B—Powell silt loam, 0 to 8 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
Powell	0-7	-11-	-67-	20-22-24	1.15-1.20-1.25	4.00-9.00-14.00	0.21-0.23-0.25	0.0-1.5-2.9	4.0-5.0-6.0	.43	.43	3	6	48
	7-15	-10-	-68-	18-23-27	1.10-1.23-1.35	4.00-9.00-14.00	0.19-0.21-0.23	0.0-1.5-2.9	1.0-2.5-4.0	.49	.49			
	15-60	-9-	-67-	18-24-30	1.60-1.63-1.65	0.42-0.91-1.40	0.09-0.11-0.12	0.0-1.5-2.9	0.1-0.6-1.0	.55	.55			
92F—Xerochrepts and Haploxerolls, very steep														
Xerochrepts	0-8	-25-	-53-	18-23-27	1.10-1.25-1.40	4.00-9.00-14.00	0.16-0.19-0.21	0.0-1.5-2.9	2.0-3.5-5.0	.37	.37	4	6	48
	8-48	-36-	-39-	20-25-30	1.10-1.25-1.40	1.40-8.00-14.00	0.11-0.13-0.15	3.0-4.5-5.9	0.5-0.8-1.0	.20	.32			
	48-60	-35-	-34-	27-31-35	1.20-1.30-1.40	1.40-3.00-4.00	0.09-0.11-0.12	3.0-4.5-5.9	0.0-0.3-0.5	.10	.32			
Haploxerolls	0-12	-24-	-51-	15-25-35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	5.0-7.0-9.0	.32	.32	5	6	48
	12-60	-39-	-37-	15-25-35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	0.5-1.3-2.0	.32	.32			

Pat's

Custom Soil Resource Report Soil Map





Map Scale: 1:1,600 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

	Area of Interest (AOI)		Spill Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features			
	Blowout	Water Features	
	Borrow Pit		Streams and Canals
	Clay Spot	Transportation	
	Closed Depression		Rails
	Gravel Pit		Interstate Highways
	Gravelly Spot		US Routes
	Landfill		Major Roads
	Lava Flow		Local Roads
	Marsh or swamp		Background
	Mine or Quarry	Aerial Photography	
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
24C	Cottrell silty clay loam, 8 to 15 percent slopes	4.0	34.4%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	7.6	65.6%
92F	Xerochrepts and Haploxerolls, very steep	0.0	0.0%
Totals for Area of Interest		11.6	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

Custom Soil Resource Report

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.

Clackamas County Area, Oregon

24C—Cottrell silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223w
Elevation: 300 to 900 feet
Mean annual precipitation: 45 to 80 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cottrell and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cottrell

Setting

Landform: Terraces, hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve, riser
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Old alluvium

Typical profile

H1 - 0 to 24 inches: silty clay loam
H2 - 24 to 55 inches: silty clay
H3 - 55 to 86 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes
(G002XY004OR)

Minor Components

Borges

Percent of map unit: 4 percent
Landform: Depressions on terraces, hillslopes
Landform position (two-dimensional): Footslope

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Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Foothlope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

92F—Xerochrepts and Haploxerolls, very steep

Map Unit Setting

National map unit symbol: 2281
Elevation: 50 to 1,000 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: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 50 percent
Haploxerolls and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerochrepts

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 48 inches: gravelly clay loam
H3 - 48 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural 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: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Description of Haploxerolls

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear

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Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 12 inches: silt loam

H2 - 12 to 60 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 1.98 in/hr)

Depth to water table: About 36 to 48 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

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Physical Soil Properties--Clackamas County Area, Oregon

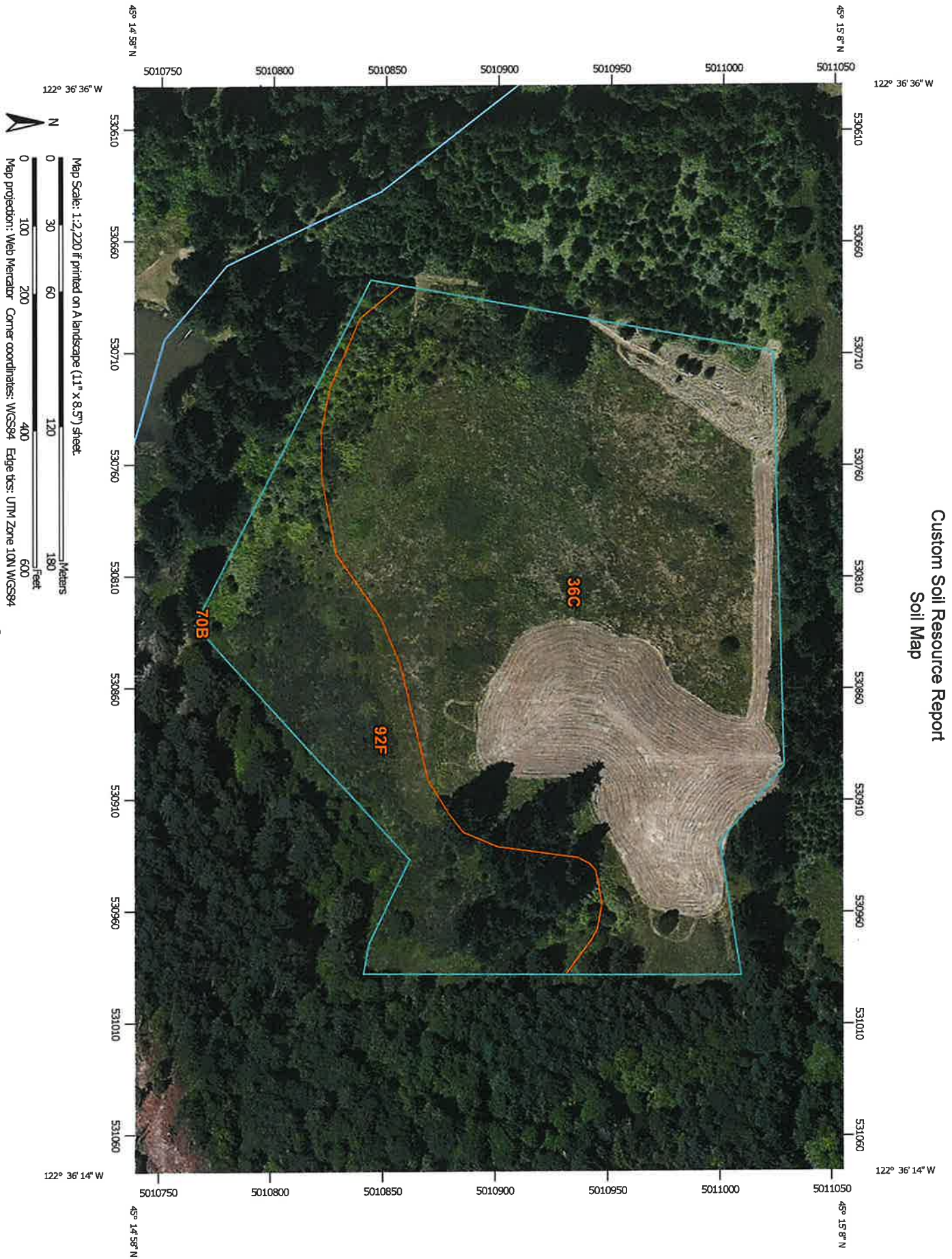
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
24C--Cottrell silty clay loam, 8 to 15 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Cottrell	0-24	-20-	-49-	27-31- 35	1.30-1.40- 1.50	4.00-9.00-14.00	0.19-0.20-0.2 1	0.0- 1.5- 2.9	3.0-3.5- 4.0	.32	.32	5	6	48
	24-55	-7-	-48-	40-45- 50	1.20-1.25- 1.30	1.40-3.00-4.00	0.15-0.16-0.1 7	3.0- 4.5- 5.9	0.5- 1.8- 3.0	.28	.28			
36C-- Handscribble silt loam, 7 to 20 percent slopes	55-86	-8-	-55-	30-38- 45	1.30-1.35- 1.40	1.40-3.00-4.00	0.15-0.18-0.2 1	3.0- 4.5- 5.9	0.0- 0.3- 0.5	.37	.37			
	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	2.0- 4.0- 6.0	.37	.37	3	6	48
Handscribble	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1 6	6.0- 7.5- 8.9	0.0- 0.3- 0.5	.24	.24			

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
92F— Xerochrepts and Haploxerolls, very steep	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Xerochrepts	0-8	-25-	-53-	18-23- 27	1.10-1.25- 1.40	4.00-9.00-14.00	0.16-0.19-0.2	0.0-1.5-2.9	2.0-3.5- 5.0	.37	.37	4	6	48
	8-48	-36-	-39-	20-25- 30	1.10-1.25- 1.40	1.40-8.00-14.00	0.11-0.13-0.1	3.0-4.5-5.9	0.5-0.8- 1.0	.20	.32			
	48-60	-35-	-34-	27-31- 35	1.20-1.30- 1.40	1.40-3.00-4.00	0.09-0.11-0.1	3.0-4.5-5.9	0.0-0.3- 0.5	.10	.32			
Haploxerolls	0-12	-24-	-51-	15-25- 35	1.10-1.35- 1.60	1.40-8.00-14.00	0.19-0.20-0.2	0.0-1.5-2.9	5.0-7.0- 9.0	.32	.32	5	6	48
	12-60	-39-	-37-	15-25- 35	1.10-1.35- 1.60	1.40-8.00-14.00	0.19-0.20-0.2	3.0-4.5-5.9	0.5-1.3- 2.0	.32	.32			

Pearson Back

Custom Soil Resource Report Soil Map



MAP LEGEND

	Area of Interest (AOI)		Area of Interest (AOI)
	Soils		Soil Map Unit Polygons
			Soil Map Unit Lines
			Soil Map Unit Points
Special Point Features			
	Blowout		Borrow Pit
	Clay Spot		Closed Depression
	Gravel Pit		Gravelly Spot
	Landfill		Lava Flow
	Marsh or swamp		Mine or Quarry
	Miscellaneous Water		Perennial Water
	Rock Outcrop		Saline Spot
	Sandy Spot		Severely Eroded Spot
	Sinkhole		Slide or Slip
	Sodic Spot		
Water Features			
	Streams and Canals		Falls
	Interstate Highways		US Routes
	Major Roads		Local Roads
	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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County/Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
36C	Hardscrabble silt loam, 7 to 20 percent slopes	11.4	75.7%
70B	Powell silt loam, 0 to 8 percent slopes	0.0	0.1%
92F	Xerochrepts and Haploxerolls, very steep	3.7	24.3%
Totals for Area of Interest		15.1	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

Custom Soil Resource Report

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.

Clackamas County Area, Oregon

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

Custom Soil Resource Report

70B—Powell silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 226I
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 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

Powell and similar soils: 80 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 15 to 23 inches to fragipan
Natural 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 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

Minor Components

Delena

Percent of map unit: 4 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope

Custom Soil Resource Report

Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)

Aquepts

Percent of map unit: 2 percent
Landform: Depressions

92F—Xerochrepts and Haploxerolls, very steep

Map Unit Setting

National map unit symbol: 2281
Elevation: 50 to 1,000 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: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 50 percent
Haploxerolls and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerochrepts

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 48 inches: gravelly clay loam
H3 - 48 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural 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: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Custom Soil Resource Report

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Description of Haploxerolls

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 60 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 1.98 in/hr)
Depth to water table: About 36 to 48 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Custom Soil Resource Report

Physical Soil Properties--Clackamas County Area, Oregon

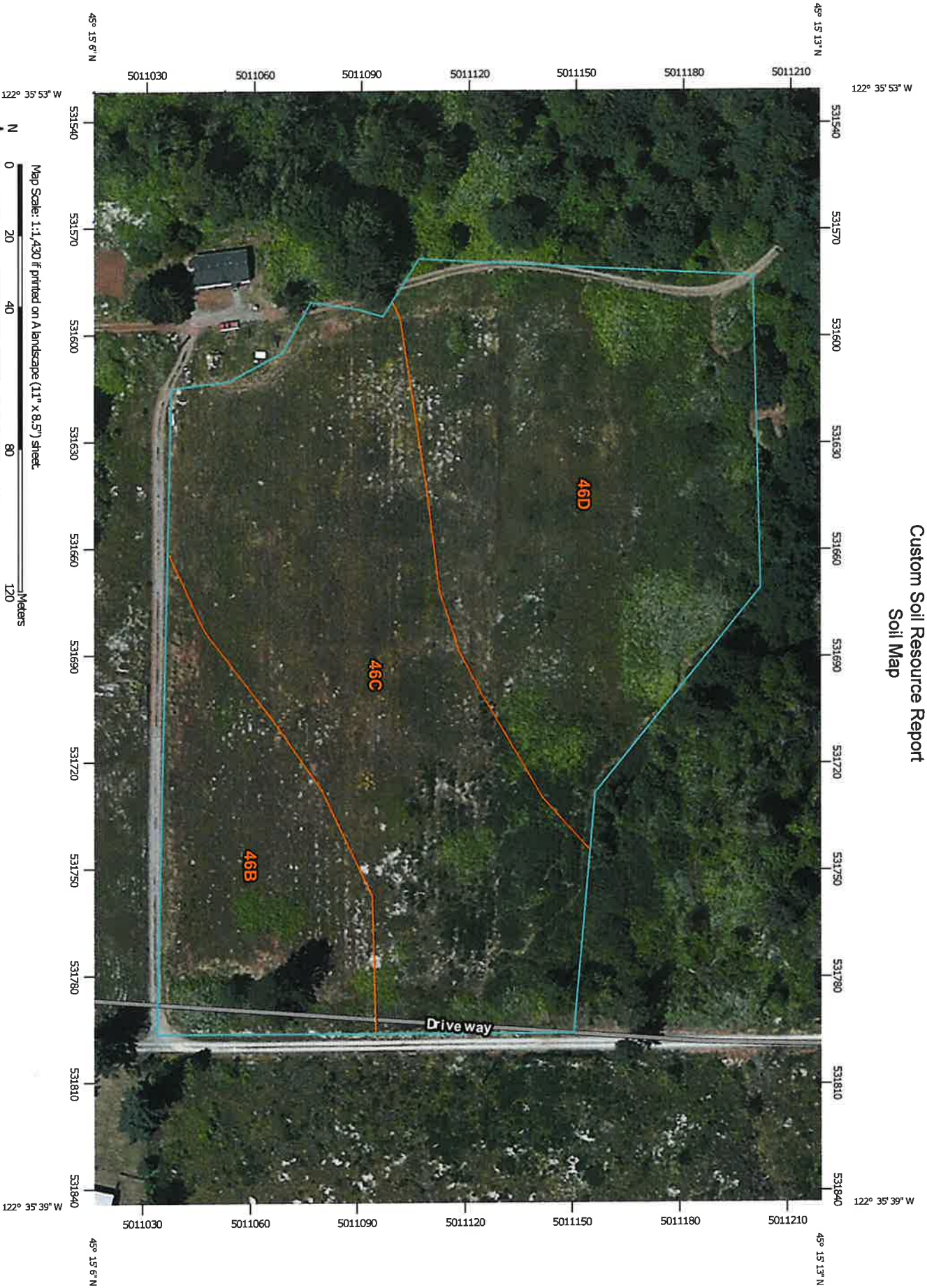
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
36C-- Hardscrabble silt loam, 7 to 20 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Hardscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	2.0-4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.5-1.3- 2.0	.49	.49			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1 6	6.0- 7.5- 8.9	0.0-0.3- 0.5	.24	.24			
70B--Powell silt loam, 0 to 8 percent slopes														
Powell	0-7	-11-	-67-	20-22- 24	1.15-1.20- 1.25	4.00-9.00-14.00	0.21-0.23-0.2 5	0.0- 1.5- 2.9	4.0-5.0- 6.0	.43	.43	3	6	48
	7-15	-10-	-68-	18-23- 27	1.10-1.23- 1.35	4.00-9.00-14.00	0.19-0.21-0.2 3	0.0- 1.5- 2.9	1.0-2.5- 4.0	.49	.49			
	15-60	-9-	-67-	18-24- 30	1.60-1.63- 1.65	0.42-0.91-1.40	0.09-0.11-0.1 2	0.0- 1.5- 2.9	0.1-0.6- 1.0	.55	.55			

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility Index
										Kw	Kt	T		
92F— Xerochrepts and Haploxerolls, very steep	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Xerochrepts	0-8	-25-	-53-	18-23-27	1.10-1.25-1.40	4.00-9.00-14.00	0.16-0.19-0.21	0.0-1.5-2.9	2.0-3.5-5.0	.37	.37	4	6	48
	8-48	-36-	-39-	20-25-30	1.10-1.25-1.40	1.40-8.00-14.00	0.11-0.13-0.15	3.0-4.5-5.9	0.5-0.8-1.0	.20	.32			
	48-60	-35-	-34-	27-31-35	1.20-1.30-1.40	1.40-3.00-4.00	0.09-0.11-0.12	3.0-4.5-5.9	0.0-0.3-0.5	.10	.32			
Haploxerolls	0-12	-24-	-51-	15-25-35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	5.0-7.0-9.0	.32	.32	5	6	48
	12-60	-39-	-37-	15-25-35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	0.5-1.3-2.0	.32	.32			

Rod Henry's

Custom Soil Resource Report
Soil Map



122° 35' 53" W

122° 35' 39" W

122° 35' 53" W

122° 35' 39" W

49° 15' 6" N

49° 15' 6" N

49° 15' 13" N

49° 15' 13" N

5011030 5011060 5011090 5011120 5011150 5011180 5011210









531540 531570 531600 531630 531660 531690 531720 531750 531780 531810 531840



Map Scale: 1:1,430 if printed on a landscape (11" x 8.5") sheet.
Map projection: Web Mercator Corner coordinates: WGS84 Edge UTM: UTM Zone 10N WGS84



MAP LEGEND

	Area of Interest (AOI)		Spill Area
	Area of Interest (AOI)		Stony Spot
	Soils		Very Stony Spot
	Soil Map Unit Polygons		Wet Spot
	Soil Map Unit Lines		Other
	Soil Map Unit Points		Special Line Features
Special Point Features			
	Blowout	Water Features	
	Borrow Pit		Streams and Canals
	Clay Spot	Transportation	
	Closed Depression		+++ Rails
	Gravel Pit		Interstate Highways
	Gravelly Spot		US Routes
	Landfill		Major Roads
	Lava Flow		Local Roads
	Marsh or swamp		Background Aerial Photography
	Mine or Quarry		
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
46B	Jory stony silt loam, 3 to 8 percent slopes	1.3	17.7%
46C	Jory stony silt loam, 8 to 15 percent slopes	3.1	42.5%
46D	Jory stony silt loam, 15 to 30 percent slopes	2.9	39.8%
Totals for Area of Interest		7.4	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

Custom Soil Resource Report

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.

Clackamas County Area, Oregon

46B—Jory stony silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2251
Elevation: 250 to 1,200 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

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

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

H1 - 0 to 8 inches: stony silt loam
H2 - 8 to 48 inches: stony silty clay
H3 - 48 to 60 inches: stony silty clay

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

46C—Jory stony silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2252
Elevation: 250 to 1,200 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

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

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

H1 - 0 to 8 inches: stony silt loam
H2 - 8 to 48 inches: stony silty clay
H3 - 48 to 60 inches: stony silty clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

46D—Jory stony silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2253
Elevation: 250 to 1,200 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

Jory and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluvium
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

H1 - 0 to 8 inches: stony silt loam
H2 - 8 to 48 inches: stony silty clay
H3 - 48 to 60 inches: stony silty clay

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural 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 storage in profile: Moderate (about 8.0 inches)

Interpretive groups

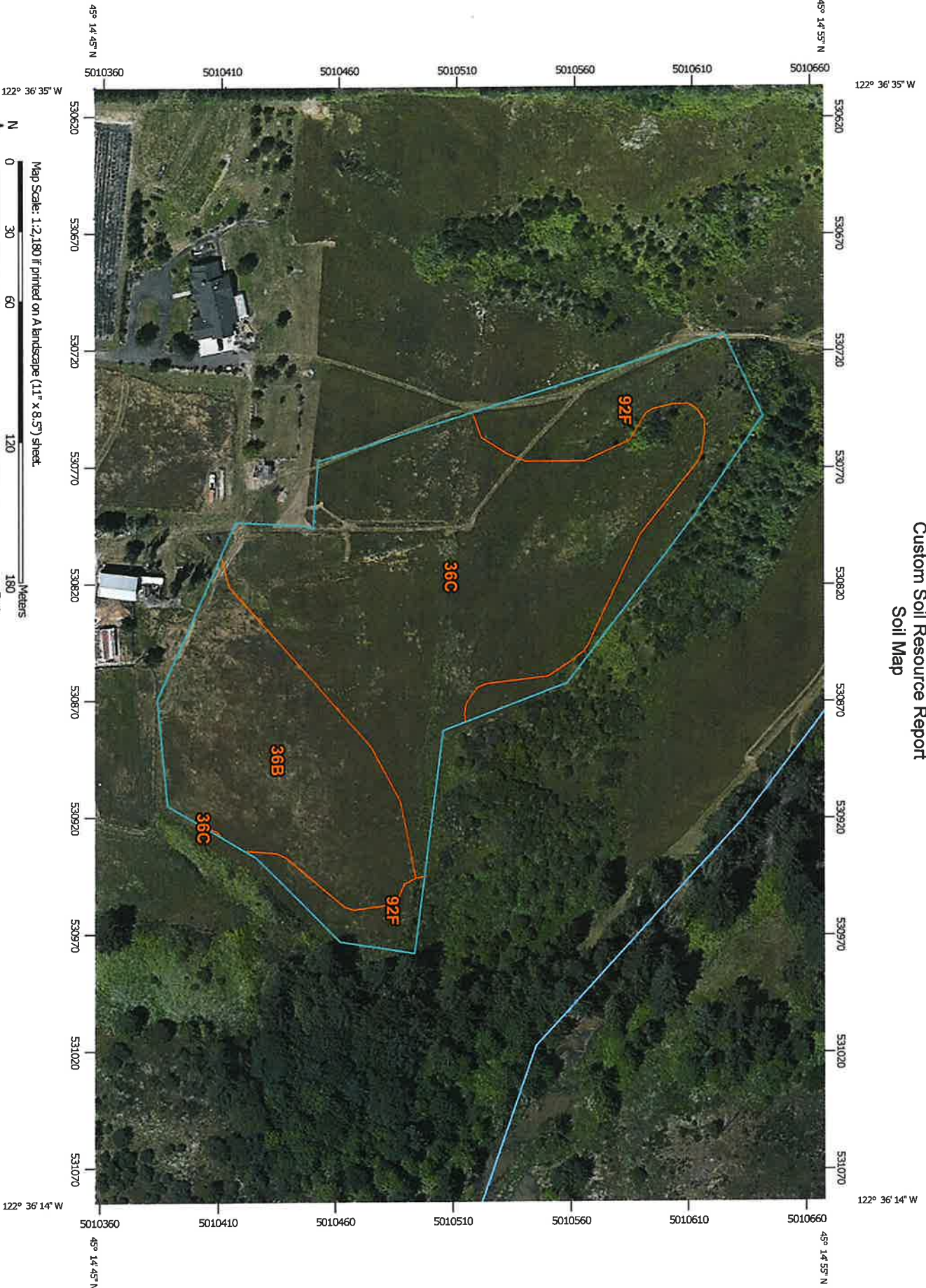
Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
46B—Jory stony silt loam, 3 to 8 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
	0-8	-25-	-52-	20-24-27	1.20-1.30-1.40	4.00-9.00-14.00	0.13-0.16-0.18	0.0-1.5-2.9	2.0-3.0-4.0	.20	.37	5	7	38
	8-48	-5-	-45-	45-50-55	1.30-1.40-1.50	1.40-3.00-4.00	0.11-0.13-0.15	3.0-4.5-5.9	1.0-2.0-3.0	.15	.24			
46C—Jory stony silt loam, 8 to 15 percent slopes														
	0-8	-25-	-52-	20-24-27	1.20-1.30-1.40	4.00-9.00-14.00	0.13-0.16-0.18	0.0-1.5-2.9	2.0-3.0-4.0	.20	.37	5	7	38
	8-48	-5-	-45-	45-50-55	1.30-1.40-1.50	1.40-3.00-4.00	0.11-0.13-0.15	3.0-4.5-5.9	1.0-2.0-3.0	.15	.24			
46D—Jory stony silt loam, 15 to 30 percent slopes														
	0-8	-25-	-52-	20-24-27	1.20-1.30-1.40	4.00-9.00-14.00	0.13-0.16-0.18	0.0-1.5-2.9	2.0-3.0-4.0	.20	.37	5	7	38
	8-48	-5-	-45-	45-50-55	1.30-1.40-1.50	1.40-3.00-4.00	0.11-0.13-0.15	3.0-4.5-5.9	1.0-2.0-3.0	.15	.24			
	48-60	-5-	-45-	45-50-55	1.30-1.40-1.50	1.40-3.00-4.00	0.11-0.13-0.15	3.0-4.5-5.9	0.5-0.8-1.0	.15	.24			

Upper (Pearson's)

Custom Soil Resource Report
Soil Map



Map Scale: 1:2,180 if printed on A landscape (11" x 8.5") sheet.
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

- Area of Interest (AOI)
- Area of Interest (AOI)
- Soils**
 - Soil Map Unit Polygons
 - Soil Map Unit Lines
 - Soil Map Unit Points
- Special Point Features**
 - Blowout
 - Borrow Pit
 - Clay Spot
 - Closed Depression
 - Gravel Pit
 - Gravelly Spot
 - Landfill
 - Lava Flow
 - Marsh or swamp
 - Mine or Quarry
 - Miscellaneous Water
 - Perennial Water
 - Rock Outcrop
 - Saline Spot
 - Sandy Spot
 - Severely Eroded Spot
 - Sinkhole
 - Slide or Slip
 - Sodic Spot
- Water Features**
 - Streams and Canals
- Transportation**
 - Rails
 - Interstate Highways
 - US Routes
 - Major Roads
 - Local Roads
- Background**
 - Aerial Photography
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: <http://websoilsurvey.nrcs.usda.gov>
 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: Clackamas County Area, Oregon
 Survey Area Data: Version 10, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
36B	Hardscrabble silt loam, 2 to 7 percent slopes	2.2	26.5%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	4.5	54.6%
92F	Xerochrepts and Haploxerolls, very steep	1.5	18.9%
Totals for Area of Interest		8.2	100.0%

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments

Custom Soil Resource Report

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.

Clackamas County Area, Oregon

36B—Hardscrabble silt loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 224j
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 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

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

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Foothlope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural 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 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)

92F—Xerochrepts and Haploxerolls, very steep

Map Unit Setting

National map unit symbol: 2281
Elevation: 50 to 1,000 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: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 50 percent
Haploxerolls and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerochrepts

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 48 inches: gravelly clay loam
H3 - 48 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural 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: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Description of Haploxerolls

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear

Custom Soil Resource Report

Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 12 inches: silt loam

H2 - 12 to 60 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 1.98 in/hr)

Depth to water table: About 36 to 48 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B

Custom Soil Resource Report

Physical Soil Properties--Clackamas County Area, Oregon

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
36B-- Hardscrabble silt loam, 2 to 7 percent slopes	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Hardscrabble	0-8	-24-	-51-	22-25- 27	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	2.0-4.0- 6.0	.37	.37	3	6	48
	8-14	-20-	-53-	25-28- 30	1.20-1.30- 1.40	4.00-9.00-14.00	0.19-0.20-0.2 1	3.0- 4.5- 5.9	0.5- 1.3- 2.0	.49	.49			
36C-- Hardscrabble silt loam, 7 to 20 percent slopes	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1 6	6.0- 7.5- 8.9	0.0-0.3- 0.5	.24	.24			
	14-60	-17-	-28-	50-55- 60	1.10-1.20- 1.30	0.01-0.20-0.42	0.11-0.14-0.1 6	6.0- 7.5- 8.9	0.0-0.3- 0.5	.24	.24			

Custom Soil Resource Report

Physical Soil Properties—Clackamas County Area, Oregon

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility Index
										Kw	Kf	T		
92F— Xerochrepts and Haploxerolls, very steep	In	Pct	Pct	Pct	g/cc	micro m/sec	In/in	Pct	Pct					
Xerochrepts	0-8	-25-	-53-	18-23-27	1.10-1.25-1.40	4.00-9.00-14.00	0.16-0.19-0.21	0.0-1.5-2.9	2.0-3.5-5.0	.37	.37	4	6	48
	8-48	-36-	-39-	20-25-30	1.10-1.25-1.40	1.40-8.00-14.00	0.11-0.13-0.15	3.0-4.5-5.9	0.5-0.8-1.0	.20	.32			
	48-60	-35-	-34-	27-31-35	1.20-1.30-1.40	1.40-3.00-4.00	0.09-0.11-0.12	3.0-4.5-5.9	0.0-0.3-0.5	.10	.32			
Haploxerolls	0-12	-24-	-51-	15-25-35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	0.0-1.5-2.9	5.0-7.0-9.0	.32	.32	5	6	48
	12-60	-39-	-37-	15-25-35	1.10-1.35-1.60	1.40-8.00-14.00	0.19-0.20-0.21	3.0-4.5-5.9	0.5-1.3-2.0	.32	.32			

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

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3/1/2017

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ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY NUTRIENT PRODUCTION

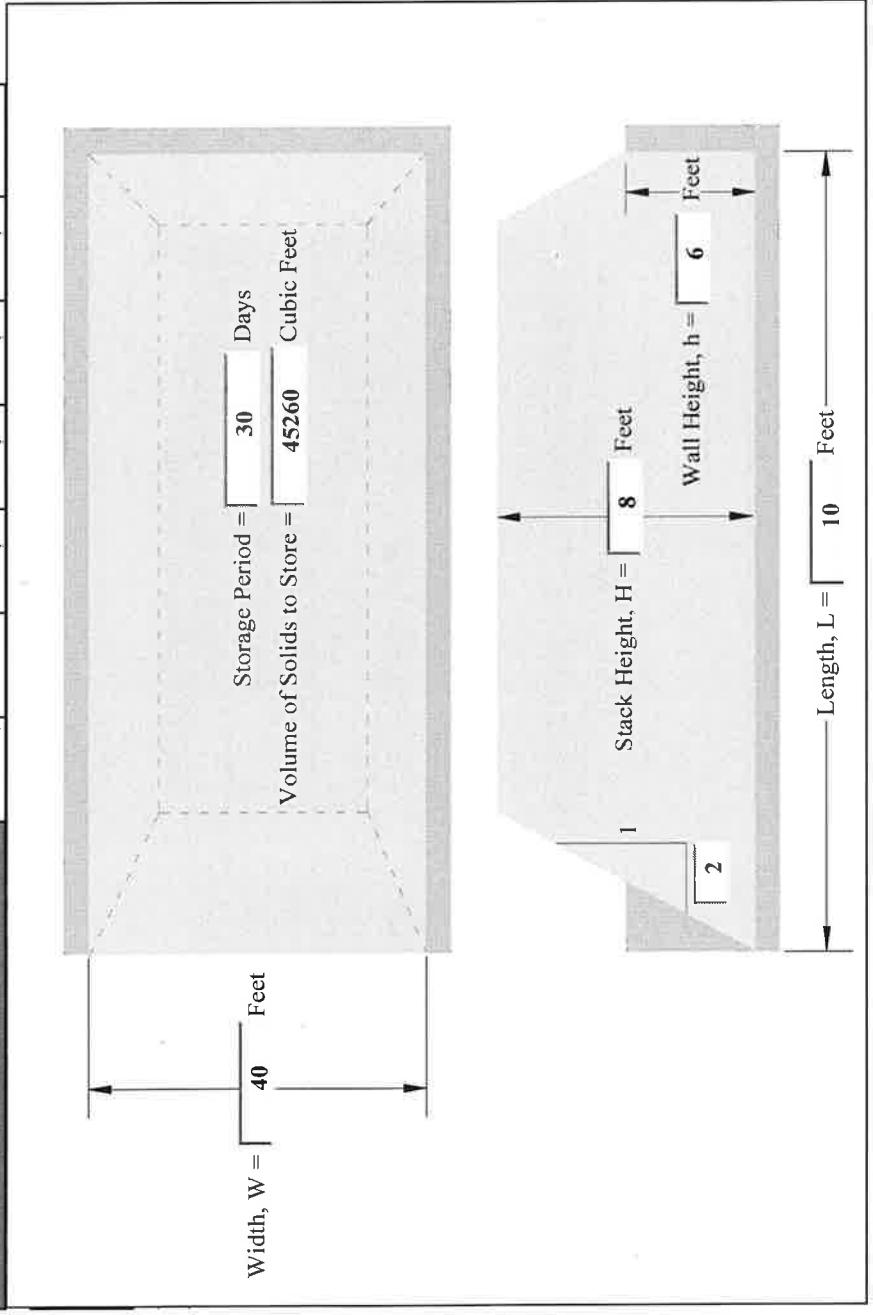
Month	Pounds of Nutrients from LIQUIDS			Pounds of Nutrients from SOLIDS			Pounds of Nutrients from GRAZING			Total Pounds of Nutrients from ALL SOURCES		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
October	0	0	0	8,705	5,817	5,900	543	284	467	9,247	6,101	6,367
November	0	0	0	8,582	5,711	5,845	368	192	316	8,949	5,904	6,162
December	0	0	0	8,976	5,959	6,134	271	142	233	9,247	6,101	6,367
January	0	0	0	8,976	5,959	6,134	271	142	233	9,247	6,101	6,367
February	0	0	0	8,107	5,382	5,540	245	128	211	8,352	5,510	5,751
March	0	0	0	8,951	5,936	6,105	575	278	479	9,526	6,214	6,584
April	0	0	0	8,424	5,629	5,710	795	385	662	9,219	6,014	6,371
May	0	0	0	8,705	5,817	5,900	822	398	684	9,526	6,214	6,584
June	0	0	0	8,424	5,629	5,710	795	385	662	9,219	6,014	6,371
July	0	0	0	8,705	5,817	5,900	822	398	684	9,526	6,214	6,584
August	0	0	0	8,705	5,817	5,900	822	398	684	9,526	6,214	6,584
September	0	0	0	8,424	5,629	5,710	525	275	452	8,949	5,904	6,162
Annual	0	0	0	103,683	69,100	70,489	6,852	3,405	5,765	110,536	72,505	76,254

ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

SOLIDS STACKING FACILITY

VOLUME OF MONTHLY SOLIDS STACKED IN FACILITY

Solids Storage Facility Parameters	Value	Month	Number of Days	Manure CF	Bedding CF	Solids to Store CF	Solids to Store Tons	Normal Runoff CF
Storage Period, Days=	30	October	31	12,422	75,563	43,992	1,584	0
Stacking Width, W in Feet=	40	November	30	12,773	73,845	43,309	1,559	0
Stacking Height, H in Feet=	8.00	December	31	13,717	76,803	45,260	1,629	0
Wall Height, h in Feet=	6.00	January	31	13,717	76,803	45,260	1,629	0
Stack Side Slope (X:1)=	2.00	February	28	12,389	69,370	40,880	1,472	0
Existing Storage, Cubic Feet=	45,000	March	31	13,428	76,459	44,943	1,618	0
Surface Area of Existing Storage, SF=	0	April	30	12,022	73,125	42,573	1,533	0
25 Year-24 Hour Storm Runoff, CF=	0	May	31	12,422	75,563	43,992	1,584	0
Volume Needed, Cubic Feet=	45,260	June	30	12,022	73,125	42,573	1,533	0
Design Volume, Cubic Feet=	539	July	31	12,422	75,563	43,992	1,584	0
Is Facility Covered? YES	▼	August	31	12,422	75,563	43,992	1,584	0
Volume Reduction Factor=	0.50	September	30	12,022	73,125	42,573	1,533	0
		Annual	365	151,779	894,904	523,341	18,840	0



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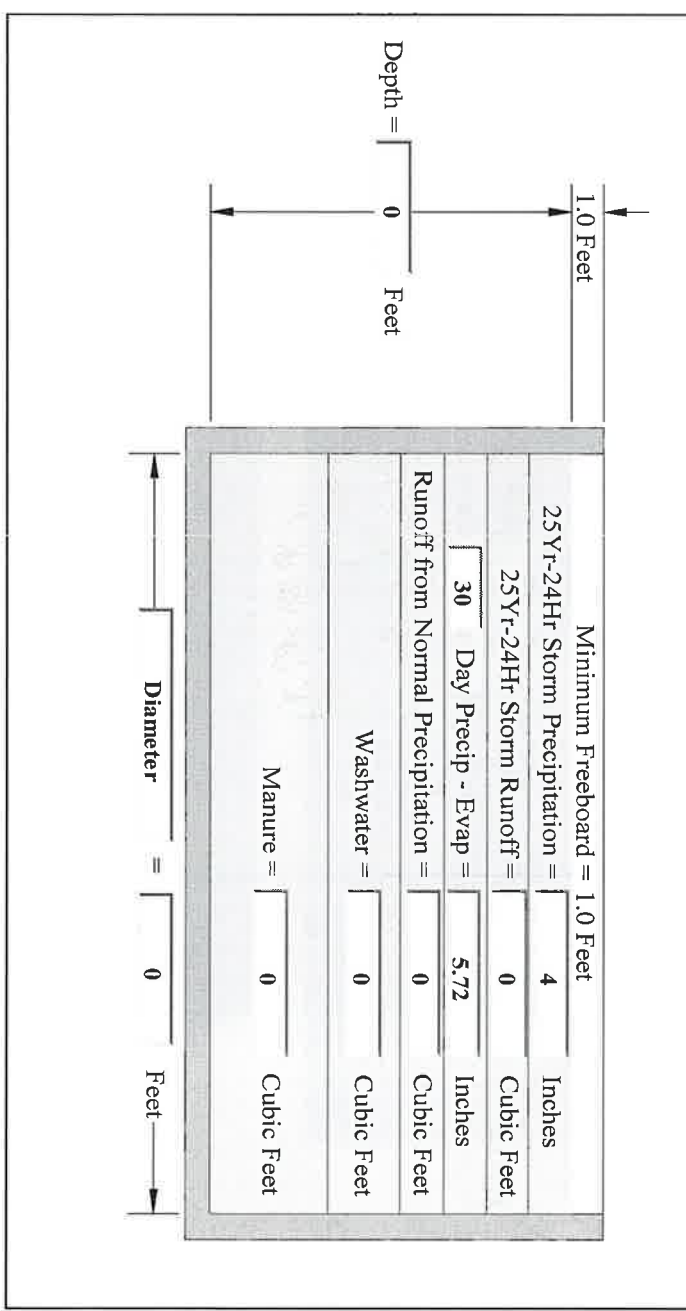
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ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

TANK	Tank Parameters	Value	MONTHLY INFLOWS INTO TANK									
			Month	Number of days	Rain-Evap on Tank CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Solids CF	Waste to Store CF	Waste to Store Gallons	
	Storage Period, Days=	30	October	31	0	0	0	0	0	0	0	0
	Tank Diameter, Feet=	0	November	30	0	0	0	0	0	0	0	0
			December	31	0	0	0	0	0	0	0	0
	Existing Storage, Cubic Feet=	0	January	31	0	0	0	0	0	0	0	0
	Surface Area of Existing Storage, SF=	0	February	28	0	0	0	0	0	0	0	0
	25 Year-24 Hour Storm Runoff, CF=	0	March	31	0	0	0	0	0	0	0	0
	Volume Needed, Cubic Feet=	0	April	30	0	0	0	0	0	0	0	0
	Design Volume, Cubic Feet=	0	May	31	0	0	0	0	0	0	0	0
	Is Tank Covered?	NO	June	30	0	0	0	0	0	0	0	0
	Tank Dimensions? Circular	▼	July	31	0	0	0	0	0	0	0	0
			August	31	0	0	0	0	0	0	0	0
			September	30	0	0	0	0	0	0	0	0
			Annual	365	0	0	0	0	0	0	0	0



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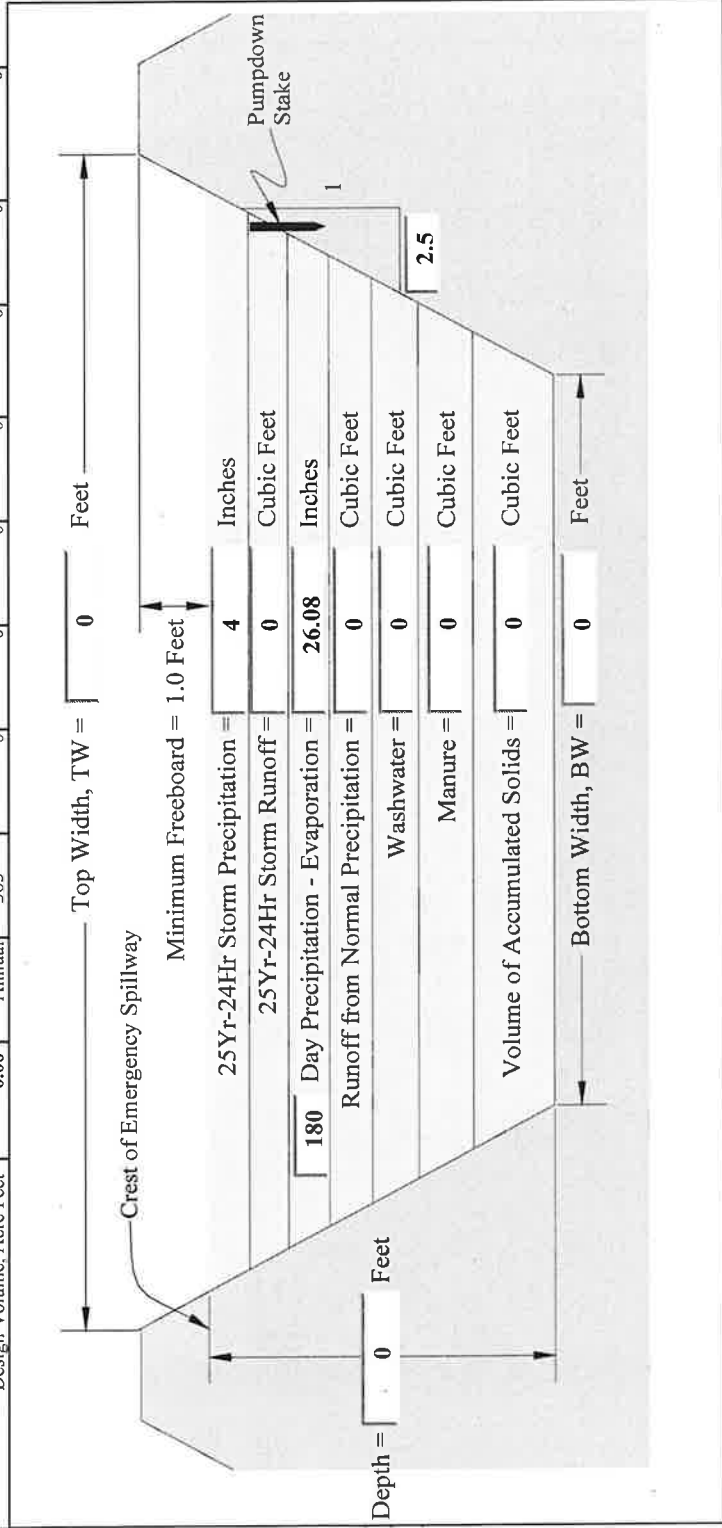
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ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

WASTEWATER STORAGE POND

MONTHLY INFLOWS INTO WASTEWATER STORAGE POND

Pond Parameters	Value	Month	Number of Days	Rain-Evap on Pond CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Solids CF	Waste to Store CF	Waste to Store Gallons
Storage Period, Days=	180	October	31	0	0	0	0	0	0	0
Side Slope (X:1)=	2.50	November	30	0	0	0	0	0	0	0
Bottom Width, BW, Feet=	0	December	31	0	0	0	0	0	0	0
Bottom Length, BL, Feet=	0	January	31	0	0	0	0	0	0	0
Accumulated Solids Duration, Years=	0	February	28	0	0	0	0	0	0	0
Existing Storage, Acre Feet=	0.00	March	31	0	0	0	0	0	0	0
Surface Area of Existing Storage, SF=	0	April	30	0	0	0	0	0	0	0
Minimum Soil Liner Depth, Feet=	1.00	May	31	0	0	0	0	0	0	0
25 Year-24 Hour Storm Runoff, CF=	0	June	30	0	0	0	0	0	0	0
Top Width, TW, Feet=	0	July	31	0	0	0	0	0	0	0
Top Length, TL, Feet=	0	August	31	0	0	0	0	0	0	0
Volume Needed, Acre Feet=	0.00	September	30	0	0	0	0	0	0	0
Design Volume, Acre Feet=	0.00	Annual	365	0	0	0	0	0	0	0



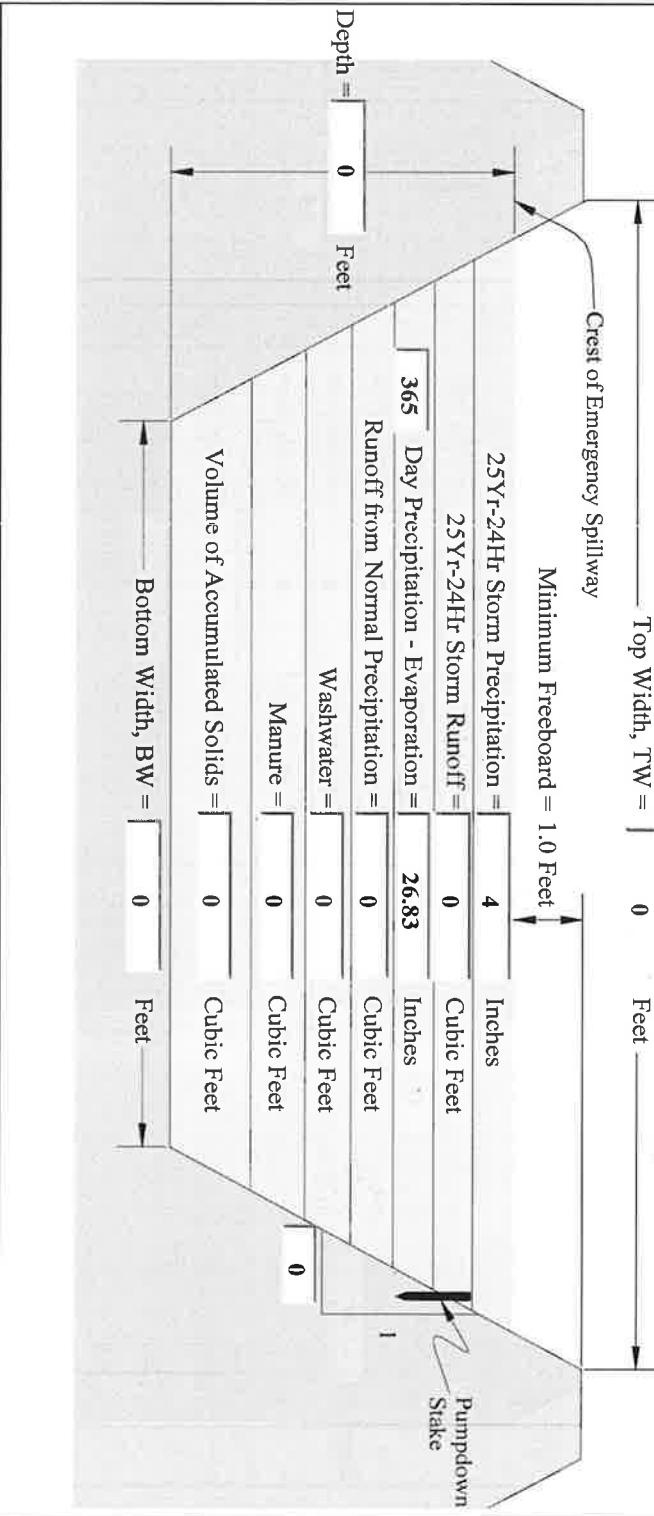
ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

EVAPORATION POND

Evaporation Pond Parameters		Value	Month	Number of Days	Rain-Evap on Pond CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Solids CF	Waste to Store CF	Waste to Store Gallons
Storage Period, Days		365	October	31	0	0	0	0	0	0	0
Side Slope (X:1)		0.00	November	30	0	0	0	0	0	0	0
Bottom Width, BW, Feet		0	December	31	0	0	0	0	0	0	0
Bottom Length, BL, Feet		0	January	31	0	0	0	0	0	0	0
Accumulated Solids Duration, Years		0	February	28	0	0	0	0	0	0	0
Existing Storage, Acre Feet		0.00	March	31	0	0	0	0	0	0	0
Surface Area of Existing Storage, SF		0	April	30	0	0	0	0	0	0	0
Minimum Soil Liner Depth, Feet		1.00	May	31	0	0	0	0	0	0	0
25 Year-24 Hour Storm Runoff, CF		0	June	30	0	0	0	0	0	0	0
Top Width, TW, Feet		0	July	31	0	0	0	0	0	0	0
Top Length, TL, Feet		0	August	31	0	0	0	0	0	0	0
Volume Needed, Acre Feet		0.0	September	30	0	0	0	0	0	0	0
Design Volume, Acre Feet		0.0	Annual	365	0	0	0	0	0	0	0

MONTHLY INFLOWS INTO EVAPORATION POND

NOT ENOUGH EVAPORATION TO DESIGN POND!



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ANIMAL WASTE MANAGEMENT SYSTEM APPLICATION

MANAGEMENT CRITERIA FOR TRACTOR SPREADER APPLICATION OF SOLIDS

To apply 1,046,683 cubic feet of solids generated from the operation it will take approximately 5,260 trips annually. Based on applying NITROGEN, N at agronomic rate use the application depths, travel lengths, and loads per acre listed below for each crop.

Field Number	Acres	Crop	Tractor Spreader Capacity		Spread Width Feet	NITROGEN, N Concentration in Storage Facility		Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Tons per Acre of Solids to Apply	Travel Length per Load Needed in Feet	Loads per Acre	Assumed Solids Density lbs/CF
			Bushels	CF		PPM	Lbs/Ton						
Pastures	97	Perennial Hay/Pasture(Med Intensity)	160	199	15	1,926	3.85	192	1.00	73.3	142	20	36
Back 80	106	Perennial Hay/Pasture(Med Intensity)	160	199	15	1,926	3.85	96	1.00	36.6	284	10	36
30 Acre	9	Perennial Hay/Pasture(Med Intensity)	160	199	15	1,926	3.85	192	1.00	73.3	142	20	36

MANAGEMENT CRITERIA FOR BIG GUN SPRINKLER APPLICATION OF LIQUIDS

To apply 0 gallons of liquids generated from the operation it will take approximately 0 hours of pumping annually. Based on applying NITROGEN, N at agronomic rate use the application depths, set times, and travel rates listed below for each crop.

Field Number	Acres	Crop	Sprinkler Flowrate GPM	Wetted Diameter Feet	Portion of Wetted Diameter Receiving Liquids	NITROGEN, N Concentration in Storage Facility		Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Inches of Liquids to Apply	Application Rate in Inches/Hour	Set Time Needed in Hours	Travel Rate Needed in Feet/Minute
						PPM	Lbs/1000Gal						
Pastures	97	Perennial Hay/Pasture(Med Intensity)				0	0	0	0				
Back 80	106	Perennial Hay/Pasture(Med Intensity)				0	0	0	0				
	9	Perennial Hay/Pasture(Med Intensity)				0	0	0	0				

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ASSISTED BY: 0

Ver: 0

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation	Pounds of Nutrients Available			Percent Nutrients Retained			Pounds of Nutrients Retained After Storage		
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Poultry										
Liquids	Storage Pond (>50%) Dilution	0	0	0	70%	85%	85%	0	0	0
Solids	Solids Storage Facility (Roofed)	103,683	69,100	70,489	70%	100%	90%	72,578	69,100	63,440
Grazing	NONE	6,852	3,405	5,765	100%	100%	100%	6,852	3,405	5,765

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available			Percent Nutrients Retained After Application			Pounds of Nutrients Retained After Application		
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Liquids	Sprinkling	0	0	0	80%	100%	100%	0	0	0
Solids	Broadcast (incorporated 7 or more days after application)	72,578	69,100	63,440	80%	100%	100%	58,063	69,100	63,440
Grazing	Grazing	6,852	3,405	5,765	85%	100%	100%	5,824	3,405	5,765

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location	Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification			
		N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	
Liquids	Between Coastal and Cascade Mountains Soil Drainage Class	0	0	0	85%	100%	100%	0	0	0	
Solids	Somewhat Poorly Drained	58,063	69,100	63,440	85%	100%	100%	49,353	69,100	63,440	
Grazing	Somewhat Poorly Drained	5,824	3,405	5,765	85%	100%	100%	4,951	3,405	5,765	
TOTAL							54,304	72,505	69,205		

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

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ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

PERCENT OF MANURE TO BE APPLIED TO FIELD AND UTILIZATION ACRES NEEDED BASED ON											
NITROGEN, N											
Field Number	Acres	Crop	LIQUIDS			SOLIDS			GRAZING		
			Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients
Pastures	97.0	Perennial Hay/Pasture(Med Intensity)	0%	0	0	24%	11,845	62	47%	2,327	12
Back 80	106.0	Perennial Hay/Pasture(Med Intensity)	0%	0	0	26%	12,832	134	53%	2,624	27
30 Acre	9.0	Perennial Hay/Pasture(Med Intensity)	0%	0	0	0%	0	0	0%	0	0
Off Farm			100%	0	0	50%	24,677	195	0%	0	0
TOTALS:	212		100%	0	0	100%	49,353	195	100%	4,951	39

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

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Worksheet OR10A-7--Waste storage period determination

Basic Storage Period, SPb = 213 Days

Enter average monthly Evapotranspiration(ET) from OSU Extension Publication 8530, Oregon Crop Water Use and Irrigation Requirements, and Precipitation(Ppt) Data from

Climatic Station - N WILLAMETTE EXP STA

Day of Year	MONTH	Crop ET, Inches	Accum ET, Inches	Ppt, Inches
1-31	January	0.39	0.39	6.04
32-59	February	0.63	1.02	5.24
60-90	March	1.46	2.48	4.28
91-120	April	3.31	5.79	3.14
121-151	May	4.53	10.32	2.50
152-181	June	5.24	15.56	1.76
182-212	July	6.22	21.78	0.73
213-243	August	5.28	27.06	0.83
244-273	September	4.02	31.08	1.81
274-304	October	2.48	33.56	3.36
305-334	November	0.43	33.99	6.48
335-365	December	0.35	34.34	6.44

a. Determine last day for the month of the year when 3/4 of Annual ET is exceeded-

3/4 of Annual ET = 0.75 x 34.34 = 25.76 Inches

L = Last Day for Month Accum ET exceeds 3/4 of Annual ET

L = 243 Days

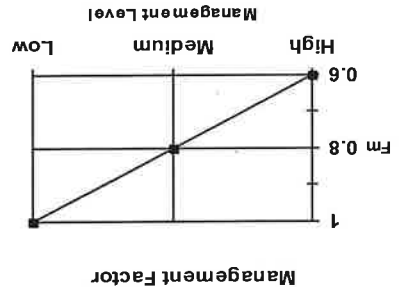
b. Determine first day for the month of the year when ET >= Ppt

E = First Day of Month ET >= Ppt

E = 91 Days

c. $SPb = 365 - (L - E) = 365 - (243 - 91) = 213$ Days

Management Factor, Fm = 0.8



Low Level, Fm = 1.0
 The operator does not utilize a waste management plan.
 Proper operation and maintenance may not be performed.

Medium Level, Fm = 0.8
 The operator utilizes an up-to-date waste management plan.
 Manure application equipment is calibrated for nutrient applications.
 Manure in storage is tested for nutrient concentrations.
 Records of time, rate and location of manure applications are maintained.
 Irrigation water management techniques are practiced.
 Crop nutrient uptake is maximized with appropriate agronomic treatments such as residue management, conservation crop rotation, crop variety selection, prescribed grazing, and pest management.
 Proper operation and maintenance is planned.

High Level, Fm = 0.6
 The operator utilizes an up-to-date waste management plan.
 Soil fertility testing is performed annually.
 Manure in storage is tested for nutrient concentrations.
 Records of time, rate and location of manure applications are maintained.
 Manure application equipment is calibrated for nutrient applications.
 Irrigation water management techniques are practiced.
 Crop nutrient uptake is maximized with appropriate agronomic treatments such as residue management, conservation crop rotation, crop variety selection, prescribed grazing, and pest management.
 Proper operation and maintenance is planned.

Worksheet OR10A-7--Waste storage period determination

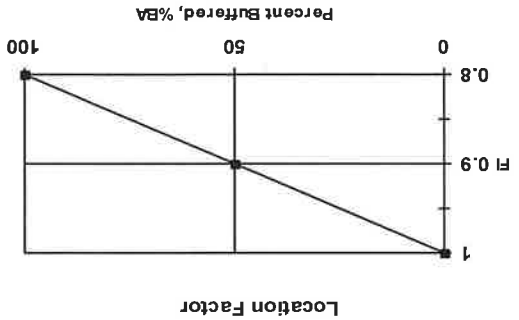
Soils must meet the following criteria for F_s to be less than 1.0:
 The average water holding capacity for the profile greater than 3.0 inches.
 A cation exchange capacity greater than 5 meq/100g of soil.
 Depth to a thin layer/cemented pan greater than 20 inches.
 Depth to high water table greater than 2 feet.
 A permeability greater than 0.05 inches/hr but less than 6 inches/hr.
 Cobbles less than 35% by weight in the surface layer.
 Stones and boulders less than 15% by weight in the surface layer.
 A pH greater than 5.0.
 Sodium Adsorption Ratio less than 13.
 Land slope less than 15%.

Soils Factor (F _s)	Consistency of Waste		
	Solid	Semi-Solid	Slurry
A	1	0.95	0.9
B	0.8	0.75	0.7
C	0.9	0.85	0.8
D	1	1	0.95

Soils Factor: $F_{s_{liquid}} = 0.90$ $F_{s_{solid}} = 0.70$

HSG	Area	F _{s_liquid}	F _{s_liquid}	Wtd	F _{s_solid}	F _{s_solid}
C	100	0.9	90.00		0.7	70.00

Location Factor: $F_l = 1.00$

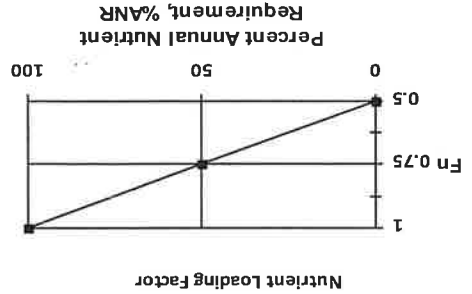


For an application area to be considered buffered there must be a 0 to 5 percent chance of flooding and the area must be at least 50 feet from water bodies, ground water sources(wells), and areas of concentrated flow. The percent buffered area(%BA) is determined by taking the total buffered area(TBA) and dividing it by the total land area(TLA) available for manure application.

$\%BA = \frac{TBA}{TLA} \times 100\%$

$\%BA = \frac{0}{212} \times 100\% = 0\%$

Nutrient Loading Factor: $F_n = 1.00$



In order for the Nutrient Loading Factor, F_n to be less than 1, the Location Factor, F_l must be 0.95 or less.
 The percent of annual nutrient requirement(%ANR) is determined by taking the total nutrients applied(TNA) annually and dividing it by the total nutrient requirements(TNR) of all of the crops grown.

$\%ANR = \frac{TNA}{TNR} \times 100\%$

$\%ANR = \frac{1,035}{1,098} \times 100\% = 94\%$

OREGON ANIMAL WASTE MANAGEMENT DESIGN AID (ORAWM)

Version 5.0

CLIENT: Ed and Lisa Heilman

ASSISTED BY: 0

Worksheet OR10A-7--Waste storage period determination

Application Method Factor: $F_{a\text{Liquid}} = 0.90$ $F_{a\text{Solid}} = 1.00$

Method 1 - Surface applied solid manure, no incorporation.
 Method 2 - Surface applied liquid manure, no incorporation.
 Method 3 - Injection or immediate incorporation.

Adjusted Storage Period: ASP_{Liquid} = 138 Days $ASP_{\text{Solid}} = 119 \text{ Days}$

$ASP = SP_b \times F_m \times F_s \times F_l \times F_n \times F_a$

$ASP_{\text{Liquid}} = 213 \times 0.8 \times 0.9 \times 1 \times 1 \times 0.9$

$ASP_{\text{Solid}} = 213 \times 0.8 \times 0.7 \times 1 \times 1 \times 1$

Adjusted earliest Day of Year for application, $E_a = ASP - (365 - L)$

$E_{a\text{Liquid}} = 16$

$E_{a\text{Solid}} = -3$

Storage Period: SP_{Liquid} = 154 Days $SP_{\text{Solid}} = 154 \text{ Days}$

The storage period must span the seasonal flooding conditions and must also span frozen ground and snow conditions where the land slope exceeds 5% and a buffer strip of less than 100 feet exists next to open water courses that affect the application area-

a. Enter L from Sheet 1 and determine the Day of Year L_f when seasonal frozen ground, snow or flooding conditions are first anticipated for the application area-

$L = 243 \text{ Days}$

If L_f comes before L then $L_{sp} = L_f$

If L_f comes after L or there is no seasonal frozen ground, snow or flooding then $L_{sp} = L$

$L_{sp} = 243 \text{ Days}$

b. Determine the Day of Year E_f when seasonal frozen ground, snow or flooded conditions are no longer anticipated for the application area-

$E_f = 32 \text{ Days}$

If E_f comes after E_a then $E_{sp} = E_f$

If E_f comes before E_a or there is no seasonal frozen ground, snow or flooding then $E_{sp} = E_a$

$E_{sp\text{Liquid}} = 32 \text{ Days}$

$E_{sp\text{Solid}} = 32 \text{ Days}$

c. $SP_{\text{Liquid}} = 365 - (L_{sp} - E_{sp\text{Liquid}}) = 154 \text{ Days}$

$SP_{\text{Solid}} = 365 - (L_{sp} - E_{sp\text{Solid}}) = 154 \text{ Days}$

d. Earliest date (E_{sp}) for manure application (month-day):

$E_{sp\text{Liquid}} = \text{February 4}$

$E_{sp\text{Solid}} = \text{February 1}$

e. Latest date (L_{sp}) for manure application (month-day) =

$L_{sp} = \text{September 31}$

CAFO NPDES General Permit #01-2016
Issuance Date: March 31, 2016
Effective Date: April 20, 2016
Expiration Date: February 28, 2021

OREGON CONFINED ANIMAL FEEDING OPERATION
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
GENERAL PERMIT NUMBER 01-2016



Oregon
Department
of Agriculture

State of Oregon
Department of Agriculture
Confined Animal Feeding Operation Program
and
Department of Environmental Quality
Water Quality Division



DEQ
State of Oregon
Department of
Environmental
Quality

In compliance with the provisions of Oregon Revised Statutes (ORS) Chapter 468B,
Oregon Administrative Rules (OAR) Chapter 340, Divisions 40, 45 and 51 and Chapter 603, Division 74,
the Federal Water Pollution Control Act as amended (The Clean Water Act),
Title 33 United States Code, Section 1251 et seq., and
the National Pollutant Discharge Elimination System (NPDES) program.

Until this permit expires or is modified or revoked, permit registrants who have properly obtained coverage under this permit are authorized to discharge to waters of the state in accordance with the special and general conditions that follow.

Ray Jarrid, Director
Natural Resources and Pesticides
Oregon Department of Agriculture

Lydia Emer
Operations Division Administrator
Oregon Department of Environmental Quality

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APR 04 2016

NATURAL RESOURCES

TABLE OF CONTENTS

Special Conditions

DEFINITIONS 3

S1. PERMIT COVERAGE..... 6

S1.A. When is a permit required and which CAFOs are covered by this permit? 6

S1.B. Can I elect coverage under this permit even if my CAFO does not discharge to surface water? 6

S1.C. How do I apply for permit coverage? 7

S1.D. How do I transfer permit coverage to a new owner or operator? 7

S1.E. What activities are covered by this permit? 7

S1.F. How do I cancel permit coverage?..... 7

S1.G. Will my information be kept confidential? 8

S1.H. What are the public notice and participation requirements of this permit? 8

S1.I. Table 2: NPDES Public Notice Requirements 9

S2. DISCHARGE LIMITATIONS AND OPERATING REQUIREMENTS..... 10

S2.A. Prohibitions and Discharge Limitations 10

S2.B. Production Area Limitations 10

S2.C. Land Application Limitations 10

S2.D. Direct Access by Animals to Surface Water of the State in the Production Area Prohibited 11

S2.E. Waste Storage Facilities 11

S2.F. Prevention of System Overloading 11

S2.G. Handling of Animal Mortalities 11

S2.H. Proper Operation and Maintenance 12

S2.I. Maintaining Compliance if System Fails 12

S2.J. Setback Requirement 12

S2.K. Manure, Litter, or Process Wastewater Transfers 12

S2.L. Proper Disposal of Other Wastes 12

S3. ANIMAL WASTE MANAGEMENT PLAN 13

S3.A. Animal Waste Management Plan (AWMP) Implementation and Compliance 13

S3.B. AWMP Submittal and Public Notice 13

S3.C. AWMP Elements 13

S3.D. Requirements for AWMP Updates and Changes 14

S4. MONITORING, INSPECTION, RECORDKEEPING, AND REPORTING REQUIREMENTS 17

S4.A. Monitoring Requirements 17

S4.B. Inspection Requirements 18

S4.C. Recordkeeping and Availability Requirements 18

S4.D. Reporting Requirements 19

S4.E. Additional Monitoring 20

General Conditions

G1. Compliance with other laws and statutes 21

G2. Duty to comply [40 CFR § 122.41(a)] 21

G3. Duty to reapply [40 CFR § 122.41(b)] 21

G4. Need to halt or reduce activity not a defense [40 CFR § 122.41(c)] 21

G5. Duty to mitigate [40 CFR § 122.41(d)] 22

G6. Proper operation and maintenance [40 CFR § 122.41(e)] 22

G7. Permit actions 22

G8. Property rights [40 CFR § 122.41(g)] 22

G9. Duty to provide information [40 CFR § 122.41(h)] 22

G10. Inspection and entry [40 CFR § 122.41(i)] 22

G11. Monitoring and records [40 CFR § 122.41(j)] 22

G12. Signatory requirement [40 CFR § 122.21(k)] 23

G13. Additional reporting requirements [40 CFR § 122.41(l)] 23

G14. Bypass [40 CFR § 122.41(m)] 24

G15. Upset [40 CFR § 122.41(n)] 24

SPECIAL CONDITIONS

DEFINITIONS

1. "25-year, 24-hour rainfall event" means an event with a probable recurrence interval of once in twenty-five years as defined by the National Weather Service in Technical Paper Number 40, "Rainfall Frequency Atlas of the United States," May 1961, or equivalent regional or state rainfall probability information developed from this source.
2. "40 CFR" means Title 40 of the Code of Federal Regulations (2014).
3. "Agency" means Oregon Department of Environmental Quality or Oregon Department of Agriculture.
4. "Agricultural stormwater" is defined at 40 CFR § 122.23(e).
5. "Animal waste management plan" or "AWMP" or "waste management plan" means a written document containing the minimum elements necessary to manage manure, litter, and process wastewater from operations covered by this permit in accordance with the terms and conditions of this permit.
6. "Agronomic application rate" means the rate or amount of nutrients applied to the soil for utilization by growing or planned crops such that the crops remove the same or greater amount of nutrients provided by the agronomic application.
7. "Bedding" means any absorbent material that is used to provide animal cleanliness and comfort in a confinement system. Bedding materials include but are not limited to: straw; sawdust; wood shavings; grass seed cleanings; recycled, composted, or dried manure solids; and recycled paper products. Bedding that comes into contact with animals, manure, litter, or process wastewater is determined to be manure, litter, or process wastewater for purposes of this permit.
8. "Confined animal feeding operation" or "CAFO" as defined in OAR 603-074-0010(3) and OAR 340-051-0010(2) means:
 - (a) The concentrated confined feeding or holding of animals or poultry, including but not limited to horse, cattle, sheep, or swine feeding areas, dairy confinement areas, slaughterhouse or shipping terminal holding pens, poultry and egg production facilities and fur farms:
 - (i) In buildings or in pens or lots where the surface has been prepared with concrete, rock or fibrous material to support animals in wet weather; or
 - (ii) That have wastewater treatment works; or
 - (iii) That discharge any wastes into waters of the state; or
 - (b) An animal feeding operation that is subject to regulation as a concentrated animal feeding operation pursuant to 40 CFR § 122.23.
9. "Director" means the director of the State of Oregon Department of Environmental Quality or director of the State of Oregon Department of Agriculture or their authorized designee(s).
10. "Discharge" when used without qualification means the "discharge of a pollutant." "Discharge of a pollutant" is defined at 40 CFR § 122.2.
11. "Dry waste" means any solid manure, litter, bedding, or waste feed that cannot be transferred or applied with a pump or pipe system. Precipitation that comes into contact with dry waste does not change dry waste into wet waste. Dry waste may contain urine, manure, leachate or incidental process wastewater that has been absorbed into the feces, and used bedding materials in amounts that allow the waste to retain the dry characteristic so that the material cannot be transferred or applied with a pump or through a pipe.
12. "Dry waste treatment works" means any plant or other works used for the purpose of treating, stabilizing or holding wastes as a dry, solid substance. Dry waste treatment works for purposes of this permit do not utilize pumps or pipes to transfer or apply dry waste and typically do not need any added water or liquid to transfer or apply dry waste. Dry waste treatment works include but are not limited to manure piles and covered dry manure stack storage facilities.
13. "Dry-weather discharge" means a discharge of manure, litter or process wastewater from a land application area that is not defined as Agricultural Stormwater (40 CFR 122.23(e)) and where the land application of manure, litter, or process wastewater has not met all the site-specific nutrient management practices contained in the department-approved Animal Waste Management Plan and specified in 40 CFR 122.42(e)(1)(vi)-(xi). Dry weather discharges include but are not limited to: discharges through tile drains, discharges combined with irrigation water, infiltration of nutrients below the crop root zone, discharges due to failure of manure application or irrigation equipment.
14. "Frozen soil" means soil that has a soil temperature of 32° F (or 0° C) or less in any three (3) continuous inches of the top 12 inches of soil.

15. "Groundwater" means water in a saturated zone or stratum beneath the surface of land or below a surface water body.
16. "Manure" means solids or liquids excreted from an animal or other material (for example, bedding, compost, litter, feed waste, silage leachate, raw materials such as feed or silage) that comes into contact with solid or liquid excreted from an animal .
17. "OAR" means Oregon Administrative Rule.
18. "ORS" means Oregon Revised Statute.
19. "Overflow" means the discharge of manure or process wastewater resulting from the filling of wastewater or manure storage structures beyond the point at which no more manure, process wastewater, or stormwater can be contained by the structure.
20. "Person" is defined at 40 CFR § 122.2.
21. "Point source" is defined at 40 CFR § 122.2.
22. "Pollutant" is defined at 40 CFR § 122.2.
23. "Pollution" or "water pollution" is defined at ORS 468B.005(5).
24. "Process wastewater" or "process wastes" means water directly or indirectly used in the operation of the CAFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning or flushing pens, barns, manure pits, or other CAFO facilities; direct contact swimming, washing, or spray cooling of animals; or dust control. Process wastewater or process wastes also includes any water that comes into contact with any raw materials, products, or byproducts including manure, litter, feed, milk, eggs, or bedding. OAR 340-051-0010(5) and OAR 603-074-0010(17)
25. "Production area" means that part of a CAFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cowyards, barnyards, medication pens, walkers, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment areas include but are not limited to settling basins, and areas within berms and diversions that separate uncontaminated stormwater. Also included in the definition of production area is any egg washing or egg processing facility, and any area used in the storage, handling, treatment, or disposal of animal mortalities. OAR 340-051-0010(6) and OAR 603-074-0010(18)
26. Quantitation Limits (QLs) – The QL is the minimum level, concentration or quantity of a target analyte that can be reported with a specified degree of confidence. It is the lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration for the analyte. It is normally equivalent to the concentration of the lowest calibration standard adjusted for sample weights, volumes, preparation and cleanup procedures employed. The QL as reported by a laboratory is also sometimes referred to as the Method Reporting Limit (MRL) or Limit of Quantitation (LOQ).
27. "Saturated soil" means soil with all available pore space filled that has reached its maximum retentive capacity as defined in "Qualitative Description of Soil Wetness" (Brady, N. and Weil, R., p. 201, 2007).
28. "Setback" as defined at 40 CFR §412.4(b)(1) means a specified distance from surface water or potential conduits to surface water where manure, litter, and process wastewater may not be land applied. Examples of conduits to surface water include but are not limited to: Open tile line intake structures, sinkholes, and agricultural well heads.
29. "Treatment works" means any plant or other works used for the purpose of treating, stabilizing or holding wastes. ORS 468B.005(8)

30. "Vegetative buffer" as defined at 40 CFR §412.4(b)(2) means a narrow, permanent strip of dense perennial vegetation established parallel to the contours of and perpendicular to the dominant slope of the field for the purposes of slowing water runoff, enhancing water infiltration, and minimizing the risk of any potential nutrients or pollutants from leaving the field and reaching surface water.
31. "Waste storage facilities" means the physical system used for the isolation and retention of process wastes on the confined animal feeding operation until their ultimate utilization.
32. "Wastes" is defined at ORS 468B.005(9).
33. "Water" or "waters of the state" is defined at ORS 468B.005(10).
34. "Waters of the U.S." is defined at 40 CFR § 122.2.
35. "Wet waste" means any liquid manure, contaminated stormwater, process wastewater, liquid feed waste and silage or manure leachate. Wet waste may include solid material particles that are suspended or dissolved in the liquid.
36. "Wet waste treatment works" means any plant or other works used for the purpose of treating, stabilizing or holding wet wastes. Wet waste treatment works for purposes of this permit include, but are not limited to: tanks or lagoons to store wet waste; pumps, pipes, curbs, gutters, and collection sumps to direct, collect, transfer, or apply wet wastes; and any system that separates dry waste from wet waste.

S1.PERMIT COVERAGE

S1.A. When is a permit required and which CAFOs are covered by this permit?

1. Any person who owns or operates a confined animal feeding operation (CAFO) that discharges to surface water of the state is required to obtain NPDES permit coverage. NPDES General Permit #01 provides coverage for the types of CAFOs listed in Table 1 below that discharge to surface water of the state. This includes concentrated animal feeding operations defined at 40 CFR § 122.23 that discharge to waters of the U.S.
2. Any person not wishing to be covered by this permit may apply for an NPDES individual permit in accordance with OAR 340-045-0030. In addition, the director may require coverage under an NPDES individual permit pursuant to the provisions in OAR 340-045-0033 and OAR 603-074-0012.

S1.B. Can I elect coverage under this permit even if my CAFO does not discharge to surface water?

Any person who owns or operates a CAFO that does not discharge to surface water of the state may voluntarily elect to be covered under this permit. Any person making such an election is subject to all applicable requirements of this permit.

Table 1: Classification of CAFOs that require coverage by NPDES General Permit #01

Type of CAFO discharging to surface water of the state	Small	Medium	Large
mature dairy cows ¹	<200	200-699	≥700
veal calves	<300	300-999	≥1,000
cattle ²	<300	300-999	≥1,000
swine ≥ 55 lbs	<750	750-2,499	≥2,500
swine < 55 lbs	<3,000	3,000-9,999	≥10,000
horses	<150	150-499	≥500
sheep or lambs	<3,000	3,000-9,999	≥10,000
turkeys	<16,500	16,500-54,999	≥55,000
chickens, including laying hens or broilers w/wet waste system	<9,000	9,000-29,999	≥30,000
laying hens w/dry waste system	<25,000	25,000-81,999	≥82,000
broiler chickens w/dry waste system	<37,500	37,500-124,999	≥125,000
ducks w/other than wet waste system	<10,000	10,000-29,999	≥30,000
ducks w/wet waste system	<1,500	1,500-4,999	≥5,000
other animal type ³	Designated by director.	Designated by director.	Designated by director.

¹ Whether milked or dry.

² Other than mature dairy cows or veal calves; cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs.

³ To determine the number of animals that require permit coverage, ODA will compare the operation to the most similar animal type in the table.

S1.C. How do I apply for permit coverage?

1. New Application

To obtain permit coverage for the first time, a person must submit to ODA an ODA *Application to Register (ATR)*, Land Use Compatibility Statement (LUCS), Animal Waste Management Plan (AWMP), and application fee. The application, LUCS, AWMP, and fee must be submitted to ODA at least 180 days prior to the time permit coverage is needed or as specified by ODA in writing. For information on AWMP requirements, see S3, p. 13.

2. Renewal of Permit Coverage

To renew permit coverage, the permit registrant must submit an ODA renewal application at least 180 days before the expiration date of this permit or as specified by ODA in the renewal notice but no later than the expiration date of this permit. Applicants must certify on their renewal application whether an AWMP is new, updated or current and on file. New and updated animal waste management plans must be submitted with the application.

3. Notification of Permit Coverage

ODA will review the application and notify the applicant in writing when permit coverage is approved or denied. Permit coverage does not begin until written notice is issued by ODA to the applicant. Written notification will include a *Notice of Registration* that will include the following information:

- (a) The owner and operator's legal name;
- (b) Facility name and location;
- (c) Contact information, including mailing address and telephone number;
- (d) Effective date of permit coverage;
- (e) Maximum number of animals allowed at the facility; and
- (f) Regulatory status of the operation. ODA will use the following classifications for regulatory status:
 - (i) *Large concentrated animal feeding operation* as defined in 40 CFR § 122.23(b)(4);
 - (ii) *Medium concentrated animal feeding operation* as defined in 40 CFR § 122.23(b)(6);
 - (iii) *Small concentrated animal feeding operation* as defined in 40 CFR § 122.23(b)(9) and designated by the director pursuant to OAR 603-074-0012;
 - (iv) *Elective large, medium, or small CAFO* sized according to Table 1, p. 6.

S1.D. How do I transfer permit coverage to a new owner or operator?

The permit registrant must complete an ODA transfer form and submit it to ODA for approval at least 30 days before transfer of the CAFO is scheduled to occur or as specified by ODA. The form must be signed by the previous owner or operator as well as the new owner or operator. ODA will respond to the request for transfer by conducting a site inspection and a review of the permit file. ODA will notify the permit registrant and transferee in writing of transfer of coverage under this permit or deny the request with an explanation of why the request was denied.

S1.E. What activities are covered by this permit?

1. This permit covers the discharge of pollutants resulting from processes, wastes, and operations that are properly identified by the registrant through its AWMP approved by ODA.
2. This permit does not cover disposal of human wastes or treatment works that mix human and animal wastes. Any person owning or operating such a system must apply to DEQ for coverage under an individual or general permit issued pursuant to ORS 468B.050. This general permit may be used in addition to an individual or general permit issued by DEQ pursuant to ORS 468B.050 that covers some other type of wastewater at this same facility, for example, septic system wastewater.
3. Pursuant to 40 CFR § 122.23(e), precipitation-related discharges that qualify as agricultural stormwater discharges from land application areas are not subject to NPDES permit requirements. For discharges from the land application area to meet the definition of agricultural stormwater, manure and wastewater must be applied in accordance with site specific practices listed in the ODA-approved AWMP that ensure appropriate agricultural utilization of nutrients.

S1.F. How do I cancel permit coverage?

1. ODA will cancel coverage under this permit upon issuance of an appropriate individual permit by ODA and DEQ or coverage under WPCF General Permit #01 is granted by ODA.

2. Any permit registrant may request in writing to ODA that coverage under this permit be cancelled if any one of the following applies:
 - (a) Conditions or standards have changed so that the CAFO no longer qualifies for or is required to have coverage under this permit.
 - (b) The permit registrant no longer has animals on site and all waste storage and control facilities have been cleaned and re-purposed or decommissioned in accordance with the following requirements:
 - (i) Cleaning/Re-purposing Requirements
 - (1) All liquid and solid manure, litter and process wastewater must be removed from the structure(s) and either land applied according to the ODA-approved AWMP or exported according to S2.K, p. 12.
 - (2) All liquid storage facilities that could fill with rain water must be flushed with clean water, the flush water land applied or exported according to S2.K, p. 12 and the remaining liquid in the structure tested to confirm the *E. coli* level is at or below the water quality standard of 406 Colony Forming Units/100ml of sample.
 - (3) All liquid transfer systems are cleaned and modified so that they are not a conduit for any pollutant to enter surface water or groundwater.
 - (ii) Decommissioning Requirements
 - (1) All liquid and solid manure, litter and process wastewater must be removed from the structure(s) and either land applied according to the approved AWMP or exported according to S2.K, p. 12.
 - (2) If the structure has a synthetic liner, the liner must be removed and disposed or recycled in a lawful manner.
 - (3) After completion of [(ii)(1)] above, any earthen structure must be filled with soil and returned to the grade matching the surrounding area. All soil fill and remaining exposed soil must be seeded to site-appropriate grass or ground cover to prevent erosion.
3. The permit registrant must also certify that it will not commence operation of a regulated CAFO at the same location until the appropriate NPDES or WPCF permit coverage has been obtained.
4. ODA will respond to the request for cancellation by conducting a site inspection and a review of the permit file. ODA will notify the permit registrant in writing of termination of coverage under this permit or deny the request with an explanation of why the request was denied.

S1.G. Will my information be kept confidential?

Information, including the name and address of an NPDES permit applicant or permit registrant, NPDES permit applications (for example, ODA *ATRs*) and their attachments (for example, AWMPs), NPDES permits, and NPDES permit discharge data cannot be kept confidential pursuant to 40 CFR § 122.7(b) and (c), ORS 468.095(1), and ORS 192.410 to 192.505. The applicant or permittee may request that director classify other records as confidential upon a proper showing that the record is a trade secret pursuant to ORS 468.095(2).

S1.H. What are the public notice and participation requirements of this permit?

1. Prior to approving new permit coverage, renewing permit coverage, or approving proposed substantial changes to an AWMP, ODA will provide public notice and participation as detailed in Table 2, p. 9.
2. ODA may batch multiple notices as regionally appropriate.
3. Application and permit documents (for example, Application to Register, renewal application, AWMP, Land Use Compatibility Statement) will be available for public review at ODA headquarters and appropriate field offices. If available, electronic copies of documents will be provided upon request.
4. ODA will schedule public hearings if written requests for public hearing are received during the comment period from at least 10 persons or from an organization or organizations representing at least ten persons. If a hearing is scheduled, ODA will provide at least 30 days notice before the hearing is held. The public comment period will remain open for additional comments for at least seven (7) days after the public hearing.

S1.I. Table 2: NPDES Public Notice Requirements

	New Application	Renewal Application	AWMP Changes
Permit Action	(a) Receipt of ODA <i>ATR</i> (<i>Application to Register</i>) for existing operation not currently under an NPDES permit or new proposed operation	(b) Receipt of renewal application	(c) Receipt of proposed substantial change to CAFO's AWMP (See S3.D, p. 14)
Public Participation Process	(i) Public notice of a comment period of at least 35 days provided as follows: <ul style="list-style-type: none"> • Published in regional newspaper; • Posted on ODA and DEQ websites; and • Emailed to interested persons list maintained by ODA. (ii) Opportunity for public hearing. See S1.H.4. (iii) A written response to relevant comments will be developed by ODA and made available to interested persons.	(i) Public notice of a comment period of at least 35 days provided as follows: <ul style="list-style-type: none"> • Posted on ODA and DEQ websites; and • Emailed to interested persons list maintained by ODA. (ii) Opportunity for public hearing. See S1.H.4. (iii) A written response to relevant comments will be developed by ODA and made available to interested persons.	(i) Public notice of a comment period of at least 35 days provided as follows: <ul style="list-style-type: none"> • Posted on ODA and DEQ websites; and • Emailed to interested persons list maintained by ODA. (ii) Opportunity for public hearing. See S1.H.4. (iii) A written response to relevant comments will be developed by ODA and made available to interested persons.
Contents of Public Notice	<ul style="list-style-type: none"> • Name of operation • Name of operator or owner if different than operator, mailing address, and telephone number • Physical address of operation • Type of operation • Number of animals proposed • Land Use Compatibility Statement (LUCS) • Summary of AWMP 	<ul style="list-style-type: none"> • Name of operation • City, county, and zip code • Permit registration number • Type of operation 	<ul style="list-style-type: none"> • Name of operation • City, county, and zip code • Permit registration number • Type of operation • Overview of proposed substantial change

S2. DISCHARGE LIMITATIONS AND OPERATING REQUIREMENTS

S2.A. Prohibitions and Discharge Limitations

1. The permit registrant must not discharge manure, litter, or process wastewater to surface water and groundwater of the state except as allowed in S2.B and S2.C and provided these surface water discharges do not exceed the following effluent limits.
 - (a) *E. coli* must not exceed zero organisms/100 mL or quantitation limit of 2 Colony Forming Units/100 mL or 0.0 most probable number/100 mL;
 - (b) Nitrate plus Nitrite Nitrogen ($\text{NO}_3 + \text{NO}_2$) must not exceed zero mg/L or quantitation limit of 0.1 mg/L;
 - (c) Total Phosphorus (P) must not exceed zero mg/L or quantitation limit of 0.1 mg/L.

Types of discharge that are prohibited include but are not limited to: contaminated runoff from confinement or waste accumulation areas; overflow or discharges from waste storage facilities; discharges due to improper land application activities from seepage below the root zone, surface drainages or field tile outlets; dry-weather discharges, discharges due to equipment failure; leakage or seepage from facilities in the production area in excess of approved designs; and discharges to underground injection control (UIC) systems.

2. Compliance with the effluent limits above must be determined by laboratory test results of a representative grab sample of the discharge taken at the time of occurrence. If a grab sample is not taken, then the permit registrant is in violation of the effluent limits.

S2.B. Production Area Limitations

1. For all CAFOs (except swine, poultry, and veal large CAFOs, the construction of which commenced after April 14, 2003):
The permit registrant must not discharge manure, litter, or process wastewater to surface water of the state from the production area, except when:
 - (a) Rainfall events cause an overflow of waste management and storage facilities designed, constructed, operated, and maintained to contain all manure, litter, and process wastewater, including the runoff and direct precipitation, from a 25-year, 24-hour rainfall event; and
 - (b) The production area is operated in accordance with the applicable inspection, maintenance, recordkeeping, and reporting requirements of this permit.
2. For swine, poultry, and veal large CAFOs the construction of which commenced after April 14, 2003:
The permit registrant must not discharge manure, litter, or process wastewater from the production area to surface water of the state.
3. The permit registrant must properly land apply manure, litter, and wastewater from the production area in a manner consistent with S2.C. All other authorized discharges from the production area must be managed to minimize impacts on surface water and groundwater of the state and meet the effluent limits in S2.A above.
4. The permit registrant must not exceed the seepage design rates approved by ODA for waste storage or animal confinement facilities in the production area and seepage to groundwater from these facilities must not violate state groundwater quality protection standards.
5. ODA will inform a permit registrant if any additional limits or controls are necessary to be consistent with the wasteload allocations in an EPA-approved or issued Total Maximum Daily Load for NPDES permit coverage or if coverage to an individual NPDES is necessary.

S2.C. Land Application Limitations

1. To prevent discharges to waters of the state, the permit registrant must apply manure, litter, or process wastewater to land application areas at agronomic rates in accordance with the permit registrant's ODA-approved AWMP. Land application areas include land under the control of the permit registrant, to which manure, litter, or process wastewater from the production area is or may be applied.
2. The permit registrant's discharges to groundwater due to seepage below the root zone of the crop or by other means must not violate state groundwater quality protection standards.

3. The permit registrant is allowed to apply manure, litter, or process wastewater to frozen soil provided:
 - (a) The AWMP addresses such applications [see S3.C.2(k), p. 14];
 - (b) The application does not result in a discharge to surface water or groundwater, except as allowed in S2.B and S2.C; and
 - (c) Land applications do not cause or contribute to a violation of state water quality standards.
4. The permit registrant must not apply manure, litter, or process wastewater to saturated soils immediately before or during rainfall events that are expected to result in surface runoff. If the permit registrant makes such an application because it is a desired alternative to allowing waste storage or treatment works to overflow (for example, land application to saturated soils to pond wastewater onsite provides for greater protection of surface water than a direct overflow of a waste storage tank to surface water), the application will be considered a violation of this permit.
5. ODA will inform a permit registrant if any additional limits or controls are necessary to be consistent with the wasteload allocations in an EPA-approved or issued Total Maximum Daily Load for NPDES permit coverage or if coverage to an individual NPDES is necessary.

S2.D. Direct Access by Animals to Surface Water of the State in the Production Area Prohibited

The permit registrant must prevent direct animal contact with surface water of the state in the production area of its CAFO. Direct animal contact means any situation where animals in the production area have free access and are allowed to loiter or drop waste in surface water. Direct contact with surface water of the state by animals on pasture or rangeland is not, by itself, a violation of this permit.

S2.E. Waste Storage Facilities

1. The permit registrant must provide adequate storage capacity for solid and liquid wastes at all times so that land application occurs only during periods when soil and weather conditions allow for agronomic application and are in compliance with the Land Application Limitations in S2.C, p. 10 of this permit.
2. The permit registrant must site, design, construct, operate, and maintain all waste storage facilities to contain all manure, litter, process wastewater, and stormwater runoff and direct precipitation from a 25-year, 24-hour rainfall event for the storage period established in the ODA-approved AWMP. New and modified construction of waste facilities must be approved in advance and prior to construction by ODA in conformance with ORS 468B.055 and OARs 340-051 and 603-074.
3. Permit registrants with a *large* CAFO must also have depth markers in all surface liquid impoundments (for example, lagoons, ponds, tanks) designed to clearly indicate the:
 - (a) Maximum design volume,
 - (b) Minimum capacity necessary to contain the 25-year, 24-hour rainfall event, including additional freeboard requirements, and
 - (c) Depth of manure and process wastewater.

S2.F. Prevention of System Overloading

1. The permit registrant may not increase the number of animals over 10% or 25 animals, whichever is greater, of the maximum number assigned by ODA in the *Notice of Registration and General Permit Summary* until an updated plan is approved in writing by ODA (see S3.B AWMP Submittal, p. 13, and S3.D Requirements for AWMP Updates and Changes, p. 14).
2. The permit registrant must ensure that animal numbers do not exceed the capacity of the waste storage facilities described in the ODA-approved AWMP.

S2.G. Handling of Animal Mortalities

The permit registrant must not dispose of animal mortalities in liquid manure or treatment works. Animal mortality composting is allowed and must be described in the Animal Waste Management Plan. The permit registrant must handle animal mortalities in such a way as to prevent discharge of pollutants to waters of the state (surface water and groundwater).

S2.H. Proper Operation and Maintenance

The permit registrant must at all times properly operate and maintain all facilities and systems used for process wastewater collection, storage and utilization, and correct any deficiencies found as soon as possible.

S2.I. Maintaining Compliance if System Fails

The permit registrant must control all applications and discharges upon reduction, loss, or failure of the waste storage or utilization facilities until the facilities are restored or an alternative method of storage or utilization is provided. This requirement also applies when the primary source of power is reduced, lost, or fails.

S2.J. Setback Requirement

The permit registrant must develop and maintain setbacks or vegetated buffers when manure, litter, or process wastewater application occur adjacent to any surface water, open tile intake structures, sinkholes, well heads, or other conduits to surface water or groundwater. The permit registrant must also include descriptions of setbacks, vegetated buffers, and/or equivalent measures in its AWMP. Compliant setbacks, vegetated buffers, or equivalent measures include the following:

1. 100 ft. setbacks (non-vegetated, non-managed buffers).
2. 35 ft. vegetated, managed buffers.
3. If approved by ODA, variable-width, seasonal setbacks determined by the type of manure, litter or process wastewater and application method used.
4. If approved by ODA, a demonstration that a setback or vegetated buffer is not necessary or may be reduced in size because implementation of alternative conservation practices or field-specific conditions will provide equivalent or better environmental protection than [1., 2. and 3.] above.

S2.K. Manure, Litter, or Process Wastewater Transfers

1. The permit registrant retains responsibility of the manure, litter, or process wastewater until the transfer or export is completed with the required documentation.
2. The permit registrant must maintain manure, litter, or process wastewater transfer or export records as required by S4.C.2(d), p. 19.
3. Prior to transferring manure, litter, or process wastewater to other persons, the permit registrant with a *large* CAFO must provide the recipient of manure, litter, or process wastewater with a manure nutrient analysis conducted within the previous 12 months.

S2.L. Proper Disposal of Other Wastes

The permit registrant must dispose of any chemicals or other wastes in accordance with applicable state regulation. The permit registrant must manage chemicals and wastes to prevent their disposal in any manure, litter, process wastewater, or stormwater storage or treatment system unless specifically designed to treat these wastes and the wastes and treatment systems are identified in the AWMP. The permit registrant must not dispose of chemicals or other wastes to any system used for the control of uncontaminated stormwater.

S3. ANIMAL WASTE MANAGEMENT PLAN

S3.A. Animal Waste Management Plan (AWMP) Implementation and Compliance

1. Upon registration to this permit, the permit registrant must implement its current ODA-approved AWMP developed for its CAFO.
2. The permit registrant's ODA-approved AWMP is incorporated into this permit by reference. The permit registrant must comply with all terms and conditions of its ODA-approved AWMP. Failure to comply with the ODA-approved AWMP constitutes a violation of the terms and conditions of this permit.

S3.B. AWMP Submittal and Public Notice

1. The applicant applying for permit coverage for the first time must submit its AWMP with the ATR to ODA for review and approval according to the schedule provided in S1.C, p. 7.
2. The existing permit registrant with coverage under NPDES General Permit #01 or another permit may submit its AWMP previously approved by ODA with the *Application to Register or Renewal Application* for review and approval according to the requirements in S1.C, p.7
3. AWMPs are subject to public notice requirements detailed in S1.H, p. 8.

S3.C. AWMP Elements

1. The permit registrant must ensure that its AWMP is adequate for the proposed or existing population of animals, reflective of the proposed or existing facility operation, and prepared in accordance with the terms and conditions of this permit, OAR 340-051, and OAR 603-074.
2. The AWMP must to the extent applicable include the following:
 - (a) Procedures to ensure collection, handling, and storage of contaminated stormwater runoff from the production area, manure, litter, and process wastewater in compliance with the requirements of S2. Discharge Limitation and Operating Requirements. Calculations used to determine that storage capacity exists must be provided, including a demonstration that facilities are at least designed and constructed to contain all manure, litter, process wastewater, and stormwater runoff and direct precipitation from a 25-year, 24-hour rainfall event.
 - (b) Procedures to ensure proper operation and maintenance of the storage facilities.
 - (c) Procedures for proper management of animal mortalities. The procedures must ensure that animal mortalities are disposed of legally and are not disposed of in any storage or treatment system that is not specifically designed to treat animal mortalities.
 - (d) Procedures to ensure that clean water is diverted, as appropriate, from the production area.
 - (e) Procedures to prevent direct contact of confined animals with surface water.
 - (f) Identification of appropriate site-specific conservation practices to be implemented, including buffers, setback areas, or equivalent practices, to control runoff of pollutants to surface water and groundwater.
 - (g) Protocols to land apply manure, litter, or process wastewater in accordance with site-specific nutrient management practices that ensure: 1) appropriate agricultural utilization of the nutrients in the manure, litter, or process wastewater, and 2) application of nutrient at rates not to exceed the maximum agronomic application rate included in the ODA-approved AWMP. The protocols must include the following:
 - (i) The NRCS Phosphorous Index, USDA/NRCS Oregon Agronomy Technical Note #26, revised October 2008 or equivalent calculation must be completed for all fields or management units that receive manure, litter or process wastewater to determine if nitrogen or phosphorous is the most limiting nutrient. The maximum nutrient application rate must be calculated for the most limiting nutrient and must account for all other nitrogen and phosphorus sources.
 - (ii) Expected crop yields.
 - (iii) Calculations showing the total nitrogen and phosphorus to be applied annually to each field from manure, litter, process wastewater, and other sources.
 - (iv) Annual manure application rates and an explanation of the basis for determining these rates. For *large* CAFOs, these rates must be based on actual test data. For other operations, data or "book values" from established reference sources (for example, Oregon Animal Waste Management program) may be used instead of actual testing.
 - (v) Method(s) used to apply manure, litter, or process wastewater

- (vi) Timing of manure, litter, and process wastewater applications.
- (h) For all operations, protocols for soil testing. For *large* CAFOs, protocols for testing of manure, litter, and process wastewater. For other operations that are not required to test manure, litter, or process wastewater, test protocols are not required but the references that are used to characterize manure, litter, or process wastewater must be included.
- (i) If applicable, an Agricultural Compost Management Plan must be included as required by OAR 340-096 for composting activities.
- (j) If applicable, a Solid Waste Conversion Technology Plan must be included as required by OAR 340-096.
- (k) Frozen soil application procedures if applications of manure, litter, or process wastewater will be made to frozen soil. At a minimum, the following must be included:
 - (i) Description of the potential receiving field(s), estimates of waste amounts and types, and estimated timing of applications.
 - (ii) Aerial photo(s) identifying all areas and surface water bodies within 1,000 ft. of the boundaries of the receiving field(s).
 - (iii) Soil map(s) identifying soil types for receiving field(s).
 - (iv) Topographic map(s) for receiving field(s).
 - (v) Description of the structural practices in place to ensure that no discharges to surface water occur during application and after the soil thaws.
 - (vi) Description of the method used to determine when soil is frozen and management practices to be followed when planning an application and during and after an application to frozen soil.
 - (vii) Description of monitoring and reporting requirements to ensure that the permit registrant is in compliance with frozen soil application procedures.
 - (viii) Procedures for transfer or export of manure, litter, or process wastewater.
 - (ix) Identification of specific records that will be maintained to document the implementation and management of the minimum elements described above.

S3.D. Requirements for AWMP Updates and Changes

(See Table 3, p.16, for an overview of the following requirements.)

1. Requirements for *small or medium* CAFOs electing permit coverage (see Table 3, p. 16, for an overview)
 - (a) **Substantial changes.** The permit registrant must submit any proposal to make substantial changes to its AWMP to ODA for approval at least 45 days in advance of implementation of the proposed changes. ODA will public notice the proposal as described in S1.H, p. 8. ODA will notify the permit registrant of its final decision concerning the proposed changes after the public notice period ends. The permit registrant must not implement a proposed change until ODA has approved it. The following types of changes to an AWMP are considered substantial:
 - (i) A change in the type of manure system including but not limited to switching from a dry to a liquid manure system, switching from a liquid to a dry manure system, or changing the manure system to accommodate an animal species or type of operation not included in the scope of the current AWMP.
 - (ii) An increase in maximum allowed animal numbers such that the operation becomes defined as a *large* CAFO.
 - (b) **Non-substantial changes.** Public notice of non-substantial changes (described below) to an AWMP is not required; however, the permit registrant must submit its proposal to make such a change to ODA for approval at least 45 days in advance of implementation of the proposed change unless a different timeframe is allowed by ODA. ODA will notify the permit registrant of its final decision concerning the proposed change after reviewing the proposal. The permit registrant must not implement a proposed change until ODA has approved it. The following changes to an AWMP are considered non-substantial provided they do not result in a substantial modification listed in paragraph (a) above:
 - (i) An increase in animal numbers greater than 10% of the registrant's maximum allowed animal numbers provided the increase does not change the operation into a *large* CAFO.
 - (ii) When facility expansions, production increases, or process modifications will result in new or increased generation of waste, litter, or process wastewater beyond the scope of the current AWMP.

2. Requirements for all other CAFOs (see Table 3, p. 16, for an overview)
- (a) *Substantial changes.* The permit registrant must submit any proposal to make substantial changes to its AWMP to ODA for approval at least 60 days in advance of the proposed changes. ODA will provide public notice on the proposal as described in S1.H, p. 8. ODA will notify the permit registrant of its final decision concerning the proposed changes after the public notice period ends. The permit registrant must not implement a proposed change until ODA has approved it. The following types of changes to an AWMP are considered substantial:
- (i) Addition of new land application areas not previously included in the AWMP, unless the land application area is covered by an existing AWMP that has already been incorporated into an existing NPDES permit and the application of manure, litter, or process wastewater on the newly added land application area is in accordance with that existing NPDES permit.
 - (ii) Any changes to the field-specific maximum annual rates for land application.
 - (iii) Any changes to the maximum amounts of nitrogen and phosphorus derived from all sources for each crop.
 - (iv) Addition of any crop or other uses not included in the AWMP and corresponding field-specific rates of application.
 - (v) A change in the type of manure system including but not limited to switching from a dry to a liquid manure system, switching from a liquid to a dry manure system, or changing the manure system to accommodate an animal species or type of operation not included in the scope of the current AWMP.
 - (vi) Any changes that are likely to increase the risk of pollutant transport to surface water or groundwater.
- (b) *Non-substantial changes.* The permit registrant must submit any proposal to make non-substantial changes to its AWMP to ODA for approval at least 60 days in advance of the proposed changes unless a different timeframe is allowed by ODA. A proposal for a non-substantial change is not subject to public notice. ODA will notify the permit registrant of its final decision concerning the proposed changes after reviewing the proposal. The permit registrant must not implement a proposed change until ODA has approved it. The following types of changes to an AWMP are considered non-substantial provided they do not result in a substantial modification listed in paragraph (a) above:
- (i) An increase in animal numbers greater than 10% of the registrant's maximum allowed animal numbers.
 - (ii) When facility expansions, production increases, or process modifications will result in new or increased generation of waste, litter, or process wastewater beyond the scope of the current AWMP.

Table 3: Overview of Requirements for Proposed Changes to AWMPs

	Small or Medium CAFO Electing Coverage		All Other CAFOs	
	<i>Substantial Change</i>	<i>Non-Substantial Change</i>	<i>Substantial Change</i>	<i>Non-Substantial Change</i>
Description of proposed change	<ol style="list-style-type: none"> 1. A change in the type of manure system including but not limited to switching from a dry to a liquid manure system, switching from a liquid to a dry manure system, or changing the manure system to accommodate an animal species or type of operation not included in the scope of the current AWMP. 2. An increase in maximum allowed animal numbers such that the operation becomes defined as a large CAFO. 	<p>The following are considered non-substantial provided they do not result in a substantial change:</p> <ol style="list-style-type: none"> 1. An increase in animal numbers greater than 10% of the registrant's maximum allowed animal numbers. 2. When facility expansions, production increases, or process modifications will result in new or increased generation of waste, litter, or process wastewater beyond the scope of the current AWMP. 	<ol style="list-style-type: none"> 1. Addition of new land application areas not previously included in the AWMP, unless the land application area is covered by an existing AWMP that has already been incorporated into an existing NPDES permit and the application of manure, litter, or process wastewater on the newly added land application area is in accordance with that existing NPDES permit. 2. Any changes to the field-specific maximum annual rates for land application. 3. Any changes to the maximum amounts of nitrogen and phosphorus derived from all sources for each crop. 4. Addition of any crop or other uses not included in the AWMP and corresponding field-specific rates of application. 5. A change in the type of manure system including but not limited to switching from a dry to a liquid manure system, switching from a liquid to a dry manure system, or changing the manure system to accommodate an animal species or type of operation not included in the scope of the current AWMP. 6. Any changes that are likely to increase the risk of nitrogen and phosphorus transport to surface water or groundwater. 	<p>The following are considered non-substantial provided they do not result in a substantial change:</p> <ol style="list-style-type: none"> 1. An increase in animal numbers greater than 10% of the registrant's maximum allowed animal numbers. 2. When facility expansions, production increases, or process modifications will result in new or increased generation of waste, litter, or process wastewater beyond the scope of the current AWMP.
Timeline to submit proposal to ODA	Submit at least 45 days in advance of proposed change(s).	Submit at least 45 days in advance of proposed change(s) unless a different timeframe allowed by ODA.	Submit at least 60 days in advance of proposed change(s).	Submit at least 60 days in advance of proposed change(s) unless a different timeframe is allowed by ODA.
Public notice process	ODA will public notice as described in S1.H, p. 8.	Not required.	ODA will public notice as described in S1.H, p. 8.	Not required.
ODA approval	ODA will notify the permit registrant of its final decision concerning the proposed change(s) after the public notice period ends.	ODA will notify the permit registrant of its final decision concerning the proposed change(s) after reviewing the proposal.	ODA will notify the permit registrant of its final decision concerning the proposed change(s) after the public notice period ends.	ODA will notify the permit registrant of its final decision concerning the proposed change(s) after reviewing the proposal.

S4. MONITORING, INSPECTION, RECORDKEEPING, AND REPORTING REQUIREMENTS

S4.A. Monitoring Requirements

1. Prohibited Discharges

If a prohibited discharge to surface water or groundwater that is not allowed by S2.B or S2.C, p. 10 occurs, the permit registrant must record the following information and notify ODA within 24 hours (see S4.D, p. 19 for written reporting requirements):

- (a) A description and cause of the discharge;
- (b) The period of discharge including exact date(s), time(s), and duration of discharge;
- (c) An estimate of discharge volume;
- (d) Name or location of receiving water;
- (e) If a grab sample was taken of the discharge;
- (f) Corrective steps taken, if appropriate, to reduce, eliminate, or prevent reoccurrence of the discharge;
- (g) For any unauthorized discharge that may have come in contact with a drinking water intake, confirmation that Oregon Emergency Response System (OERS) was notified.

2. Soil, Manure, Litter, and Process Wastewater Monitoring for Large CAFOs

The permit registrant with a *large* CAFO must conduct the following sampling and analysis:

Sample Type	Analytical Parameter	Minimum Frequency	Sample Method
<ul style="list-style-type: none"> • Liquid manure • Process wastewater (if handled separately from liquid manure) • Solid manure 	Total nitrogen Total phosphorus	Annually	Sample according to guidance contained in PNW 0533 and PNW 505.
Exported manure, litter, and process wastewater	Total nitrogen Total phosphorus	Annually	Sample according to guidance contained in PNW 0533 and PNW 505.
Soil from land application area(s)	Total nitrogen Total phosphorus Nitrate-nitrogen	Annually on a minimum of 20% of the fields or management units that receive manure, litter or process wastewater applications each year. All fields or management units must be sampled at least once every 5 years.	Sample according to guidance contained in PNW 570-E, EM 8832-E for post-harvest nitrate-nitrogen
Grab sample of effluent discharge from production or land application area	<i>E. coli</i> , Nitrate plus Nitrite Nitrogen (NO ₃ +NO ₂), Total Phosphorus (P)	Upon occurrence see S2.A.2, p.10.	Grab sample analyzed using test methods in 40 CFR Part 136

3. Soil, Manure, Litter, and Process Wastewater Monitoring for all Other Operations

The permit registrant must conduct the following sampling and analysis:

Sample Type	Analytical Parameter	Minimum Frequency	Sample Method
Soil from land application area(s)	Total nitrogen Total phosphorus	Once every 5 years from all fields or management units where manure, litter, or	Sample according to guidance contained in PNW 570-E, EM

		process wastewater is applied.	8832-E.
Grab sample of effluent discharge from production or land application area	<i>E. coli</i> , Nitrate plus Nitrite Nitrogen (NO ₃ +NO ₂), Total Phosphorus (P)	Upon occurrence see S2.A.2, p.10.	Grab Sample analyzed using test methods in 40 CFR Part 136

S4.B. Inspection Requirements

- The permit registrant must conduct the following inspections:

Item	Large CAFO	All Other Operations
(a) Stormwater diversion devices, runoff diversion structures, animal waste storage structures, and devices channeling contaminated stormwater to wastewater and manure storage and containment structures	Weekly and record results	At least once every six months
(b) Water lines, including drinking water or cooling water lines	Daily and record results	At least once every six months
(c) Equipment used for land application of manure, litter, or process wastewater	Daily when equipment is in use and record results	At least once every six months when equipment is in use
(d) Liquid impoundments for manure and process wastewater	Weekly and record depth of manure and process wastewater according to depth marker required by S2.E.3, p. 11	At least once every six months

- The permit registrant must correct any deficiencies found as a result of these inspections as soon as possible. The permit registrant with a *large* CAFO must record any actions taken to correct these deficiencies and, if deficiencies are not corrected within 30 days, provide an explanation of the factors preventing immediate correction.

S4.C. Recordkeeping and Availability Requirements

- The permit registrant must maintain all information required by this permit at the facility for at least five (5) years and make this information available to ODA upon request.
- Upon obtaining permit coverage, the permit registrant must record the following information:

Item or Parameter	Large CAFO	All Other Operations
(a) Date, amount, and nutrient loading of manure, litter, or process wastewater applied to each field.	Required	Required
(b) Weather conditions at the time of application and 24 hours before and after application.	Required	Not required
(c) Total amount of nitrogen and phosphorus actually applied annually to each field, including documentation of calculations of the total amount applied.	Required	Required

Item or Parameter	Large CAFO	All Other Operations
(d) Total amount of manure or wastewater transferred or exported to other persons.	Required. Also include: (i) Date and amount of each transfer or export (ii) Name and address of each recipient (iii) Copy of the manure nutrient analysis conducted provided to the recipient (See S2.K.3, p. 12)	Required
(e) Description of actions taken to correct deficiencies discovered during inspections.	Required (See S4.B.2, p. 18)	Not required

S4.D. Reporting Requirements

1. Reporting to ODA and Oregon Emergency Response System (OERS)
 - (a) If a discharge to surface water or groundwater occurs that is not allowed by S2.B and S2.C, p. 10, the permit registrant must notify ODA within 24 hours of the discharge. The permit registrant must submit a written report within five (5) days to ODA. The information to be submitted is listed in the monitoring requirements (See S4.A, p. 17) of this permit.
 - (b) The permit registrant must notify ODA within 24 hours of becoming aware of any significant physical failure at any time of treatment works required under this permit.
 - (c) The permit registrant must notify ODA within 24 hours of any permit noncompliance that may endanger health or the environment as described in G13.6, p. 23.
 - (d) In addition to complying with [1.(c)] above, the permit registrant must notify Oregon Emergency Response System (OERS) of any unauthorized discharge that may come in contact with a surface water or groundwater drinking water system intake within 24 hours. Notification must be made by calling OERS at 1-800-452-0311

2. Reporting of Monitoring Results of a prohibited effluent discharge
 - (a) The permit registrant must submit monitoring information for an effluent grab sample no later than one month from the date the sample was taken unless a different schedule is established by an administrative order as described in S4.E, p. 20.
 - (b) Reporting of monitoring information must include:
 - (i) The date, exact place, and time of sampling or measurements;
 - (ii) The individual(s) who performed the sampling or measurements;
 - (iii) The date(s) analyses were performed;
 - (iv) The individual(s) who performed the analyses;
 - (v) The analytical techniques or methods used; and
 - (vi) The results of such analyses that includes the sample result and quantitation limit of the analysis.

3. Annual Report
 - (a) The permit registrant must submit an annual report to ODA by March 15 of each year. The annual report must include the following for the previous calendar year :
 - (i) Maximum number and type of animals approved by ODA in the permittee's *Notice of Registration*, whether in open confinement or housed under roof (for example, beef cattle, broilers, layers, swine weighing 55 pounds or more, swine weighing less than 55 pounds, mature dairy cows, dairy heifers, veal calves, sheep and lambs, horses, ducks, turkeys, other).
 - (ii) Actual number of animals by type averaged over the year.
 - (iii) Estimated amount of total manure, bedding, litter, process wastewater, and other material that comes in contact with manure generated (tons, gallons, cubic feet, or cubic yards).
 - (iv) Estimated amount of total manure, bedding, litter, process wastewater, and other material that comes in contact with manure transferred to other persons by the permittee (tons, gallons, cubic feet, or cubic yards).
 - (v) Estimated amount of manure, bedding, litter, process wastewater, and other material that comes in contact with manure applied to land by the permittee (tons, gallons, cubic feet, or cubic yards).
 - (vi) Total number of acres for land application covered by the AWMP developed in accordance with

the terms of this permit.

- (vii) Total number of acres under control of the permittee that were used for land application of manure, litter, and process wastewater in the previous 12 months.
 - (viii) Summary of all manure, litter, and process wastewater discharges from the production area that have occurred, including date, time and approximate volume.
 - (ix) A statement indicating whether the AWMP was developed or approved by a certified waste management planner.
 - (x) Any Concentrated Animal Feeding Operation that discharges to surface waters must also report the following items (xi) through (xvi). (40 CFR 122.42(e)(4)(viii))
 - (xi) Actual crop(s) planted and actual yield(s) for each field.
 - (xii) Actual nitrogen and phosphorus content of the manure, litter, and process wastewater.
 - (xiii) Data used and results of calculations based on protocol in the ODA-approved AWMP.
 - (xiv) Amount of manure, litter, and process wastewater applied to each field during the previous 12 months.
 - (xv) Results of soil testing for nitrogen and phosphorus if testing was performed.
 - (xvi) Amount of any supplemental fertilizer applied.
- (b) The annual report must be signed and certified by the permittee or permittee's authorized representative with the following statement: "I certify, under penalty of law, that this document and all attachments were prepared under my direct supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

S4.E. Additional Monitoring

1. ODA may establish specific monitoring requirements in addition to those contained in this permit by administrative order. An administrative order is an agency action expressed in writing directed to a named person or named persons (ORS 183.310).
2. If a permittee experiences two or more discharges within a 24-month period that are not associated with a 25-year, 24-hour or greater rainfall event, ODA may require surface water and/or groundwater quality monitoring or transfer the permittee to an individual permit. Monitoring for the following parameters may be required: bacteria, total suspended solids, total kjeldahl nitrogen, biochemical oxygen demand, and other nutrient indicators. If ODA waives the additional monitoring requirements because such monitoring would be impracticable or not likely to produce useful information, ODA will set out the basis for the decision in writing and make the decision available to interested persons.

GENERAL CONDITIONS

The general conditions in this schedule apply only to the extent they do not conflict with the requirements contained in special conditions S1 through S4. If the permit requirements in special conditions S1 through S4 conflict with these general conditions, the permit requirements in special conditions S1 through S4 will control.

G1. Compliance with other laws and statutes

Nothing in the permit will be construed as excusing the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G2. Duty to comply [40 CFR § 122.41(a)]

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

1. The permittee shall comply with effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.
2. The Clean Water Act provides that any person who violates section 301, 302, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any such sections in a permit issued under section 402, or any requirement imposed in a pretreatment program approved under sections 402(a)(3) or 402(b)(8) of the Act, is subject to a civil penalty not to exceed \$25,000 per day for each violation. The Clean Water Act provides that any person who *negligently* violates sections 301, 302, 306, 307, 308, 318, or 405 of the Act, or any condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, or any requirement imposed in a pretreatment program approved under section 402(a)(3) or 402(b)(8) of the Act, is subject to criminal penalties of \$2,500 to \$25,000 per day of violation, or imprisonment of not more than 1 year, or both. In the case of a second or subsequent conviction for a negligent violation, a person shall be subject to criminal penalties of not more than \$50,000 per day of violation, or by imprisonment of not more than 2 years, or both. Any person who *knowingly* violates such sections, or such conditions or limitations is subject to criminal penalties of \$5,000 to \$50,000 per day of violation, or imprisonment for not more than 3 years, or both. In the case of a second or subsequent conviction for a knowing violation, a person shall be subject to criminal penalties of not more than \$100,000 per day of violation, or imprisonment of not more than 6 years, or both. Any person who knowingly violates section 301, 302, 303, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than \$250,000 or imprisonment of not more than 15 years, or both. In the case of a second or subsequent conviction for a knowing endangerment violation, a person shall be subject to a fine of not more than \$500,000 or by imprisonment of not more than 30 years, or both. An organization, as defined in section 309(c)(3)(B)(iii) of the CWA, shall, upon conviction of violating the imminent danger provision, be subject to a fine of not more than \$1,000,000 and can be fined up to \$2,000,000 for second or subsequent convictions.
3. Any person may be assessed an administrative penalty by the Administrator for violating section 301, 302, 306, 307, 308, 318 or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act. Administrative penalties for Class I violations are not to exceed \$10,000 per violation, with the maximum amount of any Class I penalty assessed not to exceed \$25,000. Penalties for Class II violations are not to exceed \$10,000 per day for each day during which the violation continues, with the maximum amount of any Class II penalty not to exceed \$125,000.

G3. Duty to reapply [40 CFR § 122.41(b)]

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit.

G4. Need to halt or reduce activity not a defense [40 CFR § 122.41(c)]

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

G5. Duty to mitigate [40 CFR § 122.41(d)]

The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

G6. Proper operation and maintenance [40 CFR § 122.41(e)]

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

G7. Permit actions

1. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition. [40 CFR § 122.41(f)]
2. After notice, registration under this permit may be modified or revoked as it applies to any person for cause as follows:
 - (a) Violation of any terms or conditions of the permit,
 - (b) Failure of the permittee to disclose fully all relevant facts, or misrepresentations of any relevant facts by the permittee during the permit issuance process and during the life of the permit;
 - (c) Failure to pay permit fees required by Oregon Administrative Rule when due;
 - (d) Information indicating that the permitted operation poses a threat to human health or welfare;
 - (e) A change in ownership or control of the operation, or
 - (f) Other causes listed in 40 CFR § 122.62 and 122.63.
3. Modification or revocation of coverage under this permit as it applies to any person may be initiated by ODA.
4. Issuance of coverage under an individual permit may be initiated by ODA in accordance with S1.A.2.

G8. Property rights [40 CFR § 122.41(g)]

This permit does not convey any property rights of any sort, or any exclusive privilege.

G9. Duty to provide information [40 CFR § 122.41(h)]

The permittee shall furnish to the director, within a reasonable time, any information which the director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the director, upon request, copies of records required to be kept by this permit.

G10. Inspection and entry [40 CFR § 122.41(i)]

The permittee shall allow the director or an agency authorized representative (including an authorized contractor acting as a representative of the Administrator), upon presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act or state law, any substances or parameters at any location.

G11. Monitoring and records [40 CFR § 122.41(j)]

1. Samples and measurements taken for the purpose of monitoring must be representative of the monitored activity.
2. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which must be retained for a period of at least five years (or longer as required by 40 CFR Part 503), the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a

- period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the director at any time.
3. Records of monitoring information must include:
 - (a) The date, exact place, and time of sampling or measurements;
 - (b) The individual(s) who performed the sampling or measurements;
 - (c) The date(s) analyses were performed;
 - (d) The individual(s) who performed the analyses;
 - (e) The analytical techniques or methods used; and
 - (f) The results of such analyses.
 4. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless another method is required under 40 CFR subchapters N or O.
 5. The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000, or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than \$20,000 per day of violation, or by imprisonment of not more than 4 years, or both.

G12. Signatory requirement [40 CFR § 122.21(k)]

1. All applications, reports, or information submitted to the director shall be signed and certified. (See § 122.22)
2. The CWA provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

G13. Additional reporting requirements [40 CFR § 122.41(l)]

1. *Planned changes.* The permittee shall give notice to the director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:
 - (a) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in § 122.29(b); or
 - (b) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under § 122.42(a)(1).
 - (c) The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan;
2. *Anticipated noncompliance.* The permittee shall give advance notice to the director of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.
3. *Transfers.* This permit is not transferable to any person except after notice to the director. The director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act. (See § 122.61; in some cases, modification or revocation and reissuance is mandatory.)
4. *Monitoring reports.* Monitoring results must be reported at the intervals specified elsewhere in this permit.
 - (a) Monitoring results must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the director for reporting results of monitoring of sludge use or disposal practices.
 - (b) If the permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 CFR Part 136, or another method required for an industry-specific waste stream under 40 CFR subchapters N or O, the results of such monitoring must be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the director.
 - (c) Calculations for all limitations that require averaging of measurements must utilize an arithmetic mean unless otherwise specified by the director in the permit.
5. *Compliance schedules.* Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than 14 days following each schedule date.
6. *Twenty-four hour reporting.*
 - (a) The permittee shall report any noncompliance that may endanger health or the environment. Any information must be provided orally within 24 hours from the time the permittee becomes aware of the

- circumstances. A written submission must also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission must contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.
- (b) The following must be included as information that must be reported within 24 hours under this paragraph.
 - (i) Any unanticipated bypass that exceeds any effluent limitation in the permit. (See § 122.41(g) or G14, p. 24.)
 - (ii) Any upset which exceeds any effluent limitation in the permit. (See § 122.41(n) or G15, p. 24.)
 - (iii) Violation of a maximum daily discharge limitation for any of the pollutants listed by the director in the permit to be reported within 24 hours. (See § 122.44(g).)
 - (c) The director may waive the written report on a case-by-case basis for reports under G13.6(b) of this section if the oral report has been received within 24 hours.
7. *Other noncompliance.* The permittee shall report all instances of noncompliance not reported under G13.4, 5, and 6 of this section, at the time monitoring reports are submitted. The reports must contain the information listed in G13.6 of this section.
 8. *Other information.* Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the director, it shall promptly submit such facts or information.

G14. Bypass [40 CFR § 122.41(m)]

1. *Definitions.*
 - (a) *Bypass* means the intentional diversion of waste streams from any portion of a treatment facility.
 - (b) *Severe property damage* means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
2. *Bypass not exceeding limitations.* The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of G14.3 and 4 of this section.
3. *Notice*
 - (a) *Anticipated bypass.* If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.
 - (b) *Unanticipated bypass.* The permittee shall submit notice of an unanticipated bypass as required in G13.6 of this section (24-hour notice).
4. *Prohibition of bypass.*
 - (a) Bypass is prohibited, and the director may take enforcement action against a permittee for bypass, unless:
 - (i) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
 - (ii) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
 - (iii) The permittee submitted notices as required under G14.3 of this section.
 - (b) The director may approve an anticipated bypass, after considering its adverse effects, if the director determines that it will meet the three conditions listed above in G14.4(a) of this section.

G15. Upset [40 CFR § 122.41(n)]

1. *Definition.* *Upset* means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.
2. *Effect of an upset.* An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of G15.3 of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

3. *Conditions necessary for a demonstration of upset.* A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
 - (a) An upset occurred and that the permittee can identify the cause(s) of the upset;
 - (b) The permitted facility was at the time being properly operated; and
 - (c) The permittee submitted notice of the upset as required in G13.6(b)(ii) of this section (24 hour notice).
 - (d) The permittee complied with any remedial measures required under G5 of this section.
4. *Burden of proof.* In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

NUTRIENT MANAGEMENT FOR DAIRY PRODUCTION

Manure application rates for forage production

T. Downing, D. Sullivan, J. Hart, and M. Gamroth

Most dairies can supply all the nitrogen, phosphorus, potassium, and other nutrients needed for forage production by applying manure to forage crops. As a manager, your goal is to match nutrient supply with crop needs by deciding when and how much manure to apply.

This publication explains how to estimate the amount of manure to apply for forage production. To do so, you need:

- A current manure analysis for your dairy (see *Dairy Manure as a Fertilizer Source*, EM 8586)
- A list of forage crops to be produced
- A soil test for phosphorus and potassium from each field where manure will be applied

Applying too much manure leads to several problems. First, plants take up excess amounts of nutrients such as potassium. High-potassium grass forages can lead to health problems, especially in dry cows. Second, excess manure can add nutrients and microorganisms to runoff or surface water, and can provide nitrogen that can leach into groundwater.

Application rates in this publication are based on soil tests and growing conditions in western Oregon.

Manure analysis

Analyzing manure is critical to determining the correct application rate. If you don't test your dairy's manure, you can only guess its nutrient value.

Manure testing in western Oregon has shown more variation among dairies than within one dairy. Develop a manure nutrient history for your dairy by testing manure two or three times a year for 2 or 3 years. These records will help you manage nutrient resources.

Have manure analyzed for total nitrogen (N), ammonium nitrogen ($\text{NH}_4\text{-N}$), phosphorus (P), and potassium (K). Laboratories often perform these as a standard analysis package.

Call your county office of the OSU Extension Service or your local USDA Natural Resources Conservation Service office for sampling directions. *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis* (EM 8677) lists laboratories that test manure.

Crop nitrogen requirements

Nitrogen (N) typically is the limiting nutrient for crop production on dairies. Table 1, page 3, shows the estimated nitrogen removal rate (or uptake) for average yields of the most common forage crops grown on dairies. Values in the upper part of the table are on a dry matter (DM) basis; in the lower part, as-harvested values are adjusted for moisture. For example, 1 ton of forage dry matter is equivalent to 4 tons of harvested forage if the silage is 25 percent DM. When discussing nutrient removal, you need to know whether you are dealing with as-harvested or dry-matter values so that you can interpret values correctly.

Troy Downing, Extension agriculture faculty (dairy), Tillamook County; Dan Sullivan, Extension soil scientist; John Hart, Extension soil scientist; and Mike Gamroth, Extension dairy specialist; all of Oregon State University. This publication replaces EC 1094, *Calculating the Fertilizer Value of Manure from Livestock Operations*.

Determining manure application rate

Your goal is to match manure nutrient application rates with crop removal rates. Table 1 and Figures 1 and 2 provide the information you need to determine nutrient removal for many annual and perennial crops. Instructions for using the table and figures follow.

1. In Table 1, find the crop you will grow. Let's assume it's perennial ryegrass. The table is arranged to help you separate different levels of intensity. For example, low-intensity harvesting might be only one or two cuttings per year, medium will be three to five cuttings, and high intensity is six to seven cuttings per year.
2. For our example, let's assume you harvest four times a year, and your ryegrass averages 15 percent protein. That is equivalent to 48 lb of nitrogen per ton of dry matter, yielding around 5 tons of dry matter (240 lb N) per year.
3. You need to replace 240 lb N/a/year from the four cuttings. This is equivalent to 60 lb/a of nitrogen per cutting.
4. Find the figure below (Figure 1 or 2) that represents the type of manure you want to apply. Let's assume you want to apply lagoon effluent, so you'll use Figure 2.

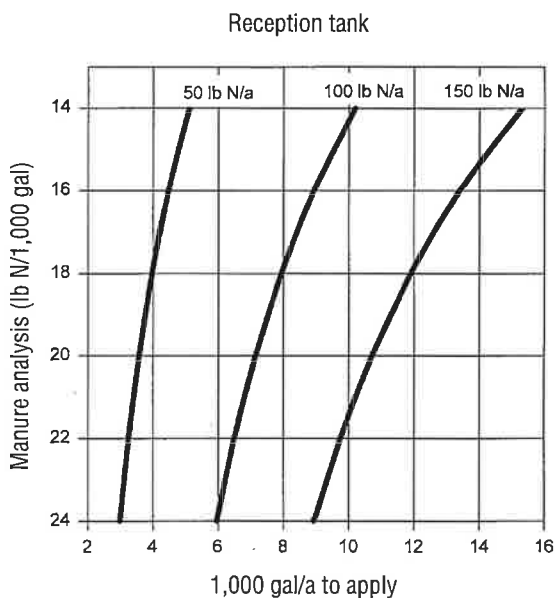


Figure 1.—Determining application rate for reception tank manure.

Note: For reception-tank manure, approximately 70 percent of the total N is considered available. For lagoon effluent, 100 percent of the total N is considered available.

5. Figure 2 contains three lines representing N application rates of 50, 100, and 150 lb N/a. Find the line closest to the rate you need to apply. In this example, you'll use the line for 50 lb/a.
6. Select the manure analysis from your dairy for nitrogen on the left side of the graph. Assume a manure test shows that the effluent contains 6 lb/1,000 gal or 750 ppm N. Move to the right across the graph until you meet the line for the application rate you have chosen (50 lb N/a).
7. Now move straight down to the line labeled "effluent acre-inches to apply" and estimate the number of acre-inches of effluent to apply (in this case, about 0.3 acre-inch). Remember that you will need about 20 percent more nitrogen because no line exists for 60 lb N/a. Your final result will be about 0.4 acre-inch.

Testing your soil for P and K

Test your soil for phosphorus (P) and potassium (K) before applying manure. Table 2 (back page) provides interpretations of P and K soil tests.

If you've applied manure for more than 5 years, additions of P and K usually are not needed. For example, potassium usually is not deficient in soils

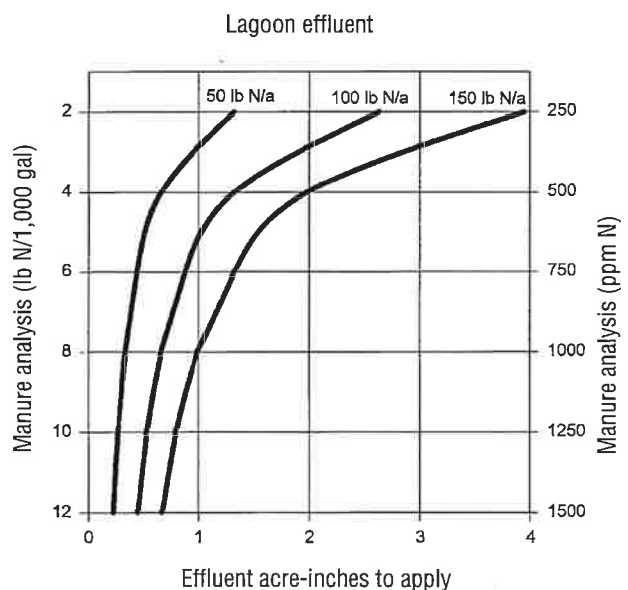


Figure 2.—Determining application rate for lagoon effluent.

Table 1.—Nitrogen, phosphorus, and potassium removal of common perennial and annual forage crops.

Crop (dry matter)	Cuttings (no.)	DM ¹ (%)	CP ¹ (%)	N (lb/t)	P (lb/t)	K (lb/t)	DM (t/a)	N used (lb/a)
Red clover	1	100	18	58	8	48	4	232
Alfalfa hay	3	100	20	64	8	42	5	320
Perennial grass (low intensity)	1-2	100	10	32	6	38	4	128
Perennial grass (medium to low intensity)	2-3	100	12	38	6	38	4.5	171
Perennial grass (medium intensity)	4-5	100	15	48	7	38	5	240
Perennial grass (medium to high intensity)	5-6	100	18	58	8	40	6	348
Perennial grass (high intensity)	6-8	100	20	64	8	40	7	448
Annual ryegrass	1	100	12	38	6	38	4	152
Annual ryegrass	2	100	15	48	7	40	5	240
Corn silage	1	100	8	25	4	20	8	200
Small grains (boot stage)	2	100	12	38	5	32	5	190
Small grains (soft dough)	1	100	8	25	5	30	4	100
Crop (as harvested)	Cuttings (no.)	DM ¹ (%)	CP ¹ (%)	N (lb/t)	P (lb/t)	K (lb/t)	AH ¹ (t/a)	N used (lb/a)
Red clover	1	25	5	14	2	12	16	232
Alfalfa	3	30	6	19	2	12	16	320
Perennial grass (low intensity)	1-2	30	3	10	2	11	13	128
Perennial grass (medium to low intensity)	2-3	30	4	11	2	11	15	171
Perennial grass (medium intensity)	4-5	30	5	14	2.1	11	17	240
Perennial grass (medium to high intensity)	5-6	30	5	17	2.4	12	20	348
Perennial grass (high intensity)	6-8	30	6	19	2.4	12	23	448
Annual ryegrass	1	30	4	11	1.8	11	13	152
Annual ryegrass	2	25	4	12	1.8	10	20	240
Corn silage	1	25	2	6.7	1	5	30	200
Small grains (boot stage)	2	30	4	11	1.5	10	16	190
Small grains (soft dough)	1	30	2	8	1.5	9	13	100

¹DM=dry matter; CP=crude protein; AH=as harvested

where manure has been applied unless the applications were light and a high yield of grass hay was removed. A manure application that meets crop N needs usually supplies sufficient amounts of P and K. Manure contains as much, if not more, K than N. For more information, see *Dairy Manure as a Fertilizer Source* (EM 8586).

In fact, fields that have received manure for a decade or more often have high soil test values for P and K. Fields with soil test K above 1,000 ppm can produce grass forage with a high K concentration. Dry cows fed grass forage containing more than 3 percent K may become seriously ill or die.

In some cases, a soil test shows excessive K, but N is needed. In this case, if another area is available for manure application, apply manure there and buy N fertilizer for the area that has excess K.

Contact your county office of the OSU Extension Service for additional information.

Soil and plant tissue testing for N

The tables and figures in this publication only estimate manure application rates. A soil test for nitrate nitrogen or a stalk nitrate test for silage corn can aid in adjusting manure application rates.

Table 2.—Interpretation of soil tests for P and K.

Soil status	Nutrient (ppm)	
	Phosphorus (P)	Potassium (K)
Deficient	below 25	below 150
Sufficient	25–50	150–500
High	50–75	500–1,000
Excess	above 75	above 1,000

For more information, see *The Presidedress Soil Nitrate Test* (EM 8650) and *Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascades* (EM 8832).

For more information

OSU Extension Service publications

Many OSU Extension Service publications may be viewed or downloaded from the Web. Visit the online Publications and Multimedia catalog at <http://extension.oregonstate.edu/catalog/>

Publications and videos also are available from OSU Extension and Experiment Station Communications. For prices and ordering information, visit our online catalog or contact us by fax (541-737-0817), e-mail (puborders@oregonstate.edu), or phone (541-737-2513).

Pirelli, G., J. Hart, S. Filley, A. Peters, M. Porath, T. Downing, M. Bohle, and J. Carr. *Early Spring Forage Production for Western Oregon Pastures*, EM 8852-E (2004)

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Calculating Dairy Manure Nutrient Application Rates

EM 8768 • April 2015

T. Downing

Whether your goal is to manage manure application to balance for nitrogen (N) or phosphorus (P), knowing how much nutrient you are applying to your fields is a crucial step toward ideal manure management. Determining the relationship between the volume of manure and the amount of nutrients applied is essential.

This publication describes how to calculate nutrient application rates and calibrate waste-handling equipment. It covers typical equipment found on dairies. Nitrogen is used in the examples, but the same techniques can be used for phosphorus.

Generally, it is desirable to apply no more than 100 pounds of nitrogen per acre at a time. See the publications listed under “For more information” (page 5) to learn how to determine appropriate nutrient application rates for your crop and location.

Doing the calculations

To calculate nutrient application rates, you need to know three things:

- The concentration of nutrients in the manure
- How much manure (pounds or gallons) you have applied
- The area (square feet or acres) that received the application

Calculating rates with a stationary gun

1. Measure the amount of manure applied

Place several straight-sided, flat-bottom buckets in the area where the gun is to apply liquid. Run the gun for a predetermined amount of time (for example, 30

minutes) and then turn off the pump. Pour the contents of all the buckets into one bucket and measure the depth of the liquid. Divide the depth by the number of buckets. The result is the inches of liquid manure applied in 30 minutes. For example, let's say you applied ½ inch in 30 minutes.

2. Measure the area covered

To calculate the area of a circle, multiply the radius squared by 3.14. (The radius is half the diameter.) For example, if your stationary gun covers a circle that is 180 feet across, then the radius is 90 feet. Multiply 90 feet by 90 feet by 3.14 to get the total area in square feet (25,434 square feet). There are 43,560 square feet in an acre, so 25,434 square feet is approximately 0.58 acres:

$$\frac{25,434 \text{ ft}^2}{43,560 \text{ ft}^2/\text{acre}} = 0.58 \text{ acre}$$

3. Convert the inches applied to gallons

If you had an average of ½ inch of liquid manure in your buckets, you can assume you applied ½ inch over the 25,434 square feet.

- a. First, convert the square feet to cubic feet by dividing 25,434 by 24 (½ inch in the bucket is ½₂₄ of a foot). This is equivalent to 1,060 cubic feet of liquid manure.

$$\frac{25,434 \text{ ft}^2}{24} = 1,060 \text{ ft}^3$$

- b. Now, convert the cubic feet to gallons. There are 7.5 gallons per cubic foot, so multiply 1,060 cubic feet by 7.5. The result is 7,950 gallons pumped in 30 minutes.

$$1,060 \text{ ft}^3 \times 7.5 \text{ gal/ft}^3 = 7,950 \text{ gal}$$

4. Calculate the total amount of nitrogen applied

If the nitrogen concentration of the manure is 10 pounds per 1,000 gallons, and you applied 7,950 gallons, then you applied 79 pounds of nitrogen.

$$\frac{7,950 \text{ gal} \times 10 \text{ lb N}}{1,000 \text{ gal}} = 79 \text{ lb N}$$

5. Calculate the amount of nitrogen applied per acre

Since you covered 0.58 acres, you applied the equivalent of 136 pounds of nitrogen per acre.

$$\frac{79 \text{ lb N}}{0.58 \text{ acres}} = 136 \text{ lb/acre}$$

Calculating rates with a traveling gun

Calibrating a traveling gun, or traveler, involves the same principles described for a stationary gun, but you adjust for the speed of the traveler (Figure 1).

For a traveler, you need to know the width of application, the number of feet of hose pulled out (the distance covered by a single pass), and the speed at which the gun is moving. For example, let's say your application is 240 feet wide and each pass is 1,000 feet long (for a total area of 240,000 square feet), and that the traveler moves at 6 feet per minute.

1. Measure the amount of liquid applied

During the application, place several straight-sided, flat-bottom buckets throughout the pass area. After one pass, combine the liquid waste collected in all the buckets into one bucket and measure the depth of the liquid. Divide this amount by the number of buckets. The result is the inches of liquid manure applied in one pass. For example, let's say your application averaged $\frac{1}{36}$ inch.

2. Convert the inches applied to gallons

- a. First, convert the square feet to cubic feet by dividing 240,000 by 36 ($\frac{1}{36}$ inch in the bucket is $\frac{1}{36}$ of a foot). This is equivalent to 6,667 cubic feet of manure.

$$\frac{240,000 \text{ ft}^2}{36} = 6,667 \text{ ft}^3$$

- b. Now, convert the cubic feet to gallons. There are 7.5 gallons in a cubic foot, so multiply 6,667 cubic feet by 7.5. The result is 50,002 gallons.

$$6,667 \text{ ft}^3 \times 7.5 \text{ gal/ft}^3 = 50,002 \text{ gal}$$



Figure 1. Calibrating a traveler involves the same principles described for a stationary gun, but you adjust for the speed of the traveler.

3. Calculate the total amount of nitrogen applied

If the manure contains 8 pounds of nitrogen per 1,000 gallons, and you applied 50,002 gallons, then you applied 400 pounds of nitrogen.

$$\frac{50,002 \text{ gal} \times 8 \text{ lb N}}{1,000 \text{ gal}} = 400 \text{ lb N}$$

4. Calculate the amount of nitrogen applied per acre

Four hundred pounds of nitrogen applied over 5.5 acres (roughly 240,000 square feet) equals around 73 pounds of nitrogen per acre.

$$\frac{400 \text{ lb N}}{5.5 \text{ acres}} = 73 \text{ lb N/acre}$$

5. Calculate application rates at various speeds

From these calculations, you can generate a table that easily demonstrates the amount of nitrogen applied at various speeds (Table 1). In the example above, the speed of the traveler was 6 feet per minute. At 3 feet per minute, the application rate would be twice that at 6 feet, or 146 pounds of nitrogen per acre.

Calculating rates with a liquid wagon or drag-hose

The following are two ways to calibrate liquid wagons to determine nutrient application rates.

The most common method

Determine the total volume of liquid applied to a field and then calculate the nutrients applied.

Table 1. Example calibration chart

Traveler speed (feet/minute)	Inches applied	N applied per acre (lb) (if 8 lb N/1,000 gal)	Total N applied (lb)		
			500 ft hose pulled	1,000 ft hose pulled	1,500 ft hose pulled
2.0	1	219	600	1,200	1,800
3.0	0.66	146	400	800	1,200
4.0	0.5	109	300	600	900
6.0	0.33	73	200	400	600

Fill in your own farm's numbers here

Traveler speed (feet/minute)	Inches applied	N applied per acre (lb) (if 8 lb N/1,000 gal)	Total N applied (lb)		
			500 ft hose pulled	1,000 ft hose pulled	1,500 ft hose pulled
2.0					
3.0					
4.0					
6.0					

1. Measure the amount of liquid applied

If you hauled 30 loads of liquid with a wagon that holds 3,000 gallons, you hauled 90,000 gallons of liquid.

$$30 \text{ loads} \times 3,000 \text{ gal} = 90,000 \text{ gal}$$

It is important to realize that although most liquid wagons are rated for a specific volume, the actual working volume is less. For example, a 3,000-gallon wagon might deliver only 2,700 gallons to the field.

2. Calculate the per-acre manure application rate

If the manure is applied to a 10-acre field, this is equivalent to 9,000 gallons per acre.

$$\frac{90,000 \text{ gal}}{10 \text{ acres}} = 9,000 \text{ gal/acre}$$

3. Calculate the per-acre nitrogen application rate

If the manure has a nitrogen concentration of 10 pounds of nitrogen per 1,000 gallons, you applied 90 pounds of nitrogen per acre.

$$\frac{9,000 \text{ gal} \times 10 \text{ lb N}}{1,000 \text{ gal}} = 90 \text{ lb N}$$

A second method

This method measures the volume of liquid applied to a small area and uses that quantity to calculate the volume applied over the entire field. It assumes that the application rate is constant.

1. Measure the amount of liquid applied

Place several trays, pans, or short buckets in the field to catch liquid applied with one pass (Figure 2). Pour the contents of all the pans into one pan and measure the depth of the liquid. Divide this number by the number of pans. The result is the inches of liquid manure applied in one pass. For example, let's say your application averaged 1/2 inch.

2. Convert the inches applied to gallons applied per acre

- a. First, convert the inches to cubic feet per acre by dividing 43,560 (the number of square feet in an acre) by 24 (1/2 inch in the bucket is 1/24 of a foot). This is equivalent to 1,815 cubic feet of liquid manure per acre.

$$\frac{43,560 \text{ ft}^2}{24} = 1,815 \text{ ft}^3/\text{acre}$$

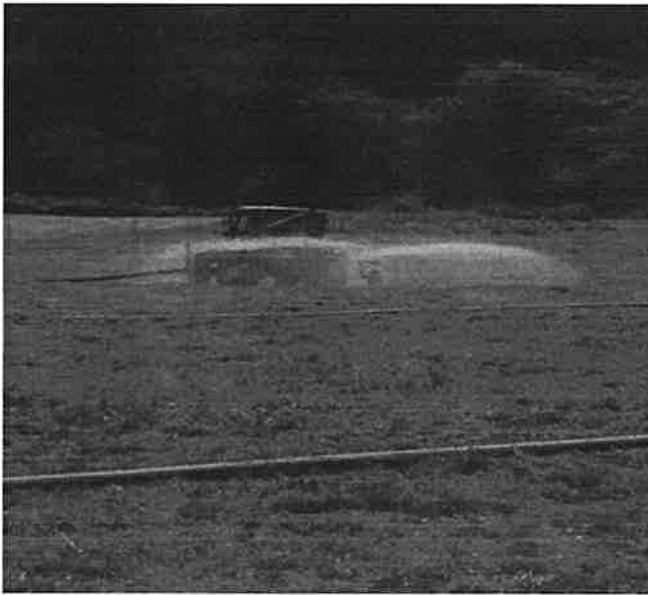


Figure 2. Place several trays, pans, or short buckets in the field to catch liquid applied with one pass with both the drag-hose application or the tank wagon.

- b. Now, convert the cubic feet per acre to gallons per acre. There are 7.5 gallons per cubic foot, so multiply 1,815 cubic feet by 7.5. The result is 13,612 gallons per acre.

$$1,815 \text{ ft}^3/\text{acre} \times 7.5 \text{ gal}/\text{ft}^3 = 13,612 \text{ gal}/\text{acre}$$

3. Calculate the nitrogen application rate

If the concentration of nitrogen is 10 pounds per 1,000 gallons, the rate of nitrogen applied is 136 pounds per acre.

$$\frac{13,612 \text{ gal}/\text{acre} \times 10 \text{ lb N}}{1,000 \text{ gal}} = 136 \text{ lb N}/\text{acre}$$

Calculating rates with a solids spreader

The following are two ways to calibrate solids spreaders.

The most common method

Calculate the nutrient (e.g., nitrogen) content of each spreader load and multiply that number by loads per acre or loads per field.

1. Calculate the capacity (in cubic feet) of your spreader

If your spreader is 16 feet long, 5 feet wide, and 5 feet deep, it holds 400 cubic feet per load.

$$16 \text{ ft} \times 5 \text{ ft} \times 5 \text{ ft} = 400 \text{ ft}^3$$

2. Calculate the nitrogen application rate

If your solid manure has a concentration of 10 pounds of nitrogen per 100 cubic feet, you are applying 40 pounds of nitrogen per load of solids.

$$\frac{400 \text{ ft}^3 \times 10 \text{ lb N}}{100 \text{ ft}^3} = 40 \text{ lb N}$$

3. Calculate the amount of nitrogen applied to the field

Record the number of loads hauled on each field. Multiply the number of loads by the amount of nitrogen per load. For example, if you hauled 25 loads of solids, multiply 25 loads by 40 pounds of nitrogen per load for a total application of 1,000 pounds of nitrogen.

$$25 \text{ loads} \times 40 \text{ lb N}/\text{load} = 1,000 \text{ lb N}$$

4. Calculate the number of pounds of nitrogen applied per acre

Divide the total amount of nitrogen applied by the number of acres, in this example 10 acres.

$$\frac{1,000 \text{ lb total N}}{10 \text{ acres}} = 100 \text{ lb N}/\text{acre}$$

A second method

This method measures the pounds of solids applied to a small area and uses that quantity to calculate the amount applied over the entire field. It assumes that the application rate is constant.

1. Measure the amount of solids applied

Place a tarp or piece of plastic in the field and apply solids over the area (Figure 3). A 10-foot by 10-foot tarp measures 100 square feet. There are 43,560 square feet in an acre, so 100 square feet is $\frac{1}{435}$ of an acre.

$$\frac{100 \text{ ft}^2}{43,560 \text{ ft}^2/\text{acre}} = \frac{1}{435} \text{ acre}$$

After spreading across the sample area, fold the tarp and weigh the solids collected on it. For example, let's assume the solids on the tarp weigh 110 pounds.

2. Convert the pounds to wet tons per acre

- a. First, convert the pounds collected to pounds per acre by multiplying 110 by 435. This is equivalent to 47,850 pounds per acre.

$$110 \text{ lb} \times 435 = 47,850 \text{ lb}/\text{acre}$$

- b. Now, convert the pounds per acre to wet tons per acre by dividing 47,850 by 2,000 (the number of

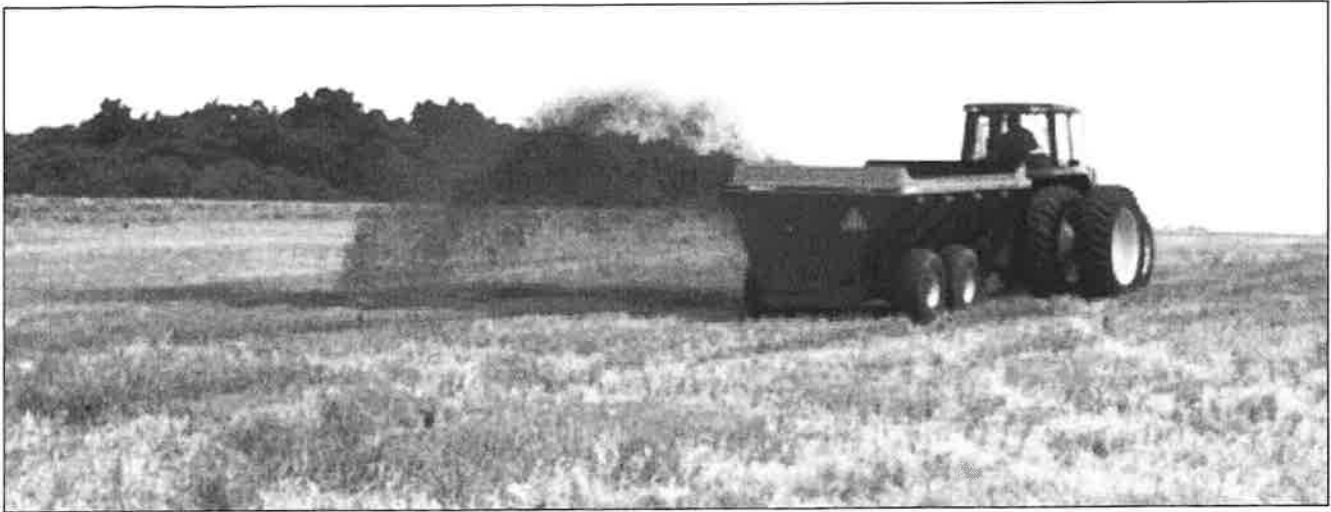


Figure 3. Place a tarp or piece of plastic in the field and apply solids over the area.

pounds per ton). The result is 24 wet tons per acre.

$$\frac{47,850 \text{ lb/acre}}{2,000} = 24 \text{ wet tons/acre}$$

3. Calculate the nitrogen application rate

If the concentration of nitrogen is 5 pounds per wet ton, the rate of nitrogen applied is 120 pounds of nitrogen per acre.

$$24 \text{ wet tons/acre} \times 5 \text{ lb N/wet ton} = 120 \text{ lb N/acre}$$

Manure sampling and testing

Having a sample analyzed by a lab is the best way to determine nutrient concentration. Testing manure for nutrient content is relatively easy; however, it can be difficult to get one sample that represents the nutrient concentration of the entire load of manure. Nutrient content can vary considerably within a load, and agitation usually is inadequate to achieve thorough mixing. Analyzing the samples taken during the calibration process is the most desirable method, especially when testing for nitrogen, because these values should represent what actually reaches the soil.

This method accounts for nutrient losses that occur during storage and application.

Take samples from a liquid tank or lagoon only after agitation.

Book values (e.g., estimates published in Extension publications) are a reasonable approach if testing is not feasible, but actual values vary from operation to operation depending on water added, feed composition (both quality and quantity), age and stage of lactation of the cattle, and the manure storage system.

For more information

There are a number of other helpful Oregon State University Extension Service publications available online at <https://catalog.extension.oregonstate.edu/>

- *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis* (EM 8677)
<https://catalog.extension.oregonstate.edu/em8677>
- *Nutrient Management for Dairy Production: Manure Application Rates for Forage Production*, (EM 8585-E)
<https://catalog.extension.oregonstate.edu/em8585>

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Revised February 2013. Revised April 2015.

Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascades

D.M. Sullivan and C.G. Cogger

Contents

What's in this publication	1
The post-harvest test and how to use it	2
What the post-harvest test measures	2
Soil sampling protocols	2
How to use the post-harvest test as a management tool	3
Crop and soil response to excess plant-available N	4
Units used in soil nitrate testing	5
Interpreting soil nitrate test results	5
Detailed suggestions for soil sampling and planning	9
Collecting, preserving, and analyzing the soil sample	9
Developing a sampling plan	11
Questions and answers	12
For more information	15

What's in this publication?

This publication describes the use of post-harvest soil nitrate testing as a tool for assessment of nitrogen (N) management in manured cropping systems west of the Cascade Mountains in Oregon, Washington, and south coastal British Columbia.

The first section of this publication gives general information on the test and is designed for use by growers and dairy operators. This section gives a brief introduction to soil sampling, but does not provide all of the technical details. The focus is on how to use the post-harvest test to improve nutrient management. This section describes:

- ◆ What the post-harvest test measures
- ◆ How to collect soil samples
- ◆ Units used in soil nitrate testing
- ◆ How to interpret soil nitrate test results for grass and silage corn crops

In addition, background information explains the rationale for the test:

- ◆ How to use the post-harvest test as a management tool (page 3)
- ◆ Crop and soil response to excess plant-available N (page 4)

The second section of this publication is designed primarily for use by conservation planners and other agricultural professionals working with farmers to implement nutrient management plans. This section is also designed for dairy operators who do their own soil sampling. This section includes detailed suggestions for the following:

- ◆ Collecting, preserving, and analyzing the soil sample
 - ◆ Developing a long-term soil sampling plan
-

The post-harvest test and how to use it

What the post-harvest test measures

The post-harvest soil nitrate test measures the quantity of plant-available nitrogen present in the nitrate form in the surface foot of soil in the late summer or early fall. The test measures nitrate-N not utilized by the recently harvested crop. Because crops differ in their ability to remove nitrate-N from the soil, test interpretation is crop-specific.

The test looks backward in time. It evaluates the balance between N supply and crop uptake for the crops produced during the summer. Nitrate-N accumulates in the soil when more plant-available N is supplied than can be utilized by the summer crop (see “Crop and soil response to excess plant-available N,” page 4).

Use the post-harvest test to:

- ◆ Get a general idea of balance between N supply from manure and other sources and crop N demand
- ◆ Identify imbalances in N supply among fields on a farm
- ◆ Identify fields that may respond to changes in timing or amount of manure application or other agronomic practices

Soil sampling protocols

Sampling depth

Sample the 0- to 12-inch depth for the post-harvest test. This shallow sampling depth is a good predictor of nitrate in the rest of the soil profile when (1) in-season irrigation is not excessive, and (2) samples are taken prior to heavy rains in the fall.

Composite soil sample

Collect a composite soil sample consisting of a mixture of 15 to 30 soil cores from each field or management unit. See “Collecting, preserving, and analyzing the soil sample” (page 9) for detailed sampling instructions and suggestions for special situations.

What fields to sample

In general, it is not necessary to sample every field on a farm every year. Consult with your farm advisor to determine any regulatory requirements for sampling frequency. We recommend that you sample selected fields that represent typical manure and crop management practices each year to track long-term trends in post-harvest soil nitrate values. See “Developing a sampling plan” (page 11) for more information.

When to sample

In general, samples for the post-harvest test should be collected as soon as possible after a crop harvest. Avoid sampling a field that has had manure application within the past 30 days.

Samples must be taken before heavy fall rains move nitrate below the 12-inch depth. Because the timing of fall rainfall is unpredictable, the best strategy is to sample fields before October 1 whenever possible.

Collect samples from medium- to fine-textured soils (loams, clay loams, and clays) prior to 5 inches of cumulative fall rainfall. Sandy soils (sand, loamy sand, or sandy loam soil texture) have lower water-holding capacities and should be sampled prior to

continues on page 5

How to use the post-harvest test as a management tool

Sampling depth and timing are critical. Interpretation tables for this test apply only to samples taken to a 12-inch depth. Surface soil (0 to 12 inches) typically contains the highest nitrate-N levels and requires the least time and effort for sample collection. Samples must be taken before heavy fall rains move nitrate below the 12-inch depth. The target sampling period generally is August 15 to October 15.

To get the most value from this test, it is important to understand:

- ◆ How the test fits into an overall nutrient management program
- ◆ Limitations to interpretation of test results
- ◆ How *not* to use the test

Using the test as part of a nutrient management program

The post-harvest test is but one measure of success in nutrient management. Post-harvest nitrate test data should be assessed in the context of the current N management plan and records of manure application. Successful N management involves a number of components, including:

- ◆ Assessing crop N needs
- ◆ Planning manure application to meet crop N needs
- ◆ Applying manure according to the plan
- ◆ Recording manure application amount and estimated plant-available N amount
- ◆ Measuring crop yield and N content
- ◆ Monitoring success of the plan

All components of the nutrient management system should be evaluated together.

Limitations to test results

Interpretive values for post-harvest soil nitrate are:

- ◆ Calibrated only for high-rainfall portions of the Pacific Northwest (west of the Cascades). Extrapolation to other environments is not recommended.

- ◆ Provided only for corn silage and grass hay/silage crops. Field research has been used as the basis for interpretive levels for these crops. Applicable research data are not available for other crops to determine post-harvest nitrate-N levels associated with good crop and nutrient management practices. However, the test may be used for relative comparisons among fields planted to another crop (e.g., comparisons among grass pasture fields).
- ◆ Based on the assumption that summer irrigation is less than, or close to, evapotranspiration to ensure that significant nitrate leaching does not occur before the fall test.
- ◆ Designed for fields with a history of applied manure (more than 3 consecutive years of regular manure application). Lower post-harvest soil nitrate test values are attainable where only fertilizer N is used, or where manure is applied infrequently.
- ◆ Based on good management of the crop and normal yields. Crop moisture stress, insect damage, or plant disease will reduce crop yield and crop uptake of nitrogen, thus increasing post-harvest soil nitrate test levels.

How *not* to use the post-harvest test

The test will *not*:

- ◆ Detect a shortage of plant-available nitrogen for crop production. Continual mineralization of nitrogen (conversion of organic N forms to plant-available N forms in the soil) can provide enough plant-available nitrogen for a crop without accumulation of nitrate-N in soil.
- ◆ Determine the source(s) of excess plant-available N. Sources of N may include manure slurry, lagoon water, fertilizer, soil organic matter, or previous crop residues.
- ◆ Predict crop response to fall manure or N fertilizer applications. The test does not predict the amount of plant-available N that will be mineralized from soil organic matter or crop residues in the fall.

Crop and soil response to excess plant-available N

Crop response to applied N. Crop N uptake is controlled by the environment, crop N uptake potential, and management. Crops respond to plant-available nitrogen supply (ammonium + nitrate-N) by the law of diminishing returns (Figure 1). Without added N, some crop yield is produced from N supplied by soil organic matter, residual plant-available N, and other non-fertilizer sources (e.g., mineralization of crop residues). Additional N supplied from manure or fertilizer increases crop yield until site yield potential is reached.

The application rate of manure or N fertilizer needed to reach near-maximum yield is termed the *agronomic rate*. Rather than a single agronomic rate, the crop response to N is best described as an agronomic rate range (Figure 1). The agronomic rate range concept allows for variability in crop performance among years and for crop uptake of N beyond the yield maximum (increased protein).

Post-harvest soil nitrate test measures nitrate-N not used by the crop. At excessive plant-available N supply levels, crop yield and crop N uptake do not respond to further N additions. The extra soil N not used by the crop accumulates as nitrate-N.

Elevated post-harvest soil nitrate-N concentrations are an indicator of one or more of the following: (1) excess plant-available N, (2) N supplied too late in the season for crop utilization, or (3) poor crop growing conditions due to insect infestation, moisture/heat stress, plant disease, or other cultural problems. If crop yields are acceptable and crop protein is at typical levels, then the most likely explanation is that plant-available N was supplied in excess of crop needs.

Because grass is more efficient than corn at N uptake, target post-harvest soil nitrate levels given in this publication are lower for grass than for corn. There are two key reasons that grass is more efficient than corn in N removal.

- ◆ Grass has a greater capacity to take up N supplied in excess of that needed for maximum yield. After enough N has been supplied

for maximum yield, grass protein content increases in response to increased N supply. With grass, soil nitrate increases only when the available N supply exceeds that required to produce near-maximum protein. Corn does not take up additional N after the maximum yield is reached. Corn silage protein does not increase much in response to excess N supply.

- ◆ Grass utilizes N mineralized late in the growing season more efficiently. Grass managed for silage or hay continues to take up N until harvest. Corn grown for silage completes its N uptake approximately 4 weeks before harvest. Some of the soil nitrate measured after corn harvest is produced by mineralization of soil organic N to available forms during the final weeks of the growing season.

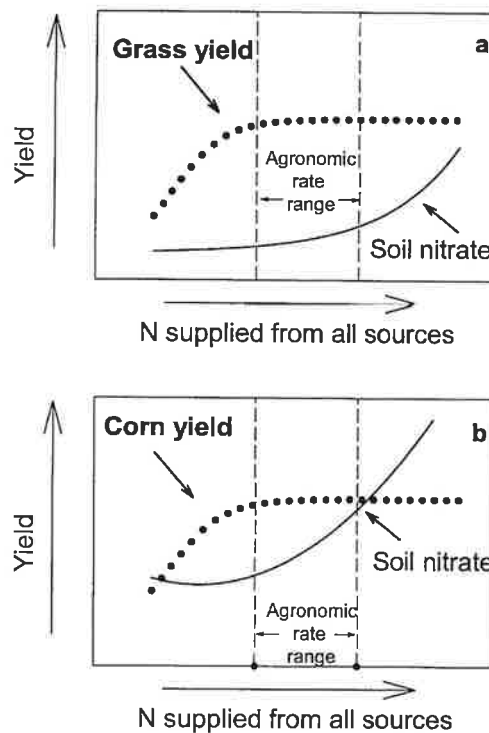


Figure 1.—Crop yield and soil nitrate response to increased N supply. Agronomic rate range = range of N supplied from all sources that results in near-maximum crop yield with acceptable post-harvest nitrate accumulation. Above the agronomic rate range, excess N accumulates as nitrate in soil. More nitrate accumulates in the agronomic rate range with corn (b) than with grass (a).

Table 1.—Average calendar date when cumulative rainfall (after September 1) reaches 5 inches west of the Cascades.^a

Cumulative rainfall after Sept. 1 (inches)	Calendar date to reach specified cumulative rainfall							
	Medford (OR)	Salem (OR)	Tillamook (OR)	Coupeville (WA)	Centralia (WA)	Lynden (WA) Abbotsford (BC)	Agassiz (BC)	Comox (BC)
3	10 Nov	20 Oct	26 Sep	31 Oct	8 Oct	1 Oct	26 Sep	10 Oct
5	29 Nov	1 Nov	8 Oct	24 Nov	23 Oct	15 Oct	9 Oct	25 Oct
7	16 Dec	13 Nov	18 Oct	15 Dec	4 Nov	27 Oct	19 Oct	6 Nov

^aAverage daily precipitation data for many other locations is available at: Western Regional Climate Center (<http://wrcc.dri.edu>) or Environment Canada (http://www.msc-smc.ec.gc.ca/climate/climate_normals/index_e.cfm).

3 inches of cumulative fall rainfall. The starting date for calculating cumulative fall rainfall is September 1. Include inches of irrigation water applied after September 1 in your estimate of cumulative rainfall.

Table 1 shows the average calendar date when cumulative fall rainfall (after September 1) reaches 5 inches at a variety of locations. For most locations, sampling prior to October 15 is acceptable in an average year. In high rainfall areas (coastal areas and the Cascade foothills), plan to sample earlier. A late October sampling date usually is acceptable in lower rainfall areas of southern Oregon, the Puget Sound islands, Olympic Peninsula, or Vancouver Island.

Units used in soil nitrate testing

In this publication, interpretation of a post-harvest soil nitrate test (Tables 3 and 4) is based on units of parts per million (ppm). Some labs report soil test nitrate-N in units of lb/acre by assuming a standard value for soil bulk density. If the lab reports nitrate-N results in pounds per acre, ask them to provide a conversion factor to express data in units of ppm. The conversion factor assumed by laboratories usually is between 3 and 4, because 1 acre-foot of dry soil usually weighs

Table 2.—Units used to report soil nitrate analyses.

Name	Interpretation	Equivalent units
nitrate-N or NO ₃ -N	N present in the nitrate form, soil dry weight basis	mg/kg or ppm (dry weight basis)

about 3.5 million pounds (3.5 lb per acre-foot = 1 ppm).

Interpreting soil nitrate test results

Data quality and variability

The first step in evaluating your soil nitrate data is to verify data quality. Determine whether the sample collection method, timing of sample collection, sample preservation, and laboratory analysis methods are acceptable. Reject data that did not result from reasonable protocols. For example, Tables 3 and 4 should not be used for soil samples collected in November after heavy fall rains.

Make sure that you understand the units used to report test results. See Table 2 for an explanation of units found in soil test reports.

Response of post-harvest soil test N to changes in management

Success in N management is indicated by long-term trends in post-harvest soil nitrate (at least 3 to 5 years). **Because of the large pool of readily mineralizable N in manured soils, fall soil nitrate values may not decline for 3 to 5 years in response to improved management.** For multiyear comparisons, sampling methods and timing must be consistent.

Some portions of a crop rotation will have higher fall nitrate values because of rapid N mineralization stimulated by tillage or incorporation of crop residues. For example, soil nitrate concentrations typically are high, regardless of overall N management, after a perennial grass sod is plowed down and reseeded.

Reductions in fall soil N are most likely to be measured when (1) commercial N fertilizer amounts are reduced or eliminated, (2) cropping systems that maximize N removal in late summer and fall (August to October) are used, and (3) manure or N application is eliminated after August 1. It is more difficult to attain post-harvest soil nitrate-N values of less than 20 ppm for corn than for grass (see “Crop and soil response to excess plant-available N,” page 4).

Interpretation for individual fields

Interpretations of soil test nitrate-N should be made first at the field level. You may be able to discover a probable cause for differences in test values among fields. Questions to ask include:

- ◆ Are relationships present between known management factors (e.g., manure application rate or timing, crop yield and quality, irrigation frequency, distance to the barn) and soil test values?
- ◆ Is a large amount of variation present between fields? Is there a logical explanation for unusual values?
- ◆ Are values for grass and corn fields similar?

Annual averages across grass and corn crops

After looking at test values for individual fields, it may be useful to look at averages across all grass or corn fields. You may want to calculate averages only for fields under similar management.

Average nitrate-N test values are most useful for consideration of changes in whole farm nutrient management. Tables 3 and 4 present interpretive information separately for grass and corn fields.

If a few fields have unusual test values, you may be justified in excluding those fields from an average. Although you may want to exclude unusually high test values from the farm average, you definitely should evaluate those fields further to determine the probable cause of the high soil test values. The unusually high test values may reflect the need for management changes or may reflect a soil sampling or analytical error.

Using the interpretive tables (Tables 3 and 4)

Interpretations and management suggestions given in Tables 3 and 4 (pages 7–8) are general in nature and should serve as only one portion of a nutrient management plan evaluation. Some of the management suggestions can be implemented for individual fields, while others need to be implemented on a whole farm basis.

Remember not to focus solely on post-harvest nitrate-N in evaluating N management. Include other important aspects of N management in your evaluation, such as success in following a plan for manure application, calibration of manure application equipment, maintaining good manure application records, and effective irrigation management.

Table 3.—Silage corn. Suggested interpretation for post-harvest soil nitrate-N (0- to 12-inch depth).^a

If post-harvest nitrate-N is less than 20 ppm (less than approximately 70 lb N per acre)

- ◆ Continue present N management.

If post-harvest nitrate-N is 20 to 45 ppm (approximately 70 to 160 lb N per acre)

- ◆ Reduce or eliminate sidedress N fertilizer application. Use the pre-sidedress nitrate test (PSNT). Apply sidedress N only when PSNT indicates a need.
- ◆ Reduce lagoon water application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.
- ◆ Reduce manure application on fields where corn follows grass sod plow-down.
- ◆ Plan to reduce manure-N application by 10 to 25 percent.
- ◆ Improve whole farm N balance.

If post-harvest nitrate-N is greater than 45 ppm (greater than approximately 160 lb N per acre)

- ◆ Apply only starter N (20 to 40 lb N/acre at planting).
- ◆ Plan not to sidedress N fertilizer in June. Apply sidedress N only when PSNT indicates a need.
- ◆ Eliminate lagoon water application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Apply manure N at a rate less than or equal to crop N removal (approximately 200 lb total N per acre).
- ◆ Eliminate manure application on a few fields or a few strips within a field next year to determine the contribution of mineralized N vs. current-season application of manure.
- ◆ Plan to reduce manure-N application by 25 to 40 percent.
- ◆ Consult experts to improve whole farm nutrient balance.

^aThe post-harvest test values listed above are for the *end* of a growing season. Management changes (if needed) should be implemented in future years. Interpretive values assume near-optimum crop yields. If yield is below average, improve agronomic practices to increase crop yield and crop N uptake.

Table 4.—Grass for hay or silage. Suggested interpretation for post-harvest soil nitrate-N (0- to 12-inch depth).^a

If post-harvest nitrate-N is less than 15 ppm (less than approximately 55 lb N per acre)

- ◆ Continue present N management.

If post-harvest nitrate-N is 15 to 30 ppm (approximately 55 to 105 lb N/acre)

- ◆ Apply manure earlier in the growing season.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.
- ◆ Check protein levels in forage. Grass crude protein greater than 21 percent is associated with increased potential for nitrate toxicity to cows.
- ◆ Plan to reduce manure-N application by 10 to 25 percent.
- ◆ Improve whole farm nutrient balance.

If post-harvest nitrate-N is greater than 30 ppm N (greater than approximately 105 lb N/acre)

- ◆ Apply manure earlier in the growing season. Reduce manure application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Total manure-N + fertilizer-N should be less than or equal to crop N removal. Even if calculated crop removal exceeds 400 lb N per acre, apply manure-N + fertilizer-N not to exceed 400 lb N per acre per year.
- ◆ Consider reseeding or interseeding if grass yield is limited by poor stand or undesirable species.
- ◆ Check protein levels in forage. Grass crude protein greater than 21 percent is associated with increased potential for nitrate toxicity to cows.
- ◆ Plan to reduce manure-N application by 25 to 40 percent.
- ◆ Consult experts to improve whole farm nutrient balance and reduce danger of nitrate toxicity to cows.

^aThe post-harvest test values listed above are for the *end* of a growing season. Management changes (if needed) should be implemented in future years. Interpretive values assume near-optimum crop yields. If yield is below average, improve agronomic practices to increase crop yield and crop N uptake.

Detailed suggestions for soil sampling and planning

Collecting, preserving, and analyzing the soil sample

Tools for field sampling

Collect a sample that is representative of the entire sampling depth. For example, a representative sample for a 0- to 12-inch depth has the same amount of soil from the soil surface (0 to 6 inches) and from the bottom of the sampling depth (6 to 12 inches).

Always use a tool specifically designed for soil sampling. Don't use a shovel, because the samples won't be uniform with depth. Tools for soil sampling often are called soil probes or augers. There are several kinds available.

Push probes are tubes that you push into the soil. They have a T-shaped handle attached to a cylindrical tube (about 1 inch diameter) with a beveled tip. The tube collects a cylinder, or "core," of soil. Push probes work well in soft, uncompacted soils.

Hammer probes are designed for hard or compacted soils. They have a sliding weight (hammer) instead of a T-handle to drive the probe into soil.

Soil test consultants often use hydraulic probes mounted on a tractor or pickup to sample soils. These reduce the time and effort of sampling in hard soils. Gravelly and rocky soils are difficult to sample. A hydraulic probe with a rotating auger can sample some gravelly soils.

A mud auger or bucket auger is the best tool for hand-sampling at sites that are difficult to sample with push probes. Use an auger for compacted, muddy, rocky, or dry soils. Augers can be purchased from several manufacturers. A 2- to 4-inch diameter mud auger (open-sided) works best for most situations because it is easy to remove the sample from the bucket. Use a larger

diameter auger for soils with large rocks. Augers sample a 4- to 6-inch depth. You will need to take several bites from the same hole to sample to 12-inch depth. You will collect a larger sample volume, about 5 to 10 times that collected with a push tube. Because of the extra effort required for auger sampling, use this method only if other sampling methods are difficult or impossible.

Field sampling protocol

Plan ahead. Use field maps and soil maps to divide the farm into different management units. A management unit is usually a field, but you may want to subdivide a large field if sections can be managed separately for nutrient application. The simplest approach is to collect a composite sample from the entire management unit. You may choose to restrict sampling to the dominant soil type if the management unit has soils that differ markedly in visual appearance (soil color, texture, organic matter).

Alternatively, you can restrict your sampling to a representative area (usually about an acre in size) within the management unit. Choosing a representative area within the field where manure application rate, timing, and uniformity are well documented is essential. If you use the "representative area" sampling approach, record the sampling location using a GPS receiver or record the distance from a fixed location (e.g., fenceline).

Avoid large buffer zones that are sometimes present adjacent to water bodies or roads, especially with big gun manure applicators. Avoid small atypical areas such as:

- ◆ Swales
- ◆ Very rocky or shallow soil (less than 12 inches deep)
- ◆ Site of an old manure pile or a feeding, watering, or resting area for livestock
- ◆ Abandoned field roads
- ◆ Field edges

Collect 15 to 30 soil cores from each management unit or representative sampling area with a push probe or similar tool. If you use an auger, 10 holes per management unit or zone is sufficient.

Choose sampling locations in a zigzag pattern across the field. Your general route of travel should be across rows, rather than down one row in the field. Make sure you sample within the part of the field where manure is routinely applied. For grazed pastures, choose sampling locations that have average crop growth and productive forage species.

Scrape away loose crop residues or manure present on the soil surface. Sample only the soil. Including the accumulated organic debris from the soil surface in the soil sample will increase variability in test results.

Once you are satisfied with a sampling strategy, repeat the same procedure each year. This will increase the validity of year-to-year comparisons of results.

Obtaining a representative sample from fields where manure has been injected into soil or placed in bands on the soil surface is difficult. The depth of manure injection, the width of injection zone, and the spacing between bands depend on equipment, soil, and the applicator. Some injection equipment can place manure below the 12-inch sampling depth used for the post-harvest nitrate test. Manure may be injected or banded more than one time per year, with several orientations in a field (e.g., north-south or east-west). Because of the added variability associated with manure injection or banding, plan to collect a larger number of soil cores to obtain a representative composite sample.

Sample handling

Mixing. If it is not too hard to break up the soil cores, break them, mix them all together, and homogenize thoroughly. Take a 1-cup subsample for shipment to the lab. If

the soil cores are too hard to break apart, send the entire sample to the lab, where they can pass the sample through a mechanical grinder. Check with the lab to make sure they will grind and mix the *entire* sample before subsampling.

Preservation. Soils kept moist and warm continue to accumulate nitrate via biological activity after sampling. The simplest way to limit biological activity is to cool the soil after collection. Put the samples in plastic bags and place them in a cooler on ice while still in the field. Refrigerate them when you return from the field. Freeze the samples if they will be held longer than 48 hours before analysis.

Shipment. Keep the samples refrigerated or frozen until you deliver them to the lab. Contact the lab before you sample, so they will be prepared to receive the samples. Use a shipping method that will get the samples to the lab within 48 hours. You may want to freeze the samples before shipping to make sure they remain cool in transit.

Working with an analytical laboratory

Choose a laboratory that has experience with agricultural samples. Ask if they participate in the North American Proficiency Testing Program or a similar quality assurance program for agricultural testing labs. Find out what extraction and analytical procedures they use. Procedures should be consistent with those recommended for the western states (Gavlak et al., 1994).

Labs may use one of several colorimetric (color-based) lab procedures or they may use an electrode method to measure nitrate. Sample comparisons have shown that the colorimetric procedures usually are more precise than the electrode method.

Some testing labs also have sampling and consulting services. This can be convenient for people who have little experience in sampling or need help with sampling.

Find out how the lab reports soil test data. Standard units for soil nitrate-N are parts per million (ppm, Table 2). If you aren't familiar with the lab, it's a good idea to obtain a copy of a sample laboratory report.

Because you will use sample results to compare post-harvest soil nitrate across years, laboratory consistency over time is a major issue. A standard reference sample (soil sample with known concentration of nitrate) can help you assess laboratory variability. Consider submitting a standard reference sample (approximately 50 to 100 g dry weight) with a nitrate-N concentration of 20 to 45 ppm with each batch of soil samples. Keep track of test results for the standard reference sample over time. If you note a major error in the nitrate concentration reported for the standard reference sample, then the test data is questionable.

Standard reference samples are available from the North American Proficiency Testing Program (see "For more information," page 15). Standard reference samples must be dried, ground, and thoroughly mixed.

We do not recommend that you split a field sample to check laboratory consistency. The one-time nature of such comparisons, the uncertainty of obtaining a homogeneous sample, and the uncertainty of sample preservation in-transit to the lab limit the interpretation of split-sample data.

Developing a sampling plan

Nutrient management plans can be voluntary, required by regulatory agencies, or a part of an agreement with a conservation planning agency (e.g., Natural Resources Conservation Service or conservation district). If your nutrient management plan is not voluntary, consult the agency that supervises your nutrient management plan to determine whether they have specific requirements for how often fields must/should be sampled.

Suggestions given here for sampling frequency are general in nature and are not intended to serve as policy for any agency.

Representative fields for long-term monitoring

Representative fields are fields that you sample every year to track trends in sample values over time. Select fields that represent typical management practices. Criteria that can be used to choose representative fields include: (1) records or estimates of annual manure application rate, (2) number of years of continuous manure application, (3) soil test values for P and K. On dairies where P and K fertilizers are not routinely applied, soil test values above 75 ppm P (Bray P1 method) and 400 ppm K (ammonium acetate method) usually reflect substantial manure application in the past.

Sample the representative fields every year to assess trends over time. If you grow corn silage and perennial grass forage, plan to sample at least four grass fields and four corn fields each year. At a small dairy (fewer than four fields), sample all fields each year.

Other fields

Periodically, you will need to evaluate the fields not designated as "representative" fields. Consider sampling all fields every 3 years. Compare whole farm soil data to representative field data.

If you have only a few fields with elevated soil test N, then focus management on those fields. If all fields on the farm give similar test data, then focus your N management efforts at the whole farm level. If representative fields consistently have test values of less than 15 ppm (grass) or less than 20 ppm (corn) over a 3-year period, and all other fields sampled have similar test values, consider reducing the number of post-harvest soil nitrate tests.

Sampling priority

Prioritize fields for fall sampling ahead of time so that you get high-priority fields sampled at an appropriate time. Highest priority should be given to representative fields used to track long-term trends. Fields with high manure application rates or elevated soil test N the previous year should also have a high priority.

Corn fields can be sampled for soil nitrate in June (PSNT, pre-sidedress nitrate test) or in the fall (post-harvest test described in this publication). You will get the most management information by sampling your high-priority representative corn fields both in June (PSNT) and after harvest. You also may want to sample fields with PSNT values greater than 45 ppm nitrate-N again in the fall.

For other corn fields where only one soil test per year is planned, we recommend using the PSNT in preference to the post-harvest soil nitrate test. The PSNT is preferred because test results are applicable to in-season N management. Growers can save money and reduce post-harvest nitrate by omitting sidedress N fertilizer application on fields where sufficient soil nitrate-N is present in June.

Sampling corn fields at PSNT time also will reduce the number of post-harvest samples that need to be collected during the short interval between harvest and the end of the fall sampling window (approximately October 15). If you miss a planned fall sampling on a corn field, consider sampling next year using the PSNT.

Grass fields are best sampled in the fall, using the protocols described in this publication. Think carefully about the best way to achieve consistent timing of sample collection for your fields. The timing of manure application and the timing of grass harvest are key variables to consider.

Samples collected shortly after manure application are not a good indicator of the

balance between N supply and crop N demand over the entire growing season. If manure is applied late in the year, postpone soil sampling until after a fall grass harvest. Wait at least 30 days after a late-season manure application before sampling. Sampling need *not* be postponed until after the last manure application or until after the last grass harvest in the fall.

Questions and answers

Why is it difficult to achieve post-harvest nitrate-N less than 15 to 20 ppm with organic sources such as manure?

First, the timing and rate of application for organic sources is less flexible than for fertilizer N. Second, environmental processes that control the quantity and timing of N availability from organic sources are difficult to manage. The biggest factors controlling N availability are soil temperature and moisture. The timing of crop N uptake usually does not match the timing of N supplied from manure and other organic sources. Soil temperature and moisture often support continued release of available N after crop N uptake is complete.

Is there a relationship between soil organic matter content and potential N mineralization?

Research west of the Cascades has demonstrated a lack of correlation between soil organic matter content and N mineralization potential for soils having 3 to 8 percent organic matter. The active fraction of soil organic matter that controls annual N mineralization rates is a small proportion of total organic matter (usually less than 10 percent of total). Recent site management affects soil N mineralization potential; it does not have much effect on soil organic matter content. Because most soil total N is contained in soil organic matter, soil total N is also an unreliable indicator of mineralization potential.

What other soil tests can be used to provide information to guide N management for corn?

Soil nitrate testing in spring and early summer can assist with N management for silage corn. Test soil ammonium + nitrate-N several weeks after a spring manure application to track early-season N availability. Test soil nitrate when corn is at the four- to six-leaf stage (pre-sidedress nitrate test, PSNT) to determine the need for sidedress N application to corn.

How much variability should I expect in post-harvest nitrate-N test values for the same grass field sampled between August 15 and October 15?

It all depends on weather, soil biology, and crop management. A good stand of actively growing grass can maintain nitrate-N concentrations of less than 15 ppm throughout the post-harvest sampling period. Where soil is dry in late summer, increased N availability may occur for 2 or 3 weeks following the first heavy rain. It may be useful to take several soil nitrate tests from the same field in the fall to document changes in nitrate concentration with time. Soil nitrate values given in the interpretive table in this publication are for typical precipitation and sampling date.

Ammonium-N is plant-available. Why doesn't the post-harvest test include ammonium-N analysis?

Post-harvest ammonium-N analyses cost money, and they do not yield reliable interpretive information. Ammonium-N does not accumulate in soils supplied with an excess of plant-available N. It is rapidly converted to nitrate. Soil samples taken at least 30 days after manure application usually have negligible ammonium-N concentrations unless soil has remained dry.

Drying of soils after sampling releases ammonium-N from microbial biomass. Most dried soils have 2 to 20 ppm ammonium-N

that is caused by the soil drying process. Dry soil ammonium-N concentrations are poorly correlated with other indices of N availability in controlled experiments.

Should post-harvest nitrate tests be used for fields with organic soils?

Other methods should be used to assess the success of nutrient management plans on organic soils. Goals for post-harvest nitrate-N of less than 20 ppm are difficult if not impossible to attain on organic soils, which contain more than 20 percent organic matter. These soils formed as organic matter accumulated under natural poorly drained conditions. Soil organic matter decomposition and N mineralization processes are greatly accelerated under typical farming practices such as artificial drainage and tillage.

Should I measure or estimate soil bulk density to estimate post-harvest nitrate-N in units of pounds per acre?

The variation in bulk densities among soils typically is less than the variation associated with soil nitrate sampling and testing. Interpretive information in this publication is based on units of parts per million (ppm; mg per kg dry soil). You can approximate soil nitrate-N in the surface foot of soil by assuming typical bulk density ($\text{ppm} \times 3.5 = \text{lb/acre}$). This conversion factor is based on the weight of 1 acre-foot of soil at a bulk density of 1.3 g cm^3 (1 acre-foot = 3.5 million lb). Organic soils (more than 20 percent organic matter) have lower bulk density (0.6 to 0.8 g cm^3).

What is whole farm nutrient management?

The goals of whole farm management are: (1) to move toward a balance of nutrient imports and exports, and (2) to utilize nutrients on the farm at agronomic rates that minimize nutrient losses to the environment. Managing nutrients at the whole farm level requires knowledge of the major nutrient imports, major nutrient exports, crop

utilization of nutrients on the farm, and nutrient losses to air and water.

The Livestock and Poultry Environmental Stewardship (LPES) Curriculum, available through the Midwest Plan Service, includes a Web presentation of whole farm nutrient management principles and a worksheet for evaluating whole farm nutrient balance. See “For more information” (page 15) for details.

What is the role of post-harvest nitrate testing in connection with Comprehensive Nutrient Management Plans (CNMPs)?

CNMPs, developed by the Natural Resources Conservation Service (NRCS) or other nutrient management professionals under NRCS supervision, are broader than just nutrient management. Other components of a CNMP are: (1) manure and wastewater handling and storage, (2) land treatment practices, (3) record-keeping, (4) feed management, and (5) other waste utilization options.

Post-harvest nitrate test values may be used as part of a process to develop a new CNMP or to update an existing CNMP. The CNMP typically includes a plan for regular

soil testing. Appropriate timing of the post-harvest nitrate test is critical (see “When to sample,” page 2), while soil samples for P and K analysis may be collected any time of the year. Soil samples collected for the post-harvest nitrate test can be analyzed by routine agronomic soil testing procedures and used in developing plans for P and K utilization in a CNMP.

What are the implications of high nitrate concentrations in forages?

Nitrate in ensiled forages can interfere with normal fermentation processes, resulting in poor-quality forage. Forage nitrate affects the distribution of nitrogen compounds in silage. It is difficult to use the silage to formulate rations that meet cow needs for specific protein fractions. Enough nitrate is sometimes present in the silage itself to create a health risk to the animal. Grass silage that is greater than 21 percent crude protein should be tested for the level of nitrate-N. See Johnson et al. (2002) for interpretation of forage nitrate concentrations.

For more information

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Many OSU Extension Service publications, as well as additional gardening information, may be viewed or downloaded from the Web (<http://eesc.oregonstate.edu>).

Copies of many of our publications and videos also are available from OSU Extension and Experiment Station Communications. For prices and ordering information, visit our online catalog (<http://eesc.oregonstate.edu>) or contact us by fax (541-737-0817), e-mail (puborders@oregonstate.edu), or phone (541-737-2513).

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Acknowledgments

This publication is a product of the Western Integrated Nutrient Management Education (WINME) project. Financial support for WINME is provided by the USDA Western Region Sustainable Agriculture Research and Education (SARE) Program.

This publication reflects a collaborative effort among organizations and individuals. Major ideas in the publication were proposed by participants at the Fall Soil Nitrate Workshop facilitated by Washington State University Cooperative Extension on 28 February 2002 in Puyallup, WA.

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Published May 2003.