REC'D FEB 07 2020

Oregon Department of Agriculture
CAFO Division
Animal Waste Management Plan
Signature Sheet

ODA USE ONLY
MA# 102688
AWMP# 20001
Approved Date_____
Received Date final version 1/22/2020

Facility Name: OSU Dairy & Swine Centers

Facility Address: 4490 Harrison Blvd
Corvallis, OR 97330

Operator: Larissa Lewis

Mailing Address: 112 Withycombe Hall
Corvallis, OR 97331

Complete if different than the Operator

Owned by: Oregon State University

Mailing Address: 112 Withycombe Hall
Corvallis, OR 97331

As the Operator of OSU Dairy & Swine Centers, I agree to manage this facility in accordance with Animal Waste Management Plan (AWMP) # 20001 on file with ODA and maintain those practices as described in the plan. This signed AWMP is incorporated into the CAFO NPDES and WPCF General Permits by reference (Permit Condition S3.A.2.).

If changes are made to the animal population, facilities or change in the type of manure system of the CAFO, a new AWMP must be submitted to ODA for approval at least 45 days before the modification is implemented unless a different schedule is allowed by ODA in writing (Permit Condition S3.D.1and 2).

	Date
Operator's Signature	01/23/2020
Operator's Name (Please Print) Larissa Lewis	

Nutrient Management Plan

For OSU Dairy & Swine Centers

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GENERAL INFORMATION
2018 Operation Information for OSU Dairy & Swine Centers

Calendar Year: 2018 Reporting: January 1 through December 31, 2018

Name:	Larissa Lee Lewis
Business	OSU Dairy & Swine Centers
Mailing	Department of Animal & Rangeland Sciences, 112 Withycombe Hall, Corvallis, OR 97331
Facility	4490 NW Harrison Boulevard, Corvallis, OR 97331 County: Benton
Telephone	(503) 867-4372 Cell Phone NA
E-mail	larissa.mcguire@oregonstate.edu

Permitted and number of animals by type on the farm averaged over the year [S4.D.2(a)/S4.D.2(a)(ii) of the permit].

Animal Type	Average Weight (Lbs)	Days on Farm		Permitted	Actual or Proposed
		Start Month	End Month		
Milker - Jersey	900	January	December	90	127
Milker - Dry	1,000	January	December	15	23
Dairy Heifers	750	January	December	90	150
Sow (gestating)	450	January	December	42	42
Grow to Finish Pig	150	January	December	120	120
Other:					
			Total Animals-	357	462

Estimated Solids Generated:		
Manure Solids Generated -	7,636	CF
Bedding Generated -	11,276	CF
Imported Solids -	0	CF
Total Solids to Store -	18,912	CF
Estimated Liquids Generated:		
Manure Liquids Generated -	68,723	CF
Rainfall-Evaporation on Storage plus Runoff Generated -	191,404	CF
Process Water Generated -	41,975	CF
Imported Liquids -	0	CF
Total Liquids to Store -	302,103	CF
Land Application:		
Estimated Liquids Applied to Land -	302,103	CF
Estimated Solids Applied to Land -	18,912	CF
Estimated Grazing Manure Applied to Land -	59,460	CF
Estimated Liquids Exported -	0	CF
Estimated Solids Exported -	0	CF
Acres of Land for Land Application Covered by NMP -	176.9	Ac
Acres of Land Under Operator Control Used for Manure Applications -	176.9	Ac

2018 Storage Facilities for OSU Dairy & Swine Centers

Facility Name	Description	Type	Capacity	Units	Storage Period (Days)	Diameter (ft)	Top Length (ft)	Top Width (ft)	Depth (ft)	Sideslope Z	Freeboard (ft)	Volume (CF)	Covered
Harvestore Tank	520K Gal Tank	Liquid	520,000	Gal	38	60			25.6		1	69,520	N
Solids Stack	Solids Stack	Solid	6,356	CF	196		40	40	8	1.6		6,356	N
100 Ft Dia Tank	881K Tank	Liquid	880,770	Gal	63	100			16		1	117,750	N
Hog Center Tank	Hog Center Collection Tank	Liquid	24,000	Gal	30							24,000	Y

2018 Storage Period Calculations for OSU Dairy & Swine Centers

SOLIDS STORAGE		Month	Number of Days	Manure CF	Bedding CF	Imported Solids CF	Solids to Store CF	Storage Volume Needed, CF
Storage Unroofed Surface Area, SF=	1,600	October	31	649	375	0	512	512
Available Storage, CF=	6,356	November	30	628	1,500	0	1,064	1,576
Solids Removal Factor=	0.10	December	31	649	1,550	0	1,099	2,675
Storage Volume Reduction Factor=	0.50	January	31	649	1,550	0	1,099	3,774
Solids Storage Period, Days=	196	February	28	586	1,400	0	993	4,767
		March	31	649	1,550	0	1,099	5,866
		April	30	628	1,500	0	1,064	6,930
		May	31	649	375	0	512	7,442
		June	30	628	363	0	495	7,937
		July	31	649	375	0	512	8,449
		August	31	649	375	0	512	8,961
		September	30	628	363	0	495	9,456
		Annual	**365**	**7,636**	**11,276**	**0**	**9,456**	

LIQUID STORAGE		Month	Number of days	Rainfall Inches	Evaporation Inches	Rain-Evap on Storages CF	Rainfall Runoff CF	Manure CF	Process Water CF	Imported Liquids CF	Monthly Liquids to Store CF	Total Storage Volume Needed, CF
Climate Station-	Benton	October	31	3.02	1.64	1,631	11,802	5,837	3,565	0	22,835	22,835
Storage Unroofed Surface Area, SF=	10,681	November	30	6.04	0.71	5,549	26,057	5,648	3,450	0	40,705	63,540
Available Storage, CF=	190,477	December	31	7.43	0.61	7,061	32,664	5,837	3,565	0	49,126	112,666
Runoff Area, SF=	57,353	January	31	6.45	0.73	5,951	28,004	5,837	3,565	0	43,357	156,023
25Yr-24Hr Storm Precip, In=	4.50	February	28	5.71	0.97	4,980	24,490	5,272	3,220	0	37,963	193,986
25Yr-24Hr Storm Runoff, CF=	19,284	March	31	4.59	1.32	3,523	19,186	5,837	3,565	0	32,110	226,096
25Yr-24Hr Storm on Storage, CF=	4,005	April	30	2.98	2.16	1,127	11,616	5,648	3,450	0	21,841	247,937
Total 25Yr-24Hr Storm Storage Needed, CF=	23,289	May	31	2.30	3.34	-619	8,463	5,837	3,565	0	17,246	265,182
Storage Period without 25yr-24 Storm, Days=	148	June	30	1.46	4.31	-2,342	4,665	5,648	3,450	0	11,422	276,604
Storage Period with 25yr-24 Storm, Days=	131	July	31	0.57	5.59	-4,392	1,043	5,837	3,565	0	6,052	282,656
		August	31	0.73	5.12	-3,810	1,622	5,837	3,565	0	7,214	289,870
		September	30	1.47	3.46	-1,575	4,709	5,648	3,450	0	12,232	302,103
		Annual	**365**	**42.75**	**29.96**	**17,084**	**174,320**	**68,723**	**41,975**	**0**	**302,103**	

2018 Manure Nutrient Balance for OSU Dairy & Swine Centers

Manure Nutrients in Storage-

Nutrient Concentrations:	Nitrogen (Total N)	Phosphorus (P_2O_5)	Potassium (K_2O)	Units
Liquid Manure-	**14.00**	**4.31**	**17.50**	lbs/1000 Gal
Solid Manure-	**9.89**	**4.45**	**6.43**	lbs/Ton

Manure Nutrient Balance-

Nutrients Generated:	N Generated (lbs) after Losses	P_2O_5 Generated (lbs) after Losses	K_2O Generated (lbs) after Losses
Liquid Manure-	31,636 lbs	9,739 lbs	39,545 lbs
Solid Manure-	1,683 lbs	757 lbs	1,094 lbs
Grazing Manure-	21,917 lbs	8,359 lbs	26,665 lbs
Total-	**55,236 lbs**	**18,856 lbs**	**67,304 lbs**

Exported Nutrients:	N Exported (lbs) after Losses	P_2O_5 Exported (lbs) after Losses	K_2O Exported (lbs) after Losses
Liquid Manure-	0 lbs	0 lbs	0 lbs
Solid Manure-	3,398 lbs	1,529 lbs	2,209 lbs
Total-	**3,398 lbs**	**1,529 lbs**	**2,209 lbs**

Crop Nutrient Removal:	N Utilized (lbs)	P_2O_5 Utilized (lbs)	K_2O Utilized (lbs)
Total-	**52,884 lbs**	**7,353 lbs**	**36,446 lbs**

Net Nutrients:	Nutrients Generated after Losses(lbs.)	Nutrients Removed by Crop and Exported after Losses (lbs)	Net Nutrient Balance after Losses (lbs)
Nitrogen (N)-	55,236 lbs	56,282 lbs	-1,045 lbs
Phosphate (P_2O_5)-	18,856 lbs	8,882 lbs	9,974 lbs
Potassium (K_2O)-	67,304 lbs	38,655 lbs	28,650 lbs

System Losses:	Nutrients Generated (lbs)	Nutrients Remaining after Losses (lbs)	Nutrients Lost in System (lbs)
Nitrogen (N)-	56,385 lbs	55,236 lbs	1,149 lbs
Phosphate (P_2O_5)-	19,974 lbs	18,856 lbs	1,118 lbs
Potassium (K_2O)-	62,549 lbs	67,304 lbs	0 lbs

Note: Total nutrients utilized and generated are computed from reference data taken from Extension Publications or the USDA Natural Resources Conservation Service National Agricultural Waste Management Field Handbook. Nutrients generated after losses are computed from analytical data by taking the total volume of material times the nutrient analysis of the material except for grazing where reference data is used.

GENERAL INFORMATION

Background And Site Information

OSU Dairy & Swine Centers are located approximately a 2 miles west of Corvallis, Oregon in Benton County, Oregon. The dairy center has been in operation on this site for more than 70 years and is located in the Oak Creek watershed . The Swine Center has also been in operation for several years and is located in the Oak Creek watershed. The watershed area surrounding the dairy and swine centers drain to Oak Creek which drains to Marys River approximately 1.67 miles downstream.

OSU Dairy & Swine Centers are owned by Oregon State University and managed by the Animal and Rangeland Sciences Department who are planning to milk 150 cows Jersey cows and 150 Jersey heifers and calves on the dairy and 42 sows and 120 grow to finish pigs at the swine center. The milk cows and heifers are typically confined from November through March and are out on pasture from April through October each year as weather conditions permit. The swine are confined 365 days a year.

The OSU Dairy & Swine Centers are currently permitted for 105 dairy cows, 90 heifers and calves, 42 sows and 120 grow to finish pigs greater than 55 pounds in average weight. A request to increase the permitted animal numbers for the OSU Dairy & Swine Centers is located in the Supplemental documents section of this plan.

The OSU Dairy & Swine Centers are currently permitted for 105 dairy cows, 90 heifers and calves, 42 sows and 120 grow to finish pigs greater than 55 pounds in average weight. A request to increase the permitted animal numbers for the OSU Dairy & Swine Centers is located in the Supplemental documents section of this plan.

Research projects may be conducted at the dairy and swine centers and all research proposals will be provided to the Oregon Department of Agriculture Confined Animal Feeding Operation Program for review. All CAFO research activities that will be conducted at the dairy and swine centers will be summarized in the annual report submitted to the Oregon Department of Agriculture Confined Animal Feeding Operation Program.

Manure, bedding and wasted feed collected on the alleyways of the livestock barns for OSU Dairy are flushed to underground liquid collection tank. Wastewater from the holding pen and milking facility is transferred to the dairy underground liquid collection tank by gravity flow through underground pipelines. Any rainfall runoff from paved areas containing manure and the solids storage area for the dairy drain to the underground collection tank. The floor of the swine is slotted so manure falls through and is collected in a underfloor tank. The swine center is totally under roofs so there is no rainfall runoff added to the swine under floor tank. The manure collected in the underfloor tank at the swine facility is transferred to the dairies storage tanks when weather conditions are unfavorable for application on the hay and pasture fields.Wastewater stored in the underground collection tank for the dairy center is agitated and pumped through a pipeline to the solid/liquid separation facility consisting of a dual screen Integrity separator with a screw press auger on the discharge. Wastewater from the solid/liquid separation facility for the dairy center drains by pipeline to the above ground storage tank shown on the Production Area Map in Section 2. A 100 foot diameter by 16 foot deep above ground uncovered tank is was constructed in 2015 which increased storage capacity. The solids cleaned from the livestock barns and from the solid/liquid separation facility for the dairy center are stored on an unroofed concrete slab area shown on the Production Area Map for the dairy in Section 2. The liquids stored in the collection tank for the swine center are pumped to the hay and pasture fields to utilize the nutrients and organics as a nutrient source. Solids stored in the solids storage area and wastewater stored in the storage tanks for the dairy center are applied to the hay and pasture land fields during the spring and

summer months to utilize the nutrients and organics. Wastewater is applied using traveling big gun sprinkler system and the solids are applied using a tractor pulled solids spreader. The wastewater from the waste storage tanks and solids from the solids storage area will be applied to the hay and pasture land fields owned by OSU Dairy & Swine Center by employees of the dairy to be used as a nutrient source.

OSU Dairy & Swine Center owns 188.2 acres for the dairy and swine center facilities described above and the hay and pasture land fields used to produce forage for the dairy livestock. These acres consist of 6.9 acres for the dairy center facilities, 4.4 acres for the swine center facilities and 176.9 acres of irrigated hay and pasture land used to produce forage for the dairy livestock. The crops grown by the OSU Dairy Center consists of perennial grass that is harvested by grazing livestock and for hay and some alfalfa and oats for hay. The estimated yields for the irrigated grass harvested by grazing livestock and as hay is 3 to 4 tons per acre at 85% dry matter. The estimated yields for the irrigated alfalfa is 5 tons per acre at 85% dry matter and the estimated yield for the oat haylage is 8.5 tons per acre at 40% dry matter.

The soil concentration of phosphorus ranges from low to medium in the OSU Dairy & Swine Center hay and pasture land fields. The phosphorus runoff risk rating is approaching a medium rating in some fields which would only allow manure to be applied on a phosphorus basis. Applications of wastewater and solids containing manure are planned on a nitrogen basis on all fields and the soil phosphorus concentrations will be monitored using soil tests. Some solids containing manure may have to be exported off farm if the soil concentrations of phosphorus increase significantly in the future. It is estimated that the dairy does not produce enough manure to meet the nutrient demand for the hay and pasture land fields. Supplemental nutrient applications to the crop, hay and pasture land fields should be based on soil tests and fertilizer guides to prevent excess soil nutrient concentrations.

Emergency Response Plan

In Case of an Emergency Storage Facility Spill, Leak or Failure-

Implement the following first containment steps:

Stop all other activities to address the spill.
Stop the flow. For example, use skid loader or tractor with blade to contain or divert spill or leak.
Call for help and excavator if needed.
Complete the clean-up and repair the necessary components.
Assess the extent of the emergency and request additional help if needed.

In Case of an Emergency Spill, Leak or Failure during Transport or Land Application-

Implement the following first containment steps:

Stop all other activities to address the spill and stop the flow.
Call for help if needed.
If the spill posed a hazard to local traffic, call for local traffic control assistance and clear the road and roadside of spilled material.
Contain the spill or runoff from entering surface waters using straw bales, saw dust, soil or other appropriate materials.
If flow is coming from a tile, plug the tile with a tile plug immediately.
Assess the extent of the emergency and request additional help if needed.

Contacts to be made by the owner or operator within 24 hours-

Organization	Phone Number
Oregon Department of Agriculture	(503) 986-4699
Natural Resources Division TTD	(503) 986-4762
635 Capitol St., N.E.	
Salem, OR 97301-2532	
Oregon Emergency Response (System OERS)	(800) 452-0311

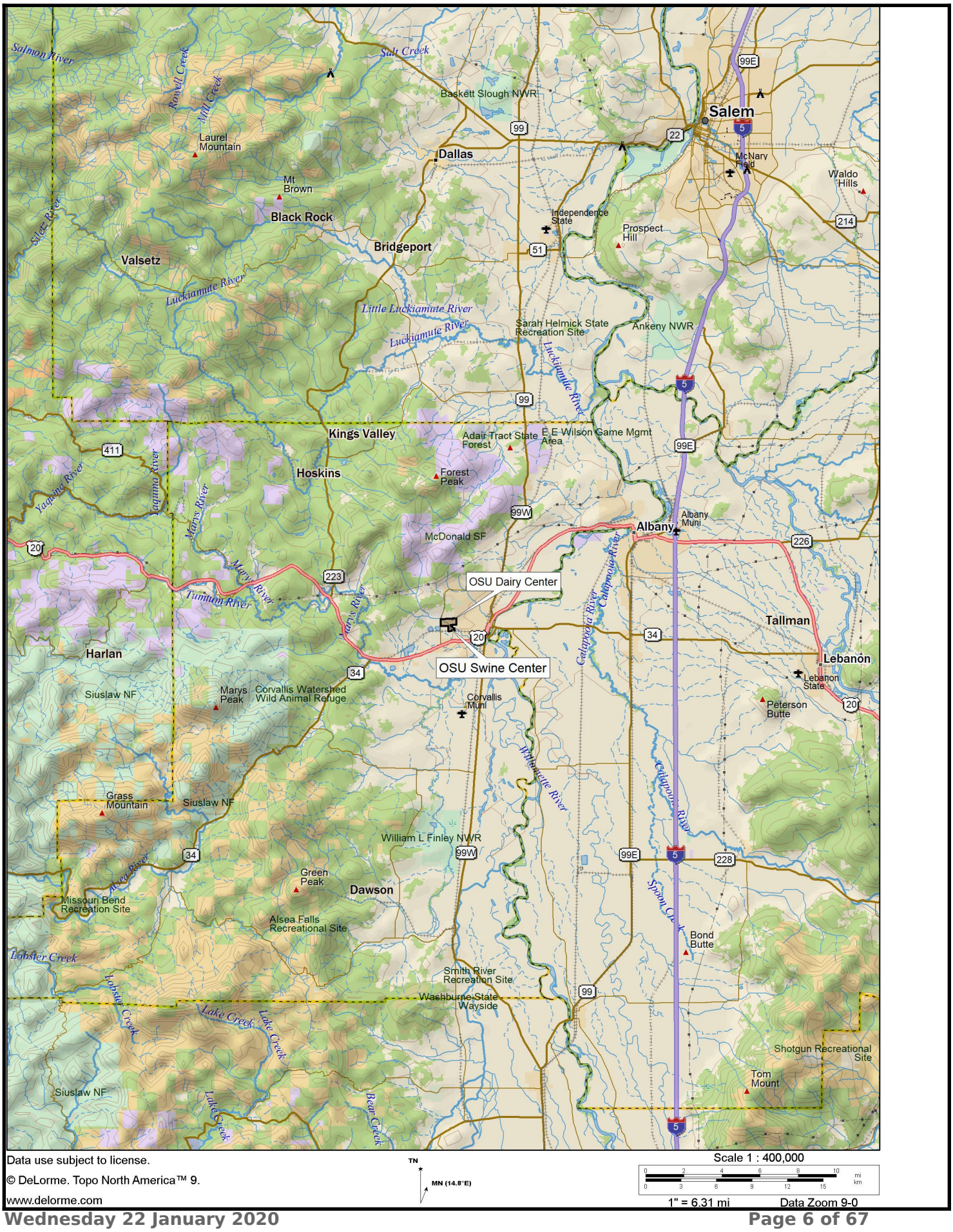
Be prepared to provide the following information:

Your name and contact information.
Farm location (driving directions) and other pertinent information.
Description of emergency.
Estimate of the amounts, area covered, and distance traveled.
Whether manure has reached surface waters or major field drains. Include the name of the surface water source that manure reached. Contact the Oregon Emergency Response System if manure entered a drinking water source.
Whether there is any obvious damage: employee injury, fish kill, or property damage.
If a grab sample of the discharge was taken.
Current status of containment efforts.

GENERAL INFORMATION

Location Maps for OSU Dairy & Swine Centers

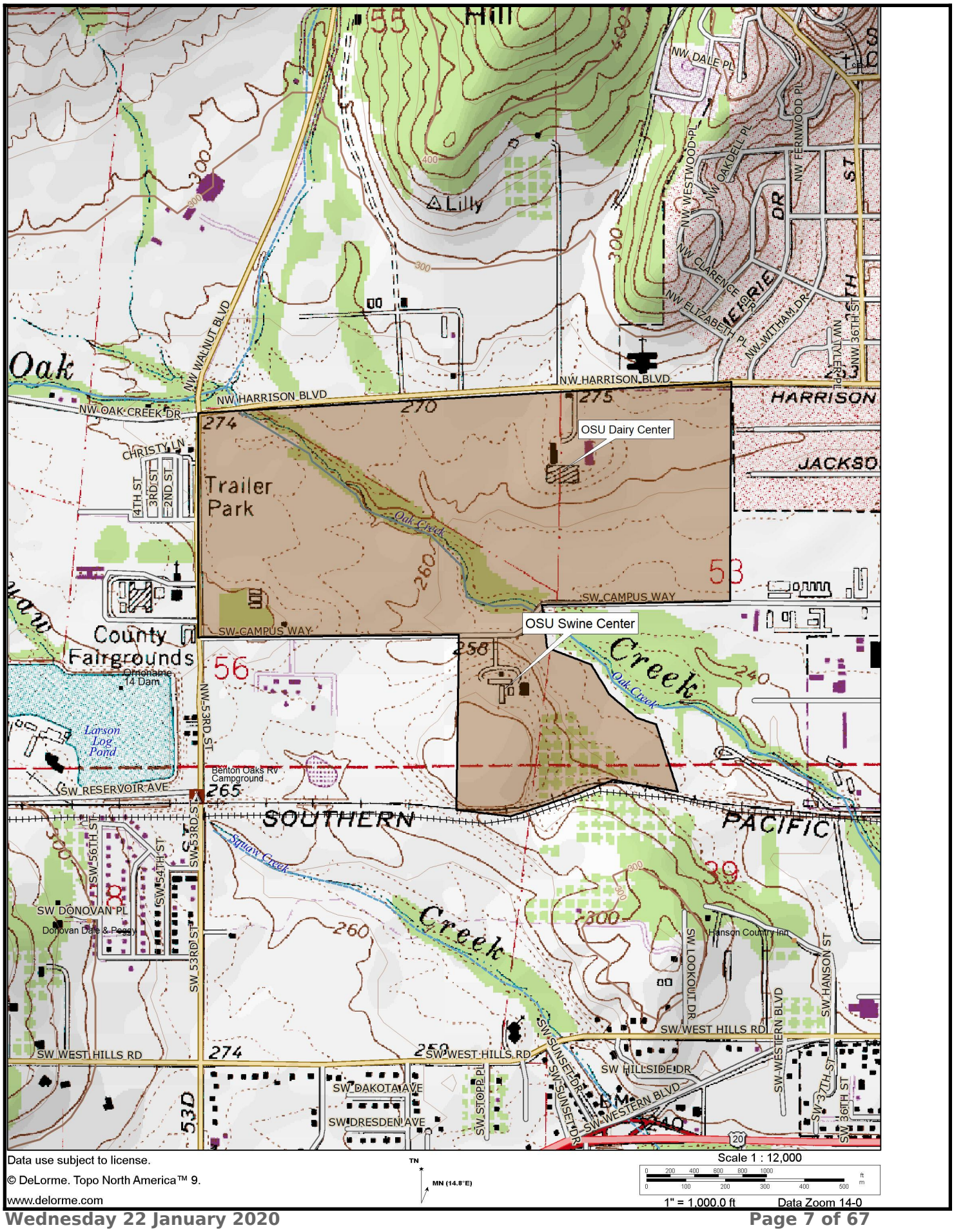
Location Map #3



GENERAL INFORMATION

Topographical Maps for OSU Dairy & Swine Centers

Topographical Map #2



Animal Mortality

To decrease non-point source pollution of surface and ground water resources, reduce the impact of odors that result from improperly handled animal mortality, and decrease the likelihood of the spread of disease or other pathogens, approved handling and utilization methods shall be implemented in the handling of normal mortality losses.
Animal mortalities must be handled in accordance to ORS 601.140 to prevent the discharge of pollutants to state waters. Animal mortalities will be managed to ensure that they are not disposed of in a liquid manure, storm water, process waste water storage or treatment system, or that is not specifically designed to treat animal mortalities.
Under no circumstances are animal mortalities to be disposed of in any type of liquid manure storage facility.
Guidance for Proper Management of Dead Animals
Refer to Plan for Catastrophic Animal Mortality Handling for guidance on what steps to take for a catastrophic animal mortality event. Having dead animals sent to an acceptable disposal site is the best method to deal with animal mortalities. A list of landfills and phone numbers can be found on the internet at http://www.deq.state.or.us/lq/sw/disposal/permittedfacilities.html. If a local landfill is not permitted to accept animal carcasses, the Oregon Department of Environmental Quality (DEQ) may grant an exception. Phone numbers to local DEQ offices can be found in most phone books or on the internet at http://www.deq.state.or.us/about/locations.html.

Under no circumstances are animal mortalities to be disposed of in any type of liquid manure storage facility.

Acceptable methods and guidance for animal mortality disposal are:
Composting- Composting animal mortalities requires a composting plan be prepared and submitted to the Oregon Department of Agriculture, Natural Resources Division. A composting plan consists of a site plan drawing of the composting facility, a description of how any runoff from the facility will be contained, a description of the composting process to be used and how the compost will be used. The composting facility for animal mortalities must have a concrete floor or similar impervious surface to prevent nutrient leaching. A roof covering the animal mortality composting facility is recommended to control moisture added by rainfall and rainfall runoff. Assistance to develop a composting plan is available from the Natural Resources Division of the Oregon Department of Agriculture, (503) 986-4700. A permit is also needed from the Department of Environmental Quality (DEQ) if animal mortalities will be imported from other farms for composting.
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 to 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.
CAUTION: It is unclear whether prions that are the proteins that cause Bovine Spongiform Encephalitis (BSE or Mad Cow Disease) are destroyed in the composting process. Animals showing signs of Mad Cow Disease and those with anthrax should not be composted and must be reported to the Oregon Department of Agriculture, Animal Health and Identification Division at (503) 986-4680 for guidance on disposal.
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 to 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. Compost from animal mortalities should not be applied to crops that will be consumed directly by humans. 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.

Natural Disposal- To allow nature to take its course the dead animal needs to be transported to a location at least ½ mile from any off-farm dwelling and at least ¼ 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. This method is not an acceptable means of disposal for a large number of animal mortalities or for byproducts generated during butchering.

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. The economics of incineration and availability of incineration units usually make this option undesirable. A permit is needed from the Oregon Department of Environmental Quality (DEQ) Air Quality program to operate an incineration unit. Contact your DEQ at (800) 452-4011 for guidance on incineration of animal carcasses.

Burial- Dead animals may be buried in accordance with ORS 601.090(7) 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.
Burial is not an acceptable method of disposal for animal byproducts generated from butchering. Burial of large numbers of animal mortalities is not acceptable unless performed in accordance with a Catastrophic Animal Mortality Management Plan. Burial of imported animal mortalities is subject to disposal regulations and the Oregon Department of Environmental Quality (DEQ), the Oregon Department of Agriculture (ODA) and the local land use planning authority should be contacted.

Plan for Catastrophic Animal Mortality Handling

The following information describes how you plan to manage catastrophic loss of animals in a manner that protects surface and ground water quality. You must follow all national, state and local laws, regulations and guidelines that protect soil, water, air, plants, animals and human health.

Guidance in the event of a catastrophic animal mortality event:
Remove animal mortalities from the livestock production area and place in an area designated for mortality storage to be determined at the time of the catastrophic event.

Contact the state veterinarian if animal death is suspicious or animal displayed unusual symptoms before death.
If it is determined that a disease outbreak may be eminent, implement procedures as directed by the State Veterinarian. This may include killing exposed animals, burning carcasses and burial of ashes in a predetermined catastrophic mortality burial areas.
Refer to state guidance regarding appropriate catastrophic animal mortality handling methods.

Contact Information-

Organization	**Phone Number**
Oregon Department of Agriculture Natural Resources Division 635 Capitol St. NE Salem, OR 97301-2532	(503) 986-4699 TTD- (503) 986-4762
Oregon Emergency Response System (OERS)	(800) 452-0311
Oregon State Veterinarian USDA APHIS 530 Center Street NE, Suite 335 Salem, OR 97301	(503) 378-4710 (503) 399-5871 Fax- (503) 399-5607

Operation and Maintenance Considerations

Wastewater Collection Tanks-

The wastewater collection tanks are used to collect and temporarily store wastewater containing manure generated by the farm. Wastewater temporarily stored in the dairy center wastewater collection tank is periodically pumped to the long term wastewater storage facility. Wastewater stored in the swine center wastewater collection tank is periodically pumped to the hay and pasture fields in accordance with guidance given in the utilization area section. Any annual buildup of solids in the wastewater collection tanks must be removed to maintain design capacity and applied to land application areas in accordance with guidance given in the utilization area section.

Inspect the collection tanks weekly to insure structural integrity. If the structural integrity of the tank is compromised, immediately empty the tank to determine the cause and make necessary repairs before putting the tank back into service. For tanks that develop minor seeps or leaks visible on the exterior, the leaks must be repaired to maintain the structural stability of the tank. Hydraulic Cement may be a viable, alternate repair method. Hydraulic Cement must be applied according to the directions provided by the cement manufacturer. Hydraulic Cement may be applied to either the inside (preferred) or outside of the tank. If repair(s) are made to the inside of the tank, the permittee should photo document the repair since it may be submerged by liquid during an inspection. If future inspections show minor leaks are still present after a repair is made using Hydraulic Cement, consult an engineer for other potential repair options.

Do not allow equipment that exceeds the design limit of the tanks on or within 20 feet of the structure.

Keep pumps, agitators, piping, valves and all other electrical and mechanical equipment in good condition by following the manufacturer’s recommendations. Maintain grounding rods and wiring for all electrical equipment in good condition. Immediately remove all foreign debris within the structure that may cause damage to pumps or agitators.

Pump the wastewater collection tanks completely empty during the summer months and cleanout any debris and other solid materials that may have accumulated in the tank. Inspect the tanks for structural damage and if structural damage to a tank is discovered seek the services of a qualified engineer to assess the damage and recommend necessary repairs before putting the tank back into service. Follow the guidance given in nutrient management section when applying wastewater to fields.

Do not dispose of animal carcasses in the wastewater collection tanks. It is against the law to do so.

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. Maintain lids, grates and shields on openings.

Provide proper ventilation before entering a tank, for any reason what so ever. Provide and use self - contained breathing apparatus (scuba) equipment when entering a tank. No persons should enter the tank unless safety ropes are used and someone else capable of providing rescue assistance is outside the tank.

Do not assume any tank, including open top tanks, are well ventilated.

Wastewater Storage Tanks-

The wastewater storage tanks are used to collect and store wastewater containing manure generated by the farm. Emptying of the wastewater storage tank should begin in the spring and continue through the spring and summer months as weather conditions permit applying wastewater in accordance with the guidance given in the utilization area section. To function properly and have the greatest management flexibility, the wastewater storage tanks must be as empty as possible in the fall before the fall and winter rainy season begins. Any annual buildup of solids in a wastewater storage tank must be removed to maintain design capacity and applied to land application areas in accordance with guidance given in the utilization area section.

Inspect all tanks weekly to insure structural integrity. If the structural integrity of a tank is compromised, immediately empty the tank to determine the cause and make necessary repairs before putting the tank back into service. Inspect the collection tank weekly to insure structural integrity. If the structural integrity of the tank is compromised, immediately empty the tank to determine the cause and make necessary repairs before putting the tank back into service. For tanks that develop minor seeps or leaks visible on the exterior, the leaks must be repaired to maintain the structural stability of the tank. Hydraulic Cement may be a viable, alternate repair method. Hydraulic Cement must be applied according to the directions provided by the cement manufacturer. Hydraulic Cement may be applied to either the inside (preferred) or outside of the tank. If repair(s) are made to the inside of the tank, the permittee should photo document the repair since it may be submerged by liquid during an inspection. If future inspections show minor leaks are still present after a repair is made using Hydraulic Cement, consult an engineer for other potential repair options.

Do not allow equipment that exceeds the design limit of the tanks on or within 20 feet of the structure.

Inspect all uncovered tanks on a biweekly basis to insure at least 12 inches of freeboard is being maintained to accommodate excess rainfall such as a 25 year-24hour storm and prevent overtopping of the tank.

Keep pumps, agitators, piping, valves and all other electrical and mechanical equipment in good condition by following the manufacturer’s recommendations. Maintain grounding rods and wiring for all electrical equipment in good condition. Immediately remove all

foreign debris within the structure that may cause damage to pumps or agitators.

Pump the wastewater storage tanks completely empty during the summer months and cleanout any debris and other solid materials that may have accumulated in the tanks. Inspect the tanks for structural damage and if structural damage to a tank is discovered seek the services of a qualified engineer to assess the damage and recommend necessary repairs before putting the tank back into service. Follow the guidance given in utilization area section when applying wastewater to fields.

Do not dispose of animal carcasses in any wastewater storage tank. It is against the law to do so.

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. Maintain lids, grates and shields on openings.

Provide proper ventilation before entering the tank, for any reason what so ever. Provide and use self - contained breathing apparatus (scuba) equipment when entering a tank. No persons should enter the tank unless safety ropes are used and someone else capable of providing rescue assistance is outside the tank.

Do not assume any tank, including open top tanks, are well ventilated.

Solids Storage Facility-

The solids storage facility used to store solids containing manure generated by the operation. Emptying of the solids storage facility should begin in the spring and continue through the spring and summer months as weather conditions permit applying solids in accordance with the guidance given in the utilization area section. To function properly and have the greatest management flexibility, the solids storage facility must be as empty as possible in the fall before the fall and winter rainy season begins.

Periodically inspect concrete and asphalt slabs, walls and curbs and repair or replace broken sections as needed. For structures that develop minor seeps or leaks visible on the exterior, the leaks must be repaired to maintain the structural stability of the structure. Hydraulic Cement may be a viable, alternate repair method. Hydraulic Cement must be applied according to the directions provided by the cement manufacturer. Hydraulic Cement may be applied to either the inside (preferred) or outside of the structure. If repair(s) are made to the inside of the structure that may not be visible at a later date, the permittee should photo document the repair since it may not be visible during an inspection. If future inspections show minor leaks are still present after a repair is made using Hydraulic Cement, consult an engineer for other potential repair options.

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 modification(s) to prevent reoccurring structural failure is essential.

Fences-

Do not allow livestock access to open water courses and drainageways. 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.

Irrigation Systems-

Maintain sprinkler irrigation systems in accordance with the manufacturer’s recommendations to help ensure trouble free operation. Prevent livestock access to equipment during operation.

Clean plugged nozzles and replace if worn or defective.

Promptly repair all leaks by replacing valves, fittings, gaskets, worn or damaged parts.

Prompt repair or replacement of damaged or worn components is necessary. Check to make sure all application components i.e. water control structures, gates, valves, ditches, etc. are functional and are in good operating condition.

Maintain screening and filtering facilities.

Maintain vigorous vegetative growth where applicable.

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 by 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 signs 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 activity.

Pumps-

Operate and maintain pumps in accordance with good judgment and manufacture’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 manufacture’s manual and recommendations. Inspect all plumbing annually as a minimum.

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

Solid/Liquid Separation Facility-

Inspect the solid/liquid separation facility daily to ensure the facility is operating properly and there has been no damage to structural components. Clean screens and outlets if they have become clogged or their capacity is not adequate for proper operation of the facility.

Prevent any spillage or leakage onto roadways when transferring solids from the solid/liquid separation facility to the solids storage area and to utilization areas.

Well(s)-

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.

Do not allow any foreign debris to accumulate and maintain soil and vegetative covering in the immediate vicinity of the well.

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 with 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-

PRODUCTION AREA

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.

PRODUCTION AREA

Production Area Maps for OSU Dairy & Swine Centers

Production Area Map

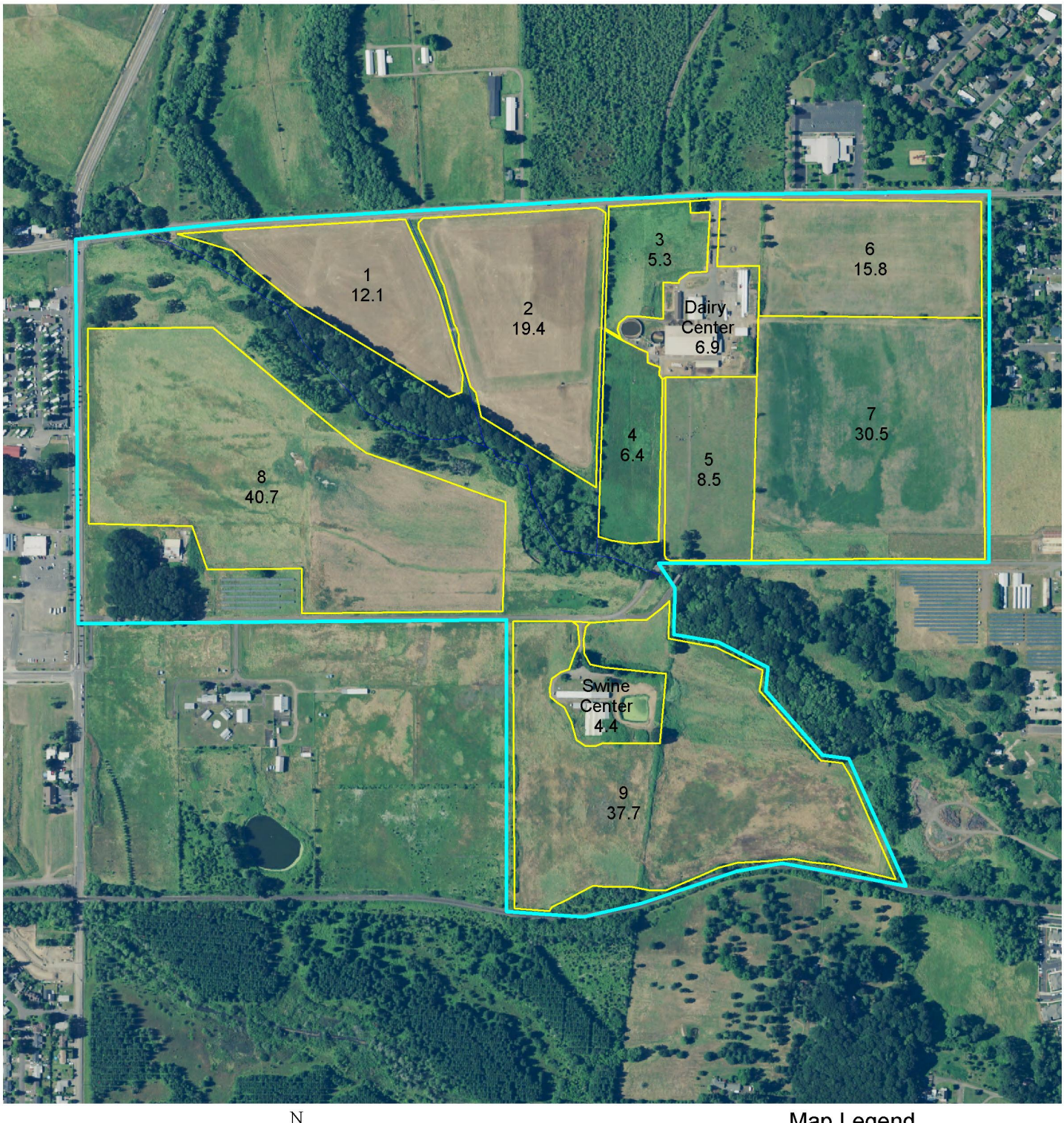
PRODUCTION AREA

Production Area Map

Field Maps for OSU Dairy & Swine Centers

Field(s) Map #3

OSU Dairy & Swine Center



N
W E
S

Scale 0 500 1000 1500 Feet

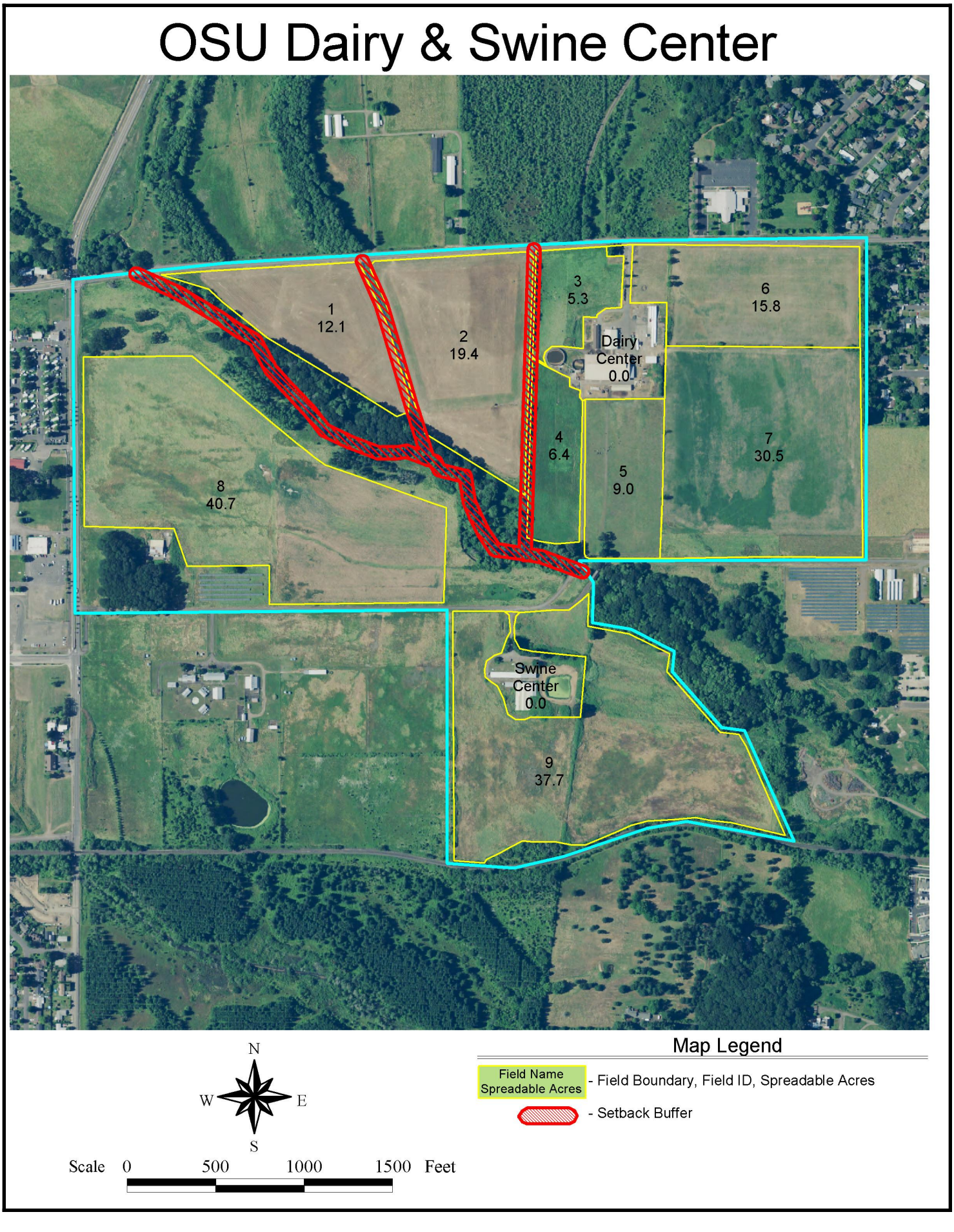
Map Legend

Field Name
Acres - Field Boundary, Field Name, Acres

UTILIZATION AREA

Setback Maps for OSU Dairy & Swine Centers

Setback Map #2



Application Considerations

The manure and irrigation application systems will be calibrated in accordance with guidance in this section to insure the applications of manure, bedding and runoff from the waste storage facilities are in accordance with agronomic rates.

No application of wastewater or solids containing manure is to be made to the field buffer areas shown on the Setback Map in Section 3-2. Applications of wastewater and solids containing manure should be made in accordance with guidance in this section to reduce the risk of contaminated runoff to surface water sources and leaching of contaminants to ground water sources.

The phosphorus runoff rating for each of the farm fields is based on the Oregon Natural Resources Conservation Service Phosphorus Index and is shown in the table in Section 4-3. Wastewater, solids and commercial fertilizer for any field with a LOW runoff rating can be applied on a nitrogen basis. Wastewater, solids and commercial fertilizer for any field with a MEDIUM or HIGH runoff rating must be applied on a phosphorus basis. No applications of manure or commercial fertilizer containing phosphorus are to be made on a field with a ZERO OUT phosphorus runoff rating.

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.

Consider using T-Sum 200 to determine when manure applications are to begin as long as you can comply with all other permit and AWMP requirements. Calculations for T-Sum 200 are outlined in OSU Extension Fertilizer Guide for Pastures (OSU FG63, 2000). T-Sum 200 is based on accumulated heat units and is an accurate guide to estimate plant activity. Research has shown that T-Sum 200 is the earliest date when plant roots begin to grow in the spring and thus are receptive to applied nutrients.

Surface air temperature is monitored and the daily minimum and maximum air temperatures are summed and divided by two to get the average daily air temperature then converted to centigrade (F degrees minus 32 times 0.556). Manure applications may begin once 200 heat units have been accumulated. However, one must still apply manure at agronomic rates based on the estimated growth potential of the crop and anticipated climatic events.

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.

Be aware of the location of sensitive areas, concerns of neighbors or concerns of the public, which require special application procedures. To reduce odor problems, apply

wastewater and solids containing manure in mid-morning when temperatures are warming and air is rising rather than in the afternoon or evening when air is cooling and settling. Avoid applications during periods of fog.
Calibrate application equipment to insure uniform distribution and accurate application rates in accordance with guidance given in the Considerations for Manure Applications and with guidance on the calibration of application equipment.

Maintain setbacks for manure application from any surface waters. The management goal is not to allow manure to enter surface waters at any time. The following table shows **minimum setback requirements** for manure applications:

Manure Type	Application Equipment	Month and Setback Distance in Feet [a, b] Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Liquid	Big gun	100	100	100	35	35	35	35	35	35	100	100	100
Liquid	Spreader Bar	100	100	35	35	35/10[c]	10	10	10	35	100	100	100
Liquid	Tank Wagon	100	100	35	35	35/10[c]	10	10	10	35	100	100	100
Liquid	Tanker Truck	100	100	35	35	35/10[c]	10	10	10	35	100	100	100
Solid	Spreader	100	100	35	35	35/10[c]	10	10	10	35	100	100	100

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.
c. This is a floating date and should be evaluated based on current weather conditions and forecast information.

Record applications, transfers or exports of nutrients (manure and fertilizer) and maintain them for at least 5 years. The CAFO Recordkeeping Calendar or other acceptable record keeping systems can be used to record this information.

CONSIDERATIONS FOR DRY SEASON MANURE APPLICATIONS:

Apply wastewater and solids containing manure at agronomic rates using the following guidelines:
Consider using T-Sum 200 as a guideline to begin making manure applications.
Do not apply to soils immediately before or during rainfall events that are expected to result in saturated soils or surface runoff.
Apply to land being prepared for crops. Till manure into soil within 3 days of application if possible or apply to actively growing crops such as grass, clover or alfalfa after cutting.
Maintain the setback buffer distances described in this section and shown on the Setback Map when making applications of liquids or solids containing manure.
Record applications, transfers or exports of nutrients (manure and fertilizer) and maintain them for at least 5 years. The CAFO Recordkeeping Calendar or other acceptable record keeping systems can be used to record this information.

CONSIDERATIONS FOR LATE 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 distances described in this section and shown on the Setback Map when making applications of liquids or solids containing manure.
- Do not apply to soils immediately before or 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 or Rare.
- Do not apply to slopes greater than 5%. See the Soil Map in Section 4-1 for the location of soil map units with slopes greater than 5%.
- 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 surface water sources.
- Apply to fields of established hay, pasture or fields containing at least 90% cover and are the furthest from open water sources.
- Do not apply wastewater or solids containing manure within 200 feet of surface water sources, drainageways, wells, or inlets to subsurface drainage systems.
- 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. The CAFO Recordkeeping Calendar or other acceptable record keeping systems can be used to record this information.
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 planned in the nutrient budget for the fields.

HOW TO CALIBRATE APPLICATION EQUIPMENT
Calibration of application equipment is a critical part of nutrient management. Calibration should be completed at least annually to insure manure and fertilizer will be uniformly applied. There are two basic approaches for calibrating a manure spreader – the load area and the weight area methods. The load area method is more accurate and can be used for both liquid and solid manure. The weight area method works only with solid or semi-solid manure.

Irrigation System Calibration

Place 3-5 buckets throughout the irrigation spray pattern and collect samples while operating the pump at a given rpm and pressure (for a traveling gun record the travel speed also). At the end of the planned sample period measure the amount of liquid collected in inches (average the samples). The following chart shows how many gallons per acre applied per inch of liquid applied:

Inches Liquid Manure Applied	**Gallons per Acre**
0.20	5,431
0.30	8,146
0.40	10,862
0.50	13,577
0.75	20,366
1.00	27,154
1.25	33,943
1.50	40,731

Soft Hose Injection System with Irrigation Hose:

Alternative 1. Use a flow meter mounted on the injector system and calculate the distance and width to determine amount applied over a measured area. Example the flow meter measures 1,000 gallons over a distance of 600 feet and 10 feet wide.

Formula: Application Rate (7,260 gallons/acre) = (Gallons Applied (1,000 gal) X 43,560 sq. ft/acre) divided by (Distance traveled (600 ft) X Application width (10 ft))

Alternative 2. (Requires a 10-20 gallon graduated measuring container)

Step 1) In the field, measure the flow out of one injector for 5 seconds into the graduated measuring container and record gallons, repeat three (3) times and average the results.

Step 2) Multiply the average amount collected from one injector by the number of injectors (equals amount applied for the whole system for 5 seconds).

Step 3) Multiply the results of Step 2 times 12 to get gallons per minute.

Step 4) Place the injector in the soil at the planned depth and operating speed and record the distance traveled in 1 minute (average 3 different measurements).

Step 5) Determine the effective application width (number of injectors X injector spacing in feet).

Step 6) Multiply the effective width times the distance traveled in 1 minute (this gives the square feet covered in 1 minute).

Step 7) Divide the result of Step 6 by 43,560 (this gives the acres covered in 1 minute).

Step 8) Divide the results of Step 3 (gallons per minute) by the results of Step 7 (acres covered in 1 minute) - (this gives the gallons applied per acre.

For example:

Step 1) Collect an average of 6 gallons from one injector for 5 seconds.

Step 2) Applicator has 8 injectors (8 injectors X 6 gallons per injector = 48 gallons for 5 seconds)

Step 3) 48 gallons in 5 seconds X 12 = 576 gallons/minute applied

Step 4) Average distance covered in 1 minute was 250 feet

Step 5) Average width of the applicator is 12 feet.

Step 6) 12 feet wide X 250 feet long = 3000 square feet

Step 7) 3000 square feet divided by 43,560 square feet/acre = .0688 acres covered in 1 minute

Step 8) 576 gallons/minute divided by .0688 acres/minute = 8,372 gallons/acre.

Manure Spreader/Tanker Calibration

There are several methods that can be used to calibrate the application rate of a manure spreader. The two best methods are the load-area method and the weight-area method. It is desirable to repeat the calibration procedure 2 to 3 times and average the results to establish a more accurate calibration. Before calibrating a manure spreader, the spreader settings such as splash plates should be adjusted so that the spread is uniform. Most spreaders tend to deposit more manure near the middle than at the edge of the spread pattern. Overlapping can make the overall application more uniform. Calibrating application rates when overlapping is involved requires measuring the width of two spreads and dividing by two to get the effective spread width.

Calibration should take place annually or whenever manure is being applied from a different source or consistency.

Load-Area Method:

The load-area method is the most accurate and can be used for both liquid and solid manure. The load area method is a 3-step process:

Step 1) Determine the amount of manure in the spreader. The most accurate way to determine the amount of manure in a spreader is weighting the spreader when it is empty and again when it is full. For a reliable estimate of spreader capacity, weigh several representative loads (at least five) to determine the average gross weight. Subtract the empty spreader weight. Then, calculate the average net loaded weight.

Step 2) Determine the area of spread using the method at the right. Width measurements near the beginning and end of the spread pattern should be avoided because the spreader may not be operating at full capacity.

Step 3) Calculate the application rate. The application rate is calculated using the formula for either liquid or solid manure.

Formula for Solid Manure Equals Tons/Acre

(Average Loaded Weight (lbs) x 21.81) divided by (Distance Traveled (ft) x Width of Spread (ft))

Formula for Liquid Manure Equals Gal/Acre

(Tank Volume (gal) x 43,560) divided by (Distance Traveled (ft) x Width of Spread (ft))

Weight-Area Method:

The weight-area method can only be used with solid or semi-solid manure. When a scale is not available, the application rate of a box spreader can be determined by collecting manure on a tarp or piece of heavy material. The weight area method is less accurate than the load area method.

This method consists of eight steps:

Step 1) Prepare/cut three 56-inch square tarps or pieces of heavy material (this size equals 1/2,000 of an acre). The pounds of manure collected on 56 inches square equals tons applied per acre.

Step 2) Weigh one of the clean tarps and a large bucket on a platform scale. Record the weight.

Step 3) Anchor the three tarps in the field ahead of the spreader near the beginning, middle, and end of the area that will be spread with one load.

Step 4) Drive over the three tarps at a normal speed to collect a representative manure

sample.
Step 5) Fold and place the first tarp into the empty bucket without spilling the manure.
Weigh the bucket, tarp, and manure. Subtract the weight of the clean tarp and bucket recorded in step 2.
Step 6) Repeat the process for each of the two remaining tarps.
Calculate the average weight (pounds) of the manure collected. This value equals tons of manure applied per acre.
Factor for converting pounds to tons and square feet to acres (21.8 = 43,560 sq ft per acre divided by 2,000 lbs/ton).
The factor for converting square feet to acres = 43,560 sq ft per acre.
Step 7) Determining Area of Spread.
The “area of spread” is the length and width of the ground covered with one load of manure. The area of spread is affected by speed and equipment settings. Spreaders discharge manure at varying rates depending on travel and PTO speed, gear box settings, and discharge openings. It is important to adjust the spreader so the pattern is as uniform as possible. Accurately measuring the length and width of this area is essential. To determine width, measure two adjacent spreads and divide by two to find the “effective” spread width. This accounts for overlap, which is often needed for a more uniform application. The length of spread is determined using the following three values:
Desired manure application rate based on soil and manure tests,
Width of the manure spread, and
Manure spreader holding capacity (weight and/or volume).
From these values, calculate the distance or lengths of spread using these formulas:
Formula: Solid Manure Equals Feet/Load
(Average Load Weight (lbs) x 21.81) divided by (Spread Width (ft) x App. Rate (tons/ac))
Formula: Liquid Manure Equals Feet/Load
(Tank Volume (gal) x 43,560) divided by (Spread Width (ft) x Desired App. Rate (gal/ac))
Step 8) Spread a load. If the distance traveled does not equal the calculated distance, adjust the speed or equipment settings.

AMOUNT OF MANURE TO APPLY FOR CROPS GROWN

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 Yield Units per Acre X actual percent (%) dry matter (DM) of harvested crop/percent (%) dry matter (DM) from table

Total P_2O_5 to apply in pounds = P in pounds per yield unit from the table for the crop grown X Yield Units per Acre X 2.291 P_2O_5/P X actual percent (%) dry matter (DM) of harvested crop/percent (%) dry matter (DM) from table

Total K_2O to apply in pounds = K in pounds per yield unit from the table for the crop grown X Yield Units per Acre X 1.205 K_2O/K X actual percent (%) dry matter (DM) of harvested crop/percent (%) dry matter (DM) from table

Example- for a field with 5 tons per acre of grass/legume hay harvested at 90% dry matter:

Total N to apply in pounds per acre = (33.92 lb N / ton) X (5 tons / acre) X (90%DM / 100% DM) = 153 lbs N / acre

UTILIZATION AREA

The following tables show 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	13.93	1.30	11.57
Caneberries	ton	2000	100	11.43	7.42	11.43
Corn, Sweet	ton	2000	100	20.67	5.60	13.66
Mixed Vegetables & Fruit	ton	2000	100	8.33	2.08	10.20
Onions	cwt	100	100	0.18	0.04	0.13
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	30.0	5.45	47.27
Squash	ton	2000	100	21.33	6.80	11.40

GRAIN, SEED OR OIL CROPS

	Yield Unit	lb/Unit	% DM	Nutrient Removal (lb/yield 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
Bluegrass, Seed	cwt	100	100	2.88	0.43	1.98
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	1.97	0.20	2.00
Fescue, seed (Fine or Tall)	lb	1	100	1.47	0.31	1.67
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 & Stems Removed	ton	2000	100	87.23	36.80	57.80
Pumpkins	ton	2000	100	4.00	1.40	6.60
Rapeseed	bushels	50	100	1.38	0.30	0.30
Red Clover seed	cwt	100	100	4.55	1.00	2.00
Ryegrass seed	cwt	100	100	1.67	0.27	1.42
Ryegrass Seed, Straw Removed	Ton	2000	100	30.00	18.80	37.60
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, Hard Red, Straw Removed	ton	2000	100	53.36	10.96	23.76

UTILIZATION AREA

HAY AND PASTURE CROPS				Nutrient Removal (lb/yield unit)		
	Yield Unit	lb/Unit	% DM	N	P	K
Alfalfa, Hay	ton	2000	100	54.40	6.83	35.70
Alfalfa, Seed	cwt	100	100	6.12	0.70	2.34
Alta Fescue Hay/Pasture	ton	2000	100	32.98	6.88	37.60
Grass Legume Hay/Pasture	ton	2000	100	33.92	5.30	7.56
Meadow Fescue Hay/Pasture	ton	2000	100	41.56	8.70	47.43
Oats Hay/Pasture	ton	2000	100	26.01	10.20	14.79
Orchardgrass Hay/Pasture	ton	2000	100	53.21	8.58	18.62
Perennial Grass Hay/Pasture	ton	2000	100	58.00	8.00	40.00
Reed Canary Grass	ton	2000	100	27.00	3.57	41.57
Ryegrass Hay	ton	2000	100	33.41	5.44	28.39
Ryegrass, Perennial Pasture	ton	2000	100	58.00	8.00	48.00
Sorghum-Sudan Haylage	ton	2000	100	54.40	6.40	58.00
Tall Fescue Hay/Pasture	ton	2000	100	39.40	4.00	40.00
Vetch Hay	ton	2000	100	51.93	7.20	44.76

SILAGE AND HAYLAGE CROPS				Nutrient Removal (lb/yield unit)		
	Yield Unit	lb/Unit	% DM	N	P	K
Alfalfa/Grass Haylage	ton	2000	100	15.60	1.02	6.84
Corn for Silage	ton	2000	100	25.00	4.00	20.00
Crimson Clover forage	ton	2000	100	40.00	4.48	33.28
Field Pea, Forage	ton	2000	100	73.60	8.00	18.00
Mustard, White	ton	2000	100	38.55	0.0	0.0
Oat haylage	ton	2000	100	26.0	10.2	14.8
Oats & Peas/ Green Beans	ton	2000	100	32.03	5.58	18.65
Perennial Grass Haylage	ton	2000	100	15.00	2.40	12.78
Red Clover forage	ton	2000	100	40.00	4.41	32.98
Ryegrass Haylage	ton	2000	100	15.00	2.40	12.78
Sorghum-Sudan Haylage	ton	2000	100	16.32	1.92	17.40
Triticale Haylage	ton	2000	100	49.00	6.80	11.40
Vetch Haylage	ton	2000	100	59.67	6.57	50.00
Wheat Haylage	ton	2000	100	41.30	5.00	57.30
Wheatgrass Hay/Pasture	ton	2000	100	49.59	6.21	68.76

OTHER CROPS				Nutrient Removal (lb/yield unit)		
	Yield Unit	lb/Unit	% DM	N	P	K
Filberts	ton	2000	100	41.70	7.30	39.29
Hops, Cones	bale	200	100	9.00	0.96	5.00
Natural Area (Trees & Grass)	ton	2000	100	10.52	1.56	9.20
Nursery Stock	ton	2000	100	8.33	2.08	10.20
Poplars, Pulpwood	ton	2000	100	0.30	0.09	0.12
Hemp/Cannabis	ton	2000	100	31.09	3.37	36.23

Note: Nutrient uptake values are taken from the NRCS National Agricultural Waste Management Field Handbook and updated with more current information from the Extension Service when available. When nutrient uptake values are not available from NRCS or Extension references, then nutrient uptake data from the NRCS Plant Database or other approved data sources is used.

Nutrient Applications

Nutrient Applications Report

OSU Dairy & Swine Centers

Corvallis

1

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
04/02/2018	100 Ft Dia Tank	Traveling Big Gun	100	98,800 Gal	114	35	143
05/01/2018	Grazing activity	Dairy Heifers	100	130 CF	77	30	42
05/30/2018	100 Ft Dia Tank	Traveling Big Gun	100	62,400 Gal	72	22	90
07/01/2018	Grazing activity	Milker - Dry	100	27 CF	18	6	7
08/01/2018	Grazing activity	Milker - Dry	100	27 CF	18	6	7
08/01/2018	Grazing activity	Dairy Heifers	100	130 CF	77	30	42
				1 Totals:	375	129	331

2

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
04/27/2018	100 Ft Dia Tank	Traveling Big Gun	100	100,000 Gal	72	22	90
05/15/2018	Grazing activity	Milker - Jersey	100	121 CF	66	25	46
05/31/2018	100 Ft Dia Tank	Traveling Big Gun	100	78,000 Gal	56	17	70
10/01/2018	Grazing activity	Milker - Jersey	100	242 CF	132	50	91
				2 Totals:	326	115	298

3

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
05/01/2018	Grazing activity	Milker - Jersey	100	121 CF	241	92	167
				3 Totals:	241	92	167

4

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
07/01/2018	Grazing activity	Milker - Jersey	100	242 CF	399	153	277
				4 Totals:	399	153	277

5

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
08/01/2018	Grazing activity	Milker - Jersey	100	242 CF	284	109	197
				5 Totals:	284	109	197

6

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
06/01/2018	Grazing activity	Milker - Jersey	100	233 CF	156	60	108
09/01/2018	Grazing activity	Milker - Jersey	100	233 CF	156	60	108
				6 Totals:	312	119	217

7

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
05/01/2018	Grazing activity	Milker - Dry	100	27 CF	7	2	3
06/01/2018	Grazing activity	Milker - Dry	100	26 CF	7	2	3
06/01/2018	Grazing activity	Dairy Heifers	100	126 CF	29	12	16
07/01/2018	Grazing activity	Dairy Heifers	100	130 CF	30	12	17
10/01/2018	Grazing activity	Milker - Dry	100	27 CF	7	2	3
10/03/2018	100 Ft Dia Tank	Traveling Big Gun	100	145,400 Gal	67	21	83
10/04/2018	100 Ft Dia Tank	Traveling Big Gun	100	145,440 Gal	67	21	83
10/05/2018	100 Ft Dia Tank	Traveling Big Gun	100	72,720 Gal	33	10	42
10/08/2018	100 Ft Dia Tank	Traveling Big Gun	100	127,260 Gal	58	18	73
				7 Totals:	306	99	322

8

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
09/01/2018	Grazing activity	Milker - Dry	100	26 CF	5	2	2
09/01/2018	Grazing activity	Dairy Heifers	100	126 CF	22	9	12
10/01/2018	100 Ft Dia Tank	Traveling Big Gun	100	109,200 Gal	38	12	47
10/01/2018	Grazing activity	Dairy Heifers	100	130 CF	23	9	12
10/02/2018	100 Ft Dia Tank	Traveling Big Gun	100	181,660 Gal	62	19	78
10/09/2018	100 Ft Dia Tank	Traveling Big Gun	100	156,000 Gal	54	17	67
10/10/2018	100 Ft Dia Tank	Traveling Big Gun	100	127,260 Gal	44	13	55
				8 Totals:	247	80	273

9

Date	Source	Equipment Used	% of Field	Amount Applied	N lbs/ac	P_2O_5 lbs/ac	K_2O lbs/ac
02/05/2018	100 Ft Dia Tank	Traveling Big Gun	100	299,200 Gal	111	34	139
03/06/2018	100 Ft Dia Tank	Traveling Big Gun	100	283,963 Gal	105	32	132
03/29/2018	100 Ft Dia Tank	Traveling Big Gun	100	240,182 Gal	89	27	111
				9 Totals:	306	94	382

Sampling Guidance

Manure and Soil Sampling Frequency

For large concentrated animal feeding operations, sample liquids and solids containing manure during applications in early spring annually and have each sample analyzed for Total Nitrogen (TKN), Ammonium Nitrogen (NH_4-N), Phosphorus (P_2O_5) and Potassium (K_2O) plus percent moisture. Ask the lab to report results in pounds per ton for the solids containing manure and in pounds per thousand gallons for liquids containing manure. Analyses of solids and liquids containing manure should be performed by a laboratory that meets the requirements and performance standards of the Manure Testing Laboratory Certification Program (MTLCP), https://www.mda.state.mn.us/licensing/licensetypes/mapprogram.aspx.

For small and medium animal feeding operations, if no samples of liquids and solids containing manure have been taken, take a sample of liquids and solids during applications in early spring once a year for three consecutive years to develop a cumulative manure analysis history as a basis for nutrient allocation to the fields. If there is a sampling history of liquids and solids containing manure, take a sample of liquids and solids during applications in early spring once every 5 years or whenever a significant change in animal numbers or in the manure handling system occurs. Have each sample analyzed for Total Nitrogen (TKN), Ammonium Nitrogen (NH_4-N), Phosphorus (P_2O_5) and Potassium (K_2O) plus percent moisture. Ask the lab to report results in pounds per ton for the solids containing manure and in pounds per thousand gallons for liquids containing manure. Analyses of solids and liquids containing manure should be performed by a laboratory that meets the requirements and performance standards of the Manure Testing Laboratory Certification Program (MTLCP), https://www.mda.state.mn.us/licensing/licensetypes/mapprogram.aspx.

Large CAFO's are required to test a minimum of 20% of their fields annually which would result in all of the fields being tested once every five (%) years. Small and Medium CAFO's are only required to test all of their fields once every five (%) years. However, from a management standpoint, more frequent soil testing offers good information on the nutrient status of your soils.

Collect soil samples from 20 percent of the fields receiving solids or liquids containing manure **annually** in the fall after harvest or before rains begin(typically September 15-October 15) in accordance with **Pacific Northwest (PNW) Extension publication 570-E, "Monitoring Soil Nutrients Using a Management Unit Approach",** https://catalog.extension.oregonstate.edu/pnw570. Have the soil samples analyzed for Total Nitrogen (TKN) and Phosphorus (P) and ask the lab to report results in parts per million (ppm). Soil test analyses should be performed by laboratories that meet the requirements and performance standards of the North American Proficiency Testing Program (NAPT) Proficiency Assessment Program (PAP); http://www.naptprogram.org/pap/.

How to Sample Liquid Manure

Obtain a composite following one of the procedures listed below and thoroughly mix. Using a plunger, an up-and-down action works well for mixing liquid manure in a five-gallon bucket. Fill a one-quart plastic bottle not more than three-quarters full with the composite sample. Store sample in freezer if not delivered to the lab immediately.

Procedure 1. Sampling from storage- Agitate storage facility thoroughly before sampling. Collect at least five samples from the storage facility or during loading using a five-gallon bucket. Place a sub sample of the composite sample in a one-quart plastic container. Sampling a liquid manure storage facility without proper agitation (2-4 hrs. minimum) is not recommended due to nutrient stratification, which occurs in liquid systems. If manure is sampled from a lagoon that was not properly agitated, typically the nitrogen and potassium will be more concentrated in the top liquid, while the phosphorus will be more concentrated in the bottom solids.

Procedure 2. Sampling during application- Place buckets around field to catch manure from spreader or irrigation equipment. Combine and mix samples into one composite sub sample in a one-quart plastic container.

How to Sample Solid Manure

Collect a composite sample by following one of the procedures listed below. A method for mixing a composite sample is to pile the manure and then shovel from the outside to the inside of the pile until well mixed. Fill a one-gallon plastic heavy-duty zip lock bag approximately one-half full with the composite sample, squeeze out excess air, close and seal. Store sample in freezer if not delivered to the laboratory immediately.

Procedure 1. Sampling while loading - Recommended method for sampling from a stack or bedded pack. Take at least ten samples while loading several spreader loads and combine to form one composite sample. Thoroughly mix the composite sample and take an approximately one pound sub sample using a one-gallon plastic bag. Sampling directly from a stack or bedded pack is not recommended.

Procedure 2. Sampling during spreading - Spread a tarp in field and catch the manure from one pass. Sample from several locations and create a composite sample. Thoroughly mix the composite sample together and take a one-pound sub sample using a one-gallon plastic bag.

Procedure 3. Sampling daily haul - Place a five-gallon bucket under the barn cleaner 4-5 times while loading a spreader. Thoroughly mix the composite sample together and take a one-pound sub sample using a one-gallon plastic bag. Repeat sampling 2-3 times over a period of time and test separately to determine variability.

Procedure 4. Sampling poultry in-house - Collect 8-10 samples from throughout the house to the depth the litter will be removed. Samples near feeders and waterers may not be indicative of the entire house and sub samples taken near here should be proportionate to their space occupied in the whole house. Mix the samples well in a five-gallon pail and take a one-pound sub sample, place it in a one-gallon zip lock bag.

Procedure 5. Sampling stockpiled litter - Take ten sub samples from different locations around the pile at least 18 inches below the surface. Mix in a five-gallon pail and place a one-pound composite sample in a gallon zip lock bag.

Sample Identification and Delivery

Identify the sample container with information regarding the farm, animal species and date. This information should also be included on the sample information sheet along with application method, which is important in determining first year availability of nitrogen.

Keep all manure samples frozen until shipped or delivered to a laboratory. Ship early in the week (Mon.-Wed.) and avoid holidays and weekends.

How to Sample Soils

Current soil tests must be used in the development and editing of nutrient management plans. A current soil test is one that is no older than 5 years that is used to represent the nutrient status of the entire field. Soil analysis must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP). Results of these analysis will be used to determine application rates for manure, litter, and process wastewater. Guidance for soil sampling can be found in the **Pacific Northwest (PNW) Extension publication 570-E, "Monitoring Soil Nutrients Using a Management Unit Approach"**, https://catalog.extension.oregonstate.edu/pnw570. **Oregon State University Extension publication EC1478, "Soil Test Interpretation Guide",** https://catalog.extension.oregonstate.edu/ec1478 provides guidance on how to determine soil nutrient concentrations and how to adjust soil pH to improve nutrient availability.

Field Area. A composite soil sample should represent a uniform field area. Each area should have similar crop and fertility history. Soil characteristics (color, slope, texture, drainage) should be similar. Exclude small areas within a field that are obviously different. The field area represented by a single composite sample should represent no more than 40 irrigated acres or 100 dry land acres.

Sampling Depth. Laboratory tests are calibrated to specific depths. It is vital to collect samples from appropriate depths. Sampling depth for most soils is the rooting depth in 6-inch intervals. In Oregon, as a minimum, soil samples should be collected from the 0-12" depth. The 0-6" surface soil samples are normally used for conventional tests of organic matter, nitrogen, phosphorus, potassium, pH and salt levels. Additionally, subsurface samples from the 6-24" depth are needed to estimate nitrogen availability for crops grown in dry land areas.

Post Harvest Soil Testing for Evaluating Nutrient Applications. Refer to **Pacific Northwest (PNW) Extension publication 570-E, "Monitoring Soil Nutrients Using a Management Unit Approach"**, https://catalog.extension.oregonstate.edu/pnw570, for guidance on how to evaluate nutrient applications and crop uptake of nutrients.

Manure Tests

Nutrient Analysis Report

OSU Dairy & Swine Centers

Corvallis

Sample Date	Storage Name	Units	Total N	P_2O_5	K_2O	NH_4-N	NO_3-N	Org N	Density Lbs/CF
03/06/2014	Solids Stack	lbs/Ton	9.89	4.45	6.43	4.0	null	5.89	36.0
03/06/2014	Harvestore Tank	lbs/1000gal	8.95	4.09	6.34	3.0	null	5.95	62.0
03/06/2014	100 Ft Dia Tank	lbs/1000gal	8.95	4.09	6.34	3.0	null	5.95	62.0
02/24/2017	Solids Stack	lbs/Ton	9.89	4.45	6.43	4.0	0.0	5.89	36.0
02/24/2017	Harvestore Tank	lbs/1000gal	8.95	4.09	6.34	3.0	0.0	5.95	62.0
02/24/2017	100 Ft Dia Tank	lbs/1000gal	8.95	4.09	6.34	3.0	0.0	5.95	62.0
08/22/2019	100 Ft Dia Tank	lbs/1000gal	14.0	4.31	17.5	7.0	0.31	6.69	62.0
01/01/2018	Swine Center Tank	lbs/1000gal	14.0	4.31	17.5	7.0	0.31	6.69	62.0
01/01/2018	100 Ft Dia Tank	lbs/1000gal	14.0	4.31	17.5	7.0	0.31	6.69	62.0
08/22/2019	Harvestore Tank	lbs/1000gal	14.0	4.31	17.5	7.0	0.31	6.69	62.0

Soil Tests

Soils Testing Report

OSU Dairy & Swine Centers

4490 NW Harrison Boulevard, Corvallis

1

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
9/4/2016	OSU Lab		12.0	6.1	6.9				147.0		463.0													
11/21/2018	OSU Lab	GP219143	12.0	6.72	6.92		2.63		35.3		237.0	1.8 meq	3.7 meq		24.5 ppm			0.4	3.8	77.6	3.0	133.4		

2

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
9/4/2016	OSU Lab		12.0	6.1	6.8				100.0		436.0													
11/21/2018	OSU Lab	GP219143	12.0	5.92	6.15		9.27		11.1		189.0	0.8 meq	1.5 meq		49.2 ppm			0.4	0.9	27.8		52.9		

3

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
9/4/2016	OSU Lab		12.0	5.7	6.5				42.0		426.0													
11/21/2018	OSU Lab	G219143	12.0	5.86	5.9		7.58		14.2		146.0	3.4 meq	5.2 meq		23.1 ppm			50.3	2.5	54.9		285.5		

4

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
9/4/2016	OSU Lab		12.0	5.3	6.3				131.0		164.0													
11/21/2018	OSU Lab	G219143	12.0	5.68	6.13		7.31		7.9		317.0	3.1 meq	4.0 meq					50.5	1.4	53.7		256.8		

5

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
9/4/2016	OSU Lab		12.0	5.9	6.5				106.0		88.0													
11/21/2018	OSU Lab	G219143	12.0	5.47	6.26		6.23		22.1		173.0	4.2 meq	4.8 meq					50.3	2.6	26.9	2.9	235.6		

6

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
9/4/2016	OSU Lab		12.0	6.2	6.8				45.0		309.0													
11/21/2018	OSU Lab	G219143	12.0	5.37	6.08		5.81		12.7		83.0	3.8 meq	4.1 meq					50.2	1.4	20.1	3.5	228.6		

7

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
9/4/2016	OSU Lab		12.0	6.0	6.9				148.0		732.0													
11/21/2018	OSU Lab	G219143	12.0	5.47	6.26		6.23		22.1		173.0	4.2 meq	4.8 meq					50.3	2.6	26.9	2.9	235.6		

8

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
11/21/2018	OSU Lab	G219143	12.0	6.72	5.92		2.63		35.3		237.0	1.8 meq	3.7 meq		24.5 ppm			0.4	3.8	77.6	3.0	133.4		

9

Test Date	Lab #	Sample ID	Depth	pH	BpH	SS (ppm)	OM %	Ex Carb	Bray P	Olsen P	K (ppm)	Mg	Ca	Na	NO3-N	NH4-N	S (ppm)	B (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Fe (ppm)	Al (ppm)	Cl (ppm)
11/21/2018	OSU Lab	G219143	12.0	5.86	5.9		7.58		14.2		146.0	3.4 meq	5.2 meq		23.1 ppm			50.3	2.5	54.9	4.0	285.5		

Soil test analyses should be performed by laboratories that meet the requirements and performance standards of the North American Proficiency Testing Program (NAPT) Proficiency Assessment Program (PAP);
http://www.naptprogram.org/pap/

Nutrient Balances

Nutrient Balances Report

OSU Dairy & Swine Centers

Corvallis

Field	Acres	Crop	Yield	Nutrient Uptake (lbs/ac)			Nutrient Applied (lbs/ac)			Nutrient Balance (lbs/ac)		
				N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1	12.1	Grass Hay/Pasture	7 Ton	409	129	340	375	295	398	(-34)	166	59
2	19.4	Grass Hay/Pasture	5.9 Ton	328	110	271	326	264	359	(-2)	153	88
3	5.3	Grass Hay/Pasture	4.6 Ton	269	85	224	241	211	202	(-28)	126	(-22)
4	6.4	Grass Hay/Pasture	7.2 Ton	419	132	348	399	350	334	(-20)	217	(-14)
5	9.0	Grass Hay/Pasture	4.9 Ton	286	90	238	284	249	238	(-3)	158	(-0)
6	15.8	Grass Hay/Pasture	5.6 Ton	326	103	271	312	273	261	(-15)	170	(-10)
7	30.5	Grass Hay/Pasture	5.7 Ton	332	105	276	306	228	389	(-26)	123	113
8	40.7	Grass Hay/Pasture	4.6 Ton	267	84	222	247	183	329	(-19)	99	108
9	37.7	Grass Hay/Pasture	5.5 Ton	319	101	265	306	216	461	(-13)	115	195

Export Nutrient History

Exports Report

OSU Dairy & Swine Centers

Corvallis

Storage	Date Exported	Quantity		Analysis Available	Total N	P_2O_5	K_2O	Target
Solids Stack	01/25/2018	6.0	Loads	Yes	202	91	131	Jones Farm
Solids Stack	02/20/2018	30.0	Loads	Yes	1,009	454	656	Jones Farm
Solids Stack	04/26/2018	30.0	Loads	Yes	1,009	454	656	Grass Seed Field
Solids Stack	09/26/2018	35.0	Loads	Yes	1,178	530	766	Grass Seed Field
Sub Totals:		101	Loads		3,398	1,529	2,209	
Totals:		101	Loads		3,398	1,529	2,209	

Cropping History

Cropping Report

OSU Dairy & Swine Centers

Corvallis

Planted	Field	Acres	Crop	Yield	Nutrient Uptake (lbs/ac) N	P_2O_5	K_2O
01/01/2018	1	12.1	Grass Hay/Pasture	3 Ton	58	18	48
	1 Totals:				58	18	48
01/01/2018	2	19.4	Grass Hay/Pasture	5 Ton	58	18	48
	2 Totals:				58	18	48
01/01/2018	3	5.3	Grass Hay/Pasture	3 Ton	58	18	48
	3 Totals:				58	18	48
01/01/2018	4	6.4	Grass Hay/Pasture	4.5 Ton	58	18	48
	4 Totals:				58	18	48
01/01/2018	5	9.0	Grass Hay/Pasture	3 Ton	58	18	48
	5 Totals:				58	18	48
01/01/2018	6	15.8	Grass Hay/Pasture	3.5 Ton	58	18	48
	6 Totals:				58	18	48
01/01/2018	7	30.5	Grass Hay/Pasture	4 Ton	58	18	48
	7 Totals:				58	18	48
01/01/2018	8	40.7	Grass Hay/Pasture	3.5 Ton	58	18	48
	8 Totals:				58	18	48
01/01/2018	9	37.7	Grass Hay/Pasture	5.5 Ton	58	18	48
	9 Totals:				58	18	48

Irrigation Water Management

The application of Irrigation Water Management to the irrigated fields as shown on the Field Map will manage soil moisture to promote the desired crop response, optimize the available water supplies, minimize irrigation induced erosion, decrease non-point source pollution of surface and groundwater sources, manage salts in the crop root zone and manage the crop micro climate.

Permits: Under Oregon law all water is publicly owned, and anyone planning to store or divert surface or groundwater for the purpose of irrigation must obtain a permit or water right from the Oregon Water Resources Department. These permits or water rights must be obtained prior to the use of the water. It is the responsibility of the Farmer to file for the necessary permits or water rights. More information about Oregon water rights can be found at http://www.oregon.gov/owrd/Pages/wr/index.aspx.

The irrigation system used to irrigate crops should be adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, etc.) and capable of applying water and wastewater to meet the consumptive use of the crop. The following table shows the estimated Available Water Holding Capacity (AWHC) and sprinkler intake rates by soil texture that should be considered in the design of the irrigation system.1/

Symbol	Soil Texture	AWHC Range (in/in)	Sprinkler Intake Rate Range (in/hour)
COS	Coarse Sand	0.01-0.03	1.0+
S	Sand	0.01-0.03	0.5+
FS	Fine Sand	0.05-0.07	0.5+
VFS	Very Fine Sand	0.05-0.07	0.5+
LCOS	Loamy Coarse Sand	0.06-0.08	1.0+
LS	Loamy Sand	0.06-0.08	0.4-1.5
LFS	Loamy Fine Sand	0.09-0.11	0.4-1.5
LVFS	Loamy Very Fine Sand	0.10-0.12	0.3-1.25
COSL	Coarse Sandy Loam	0.10-0.12	0.3-1.25
SL	Sandy Loam	0.11-0.13	0.3-1.25
FSL	Fine Sandy Loam	0.13-0.15	0.3-1.0
VFSL	Very Fine Sandy Loam	0.15-0.17	0.3-1.0
L	Loam	0.16-0.18	0.6-0.7
SIL	Silt Loam	0.19-0.21	0.5-0.7
SI	Silt Loam	0.16-0.18	0.5-0.7
SCL	Sandy Clay Loam	0.14-0.16	0.1-0.5
CL	Clay Loam	0.19-0.21	0.1-0.5
SICL	Silty Clay Loam	0.19-0.21	0.1-0.4
SC	Sandy Clay	0.15-0.17	0.1-0.4
SIC	Silty Clay	0.15-0.17	0.1-0.2
C	Clay	0.14-0.16	0.1-0.2

1/ Values in this table are taken from the Natural Resources Conservation Service National Engineering Handbook, Part 652, Irrigation Guide and are estimates based on soil texture and should only be used where local data is unavailable.

Irrigation water management requires knowledge, skills, and desire to determine when irrigation water should be applied. The main factors influencing IWM are irrigation interval (time between irrigations), irrigation set time (time water is applied), and application rate (rate at which water is applied). These parameters define the timing and duration of irrigation and the amount of water applied. System design and maintenance are also important factors influencing irrigation water management.

UTILIZATION AREA

Guidance given in the irrigation water requirements worksheets was developed based on Oregon State University Extension Miscellaneous 8530, Oregon Crop Water Use and Irrigation Requirements publication. For additional information on irrigation water management contact a professional with the required knowledge and skill. The following average monthly evapotranspiration and precipitation graphs can be used to estimate when to irrigate and how much to apply:

UTILIZATION AREA

Irrigation Water Flows, Volumes, and Relationships

Equation 1 -

$$Q \times T = D \times A$$

wher

Q = flow rate (acre-in/hr or cfs)
T = time (hr)
D = gross depth applied (in)
A = area (acres)

Equation 2 -

$$Q = \frac{453 \times A \times}{F \times H}$$

wher

Q = flow rate (acre-in/hr or cfs)
A = area (acres)
D = gross depth applied (in)
F = irrigation period (days)
H = Hours of operation per

Water Flow

1 cubic foot per second (cfs)
= 448.8 gallons per minute
1 cfs for 1 hour = 0.99 acre-inch
1 cfs for 24 hr = 1.98 acre-ft
1,000 gpm = 2.23 cfs
1,000 gpm for 24 hr = 4.42 ac-ft
1 gpm/acre =0.053 ac-in/ac/day
1 cfs = 40 miner's inches in OR, No CA
1 cfs = 50 miner's inches in ID, WA

1 miner's inch = 11.22 gpm in OR
1 miner's inch = 9 gpm in ID, WA
1 cfs = 28.32 liters/sec
1 cubic meter/sec = 35.3 cfs
1 liter/sec = 15.85 gpm

Q x T = D x where:

Q = cfs, T = hr, D = inches depth; A =

Gpm for 5 ft/s velocity in PVC pipe:

6"	8"	10"	12"	14"
480	800	125	175	215

Water Volumes & Weights:

1 cubic foot = 7.48 gallons
= 62.4 lbs = 28.3 liters
1 acre-foot = 43,560 cubic feet
(1 acre covered 1 ft deep)
12 acre-in = 1 acre-ft = 325,829 gal
1 million gallons = 3.07 acre-ft
1 acre-ft = 1,234 cubic meters
1 cu meter = 1,000 liters = 35.3 cu ft

Pressure and Pressure Head:

1 psi = 2.31 ft of pressure head
1 atmosphere (sea level)
= 14.7 psi = 33.9 ft of head

Lengths and Areas:

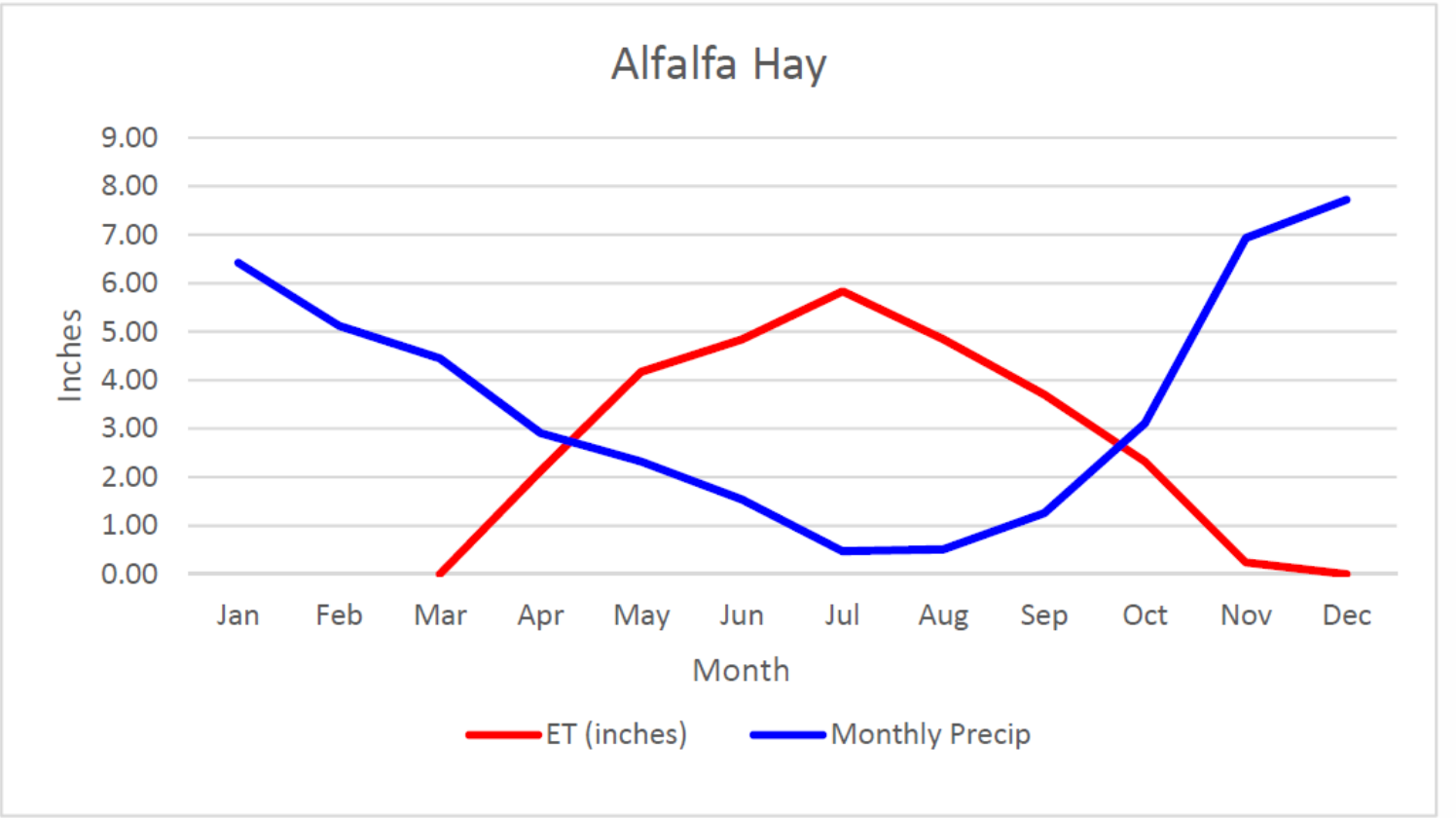
1 mile = 5,280 ft = 1.61 km
1 meter = 3.28 ft = 39.37 inches
1 acre = 43,560 square ft
1 hectare = 2.47 acres

Pump Power Requirement

$$Horsepower = \frac{Pump\ \ Head\ \ in\ \ ft\ \ x\ \ gpm}{39.6 \times \%\ Pump\ \ Efficiency}$$

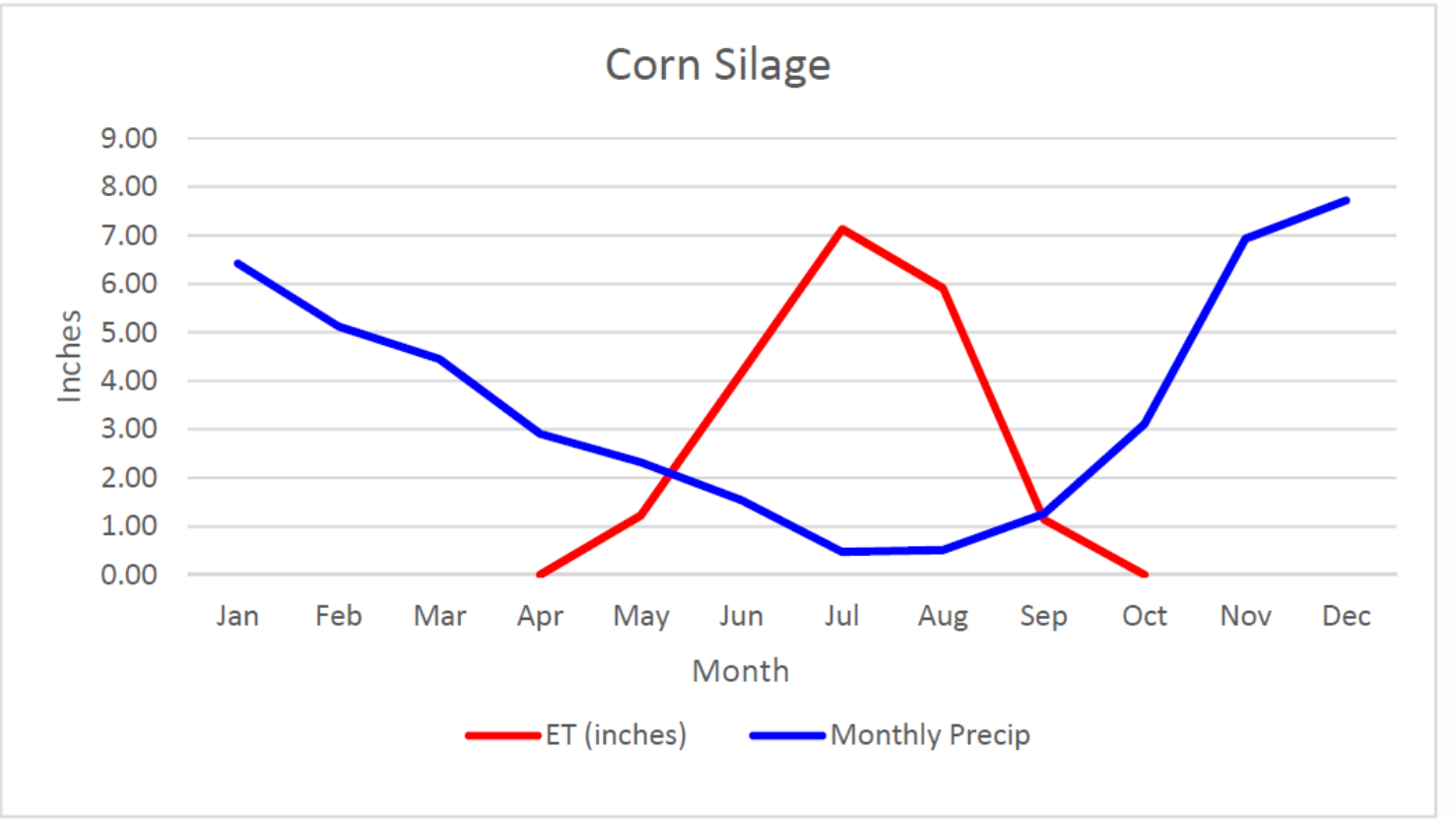
UTILIZATION AREA

Crop-	Alfalfa Hay	
Region-	Willamette Valley	
Total Seasonal Evapotranspiration-	28.07	Inches
Peak Evapotranspiration Rate-	0.19	Inches/Day
Maximum Allowed Depletion-	50	%
Critical Moisture Deficit Period-	Jul	



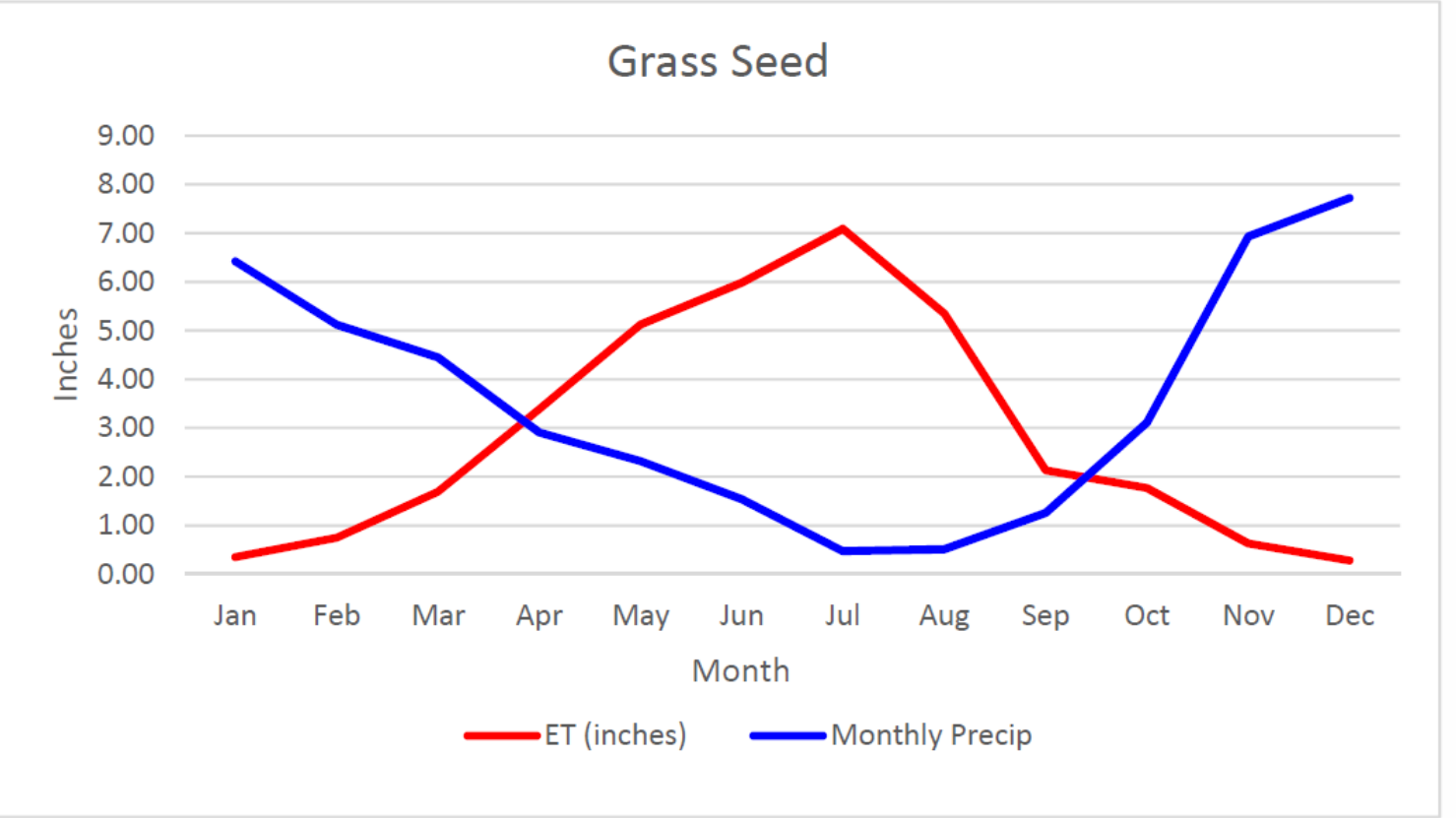
UTILIZATION AREA

Crop-	Corn Silage	
Region-	Willamette Valley	
Total Seasonal Evapotranspiration-	19.57	Inches
Peak Evapotranspiration Rate-	0.24	Inches/Day
Maximum Allowed Depletion-	50	%
Critical Moisture Deficit Period-	Jul	



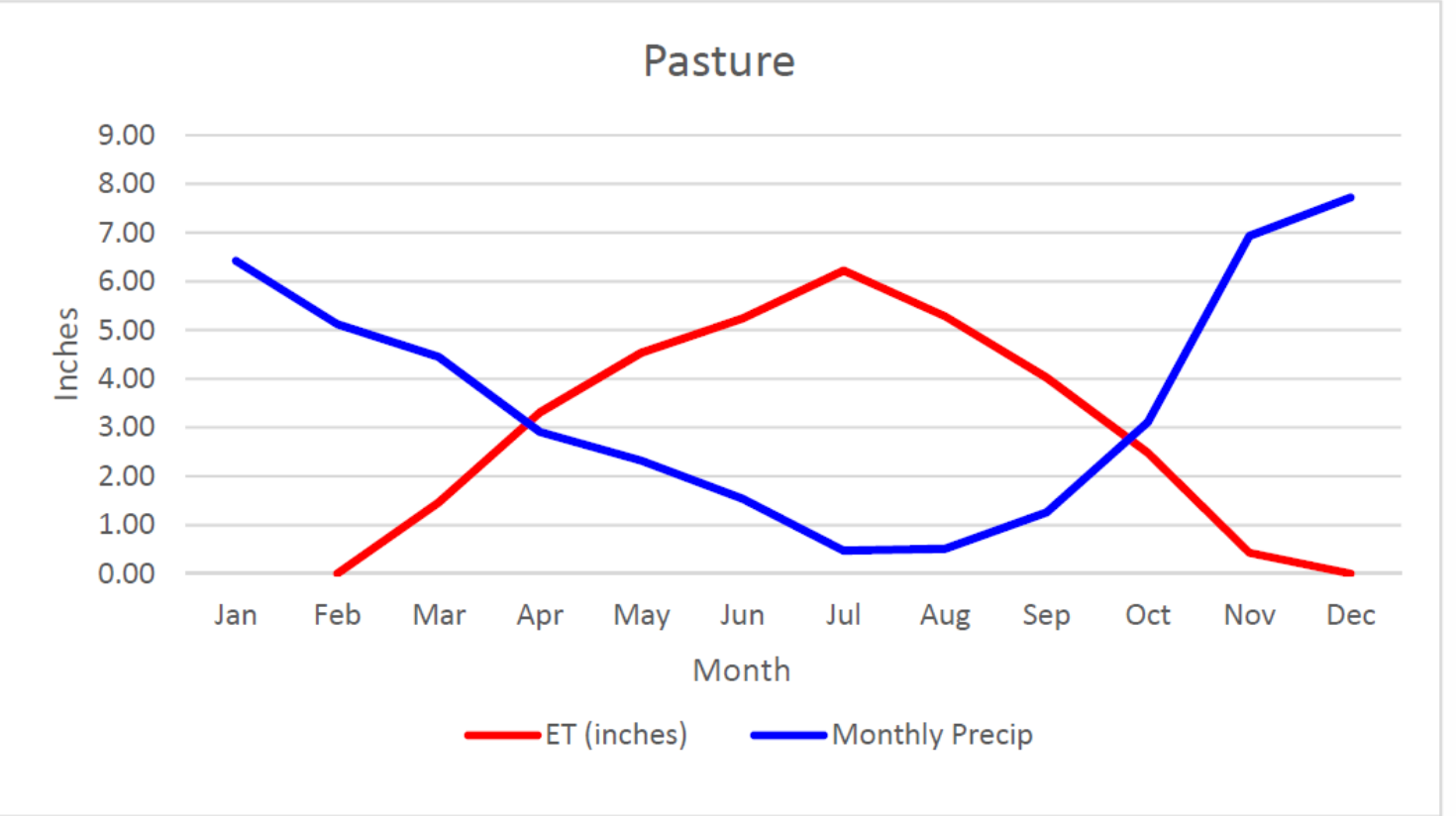
UTILIZATION AREA

Crop-	Grass Seed	
Region-	Willamette Valley	
Total Seasonal Evapotranspiration-	34.53	Inches
Peak Evapotranspiration Rate-	0.24	Inches/Day
Maximum Allowed Depletion-	50	%
Critical Moisture Deficit Period-	Jul	



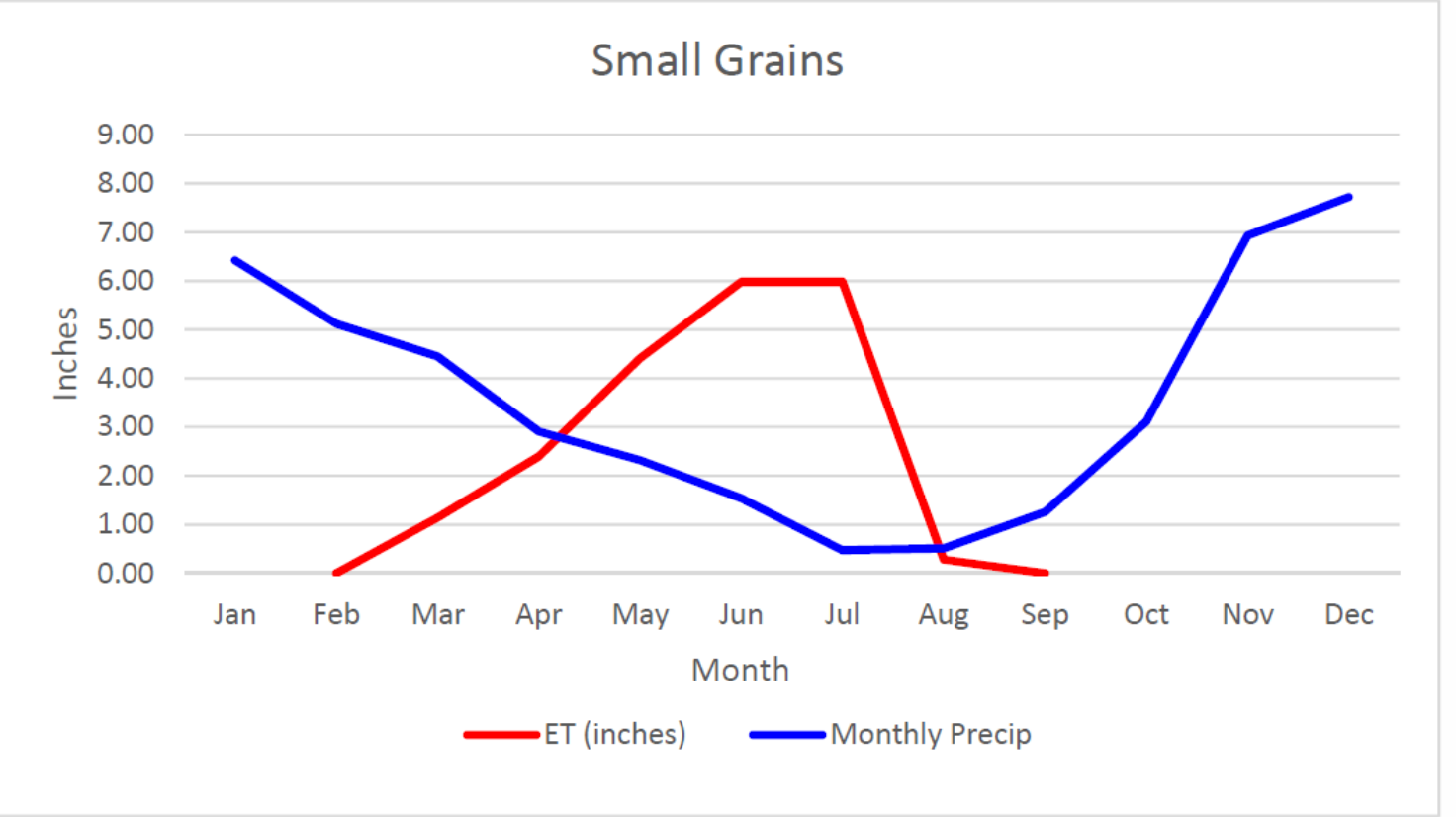
UTILIZATION AREA

Crop-	Pasture	
Region-	Willamette Valley	
Total Seasonal Evapotranspiration-	32.97	Inches
Peak Evapotranspiration Rate-	0.21	Inches/Day
Maximum Allowed Depletion-	50	%
Critical Moisture Deficit Period-	Jul	



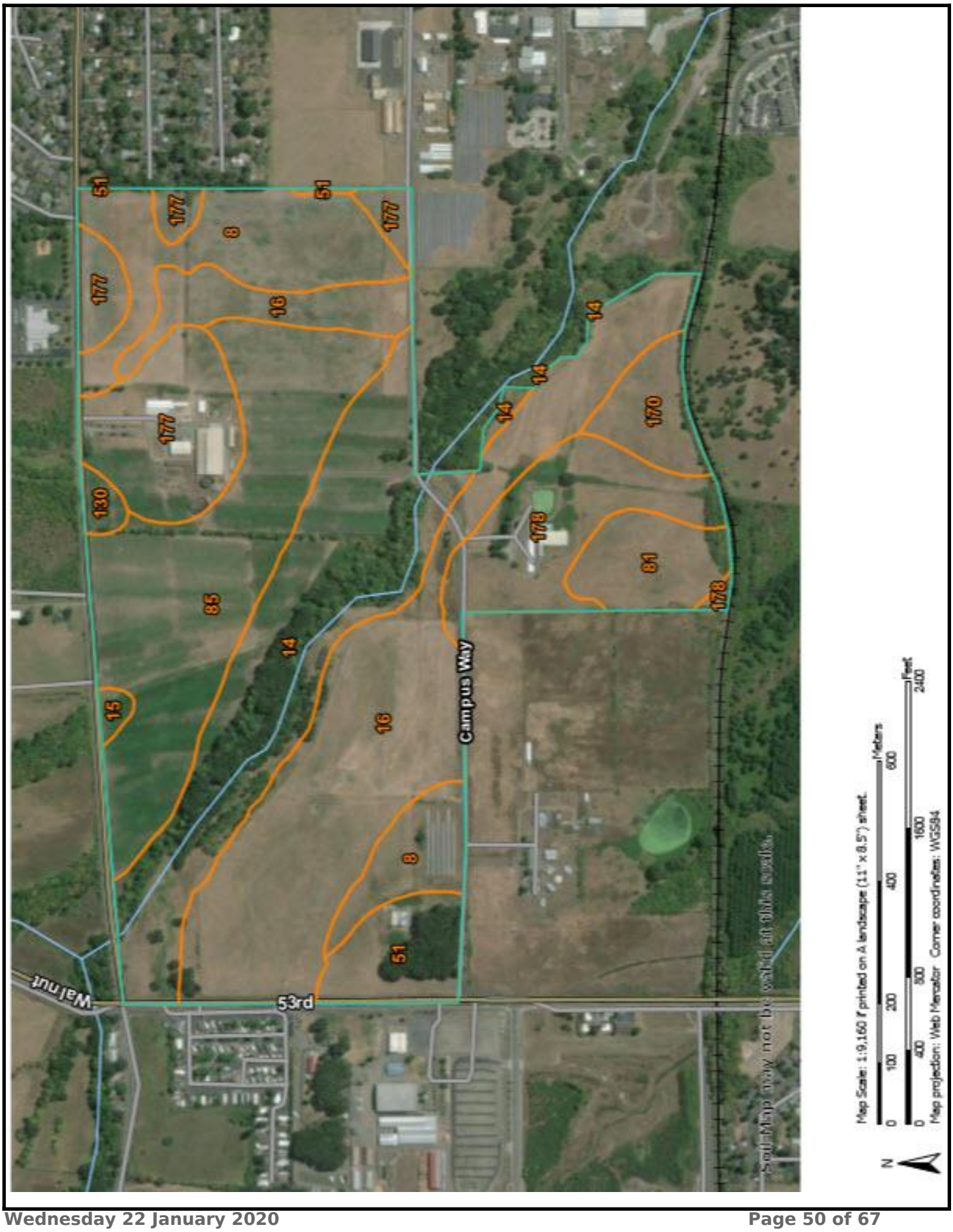
UTILIZATION AREA

Crop-	Small Grains	
Region-	Willamette Valley	
Total Seasonal Evapotranspiration-	20.19	Inches
Peak Evapotranspiration Rate-	0.20	Inches/Day
Maximum Allowed Depletion-	50	%
Critical Moisture Deficit Period-	Jun	



Soil Maps for OSU Dairy & Swine Centers

Soils Map #2



Soil Reports

Map Unit Description

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 in this report, 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, soils that are similar to the named components, and some minor components that differ in use and management from the major soils.

Most of the soils similar to the major components 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. Some minor components, however, have properties and behavior 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*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given 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.
Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Benton County, Oregon

8—Amity silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2vw8
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 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

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

Description of Amity

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Silty glaciolacustrine deposits

Typical profile

Ap - 0 to 7 inches: silt loam
A - 7 to 16 inches: silt loam
E - 16 to 22 inches: silt loam
Bt1 - 22 to 28 inches: silty clay loam
Bt2 - 28 to 35 inches: silty clay loam *C - 35 to 72 inches:* silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained *Capacity of the most limiting layer to transmit water (Ksat):*
Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 16 to 22 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 12.2 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Dayton

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: Yes

Willamette

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: No

14—Bashaw clay, flooded, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2vpx
Elevation: 120 to 500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Bashaw, Flooded

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium derived from basalt

Typical profile

A - 0 to 3 inches: clay
Bssg1 - 3 to 14 inches: clay
Bssg2 - 14 to 31 inches: clay
Bssg3 - 31 to 48 inches: clay *Cg - 48 to 60 inches:* clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) *Depth to water table:* About 0 to 3 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent

Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Forage suitability group: Poorly Drained (G002XY006OR) *Hydric soil rating:* Yes

Minor Components

Waldo

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave *Hydric soil rating:* Yes

Witham

Percent of map unit: 2 percent
Landform: Alluvial fans *Hydric soil rating:* No

Bashaw, nonflooded

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread *Hydric soil rating:* Yes

Wapato

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

15—Bashaw clay, nonflooded, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2vpn
Elevation: 200 to 500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bashaw, nonflooded, and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bashaw, Nonflooded

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium derived from basalt

Typical profile

Ap1 - 0 to 4 inches: clay
Ap2 - 4 to 11 inches: clay
Bssg1 - 11 to 27 inches: clay
Bssg2 - 27 to 44 inches: clay *Cg - 44 to 60 inches:* clay

Properties and qualities

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

Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 4 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Forage suitability group: Poorly Drained (G002XY006OR) *Hydric soil rating:* Yes

Minor Components

Witham

Percent of map unit: 5 percent
Landform: Alluvial fans *Hydric soil rating:* No

Bashaw

Percent of map unit: 3 percent
Landform: Flood plains *Hydric soil rating:* Yes

Gellatly

Percent of map unit: 2 percent
Landform: Hillslopes
Hydric soil rating: No

Mcalpin

Percent of map unit: 2 percent
Landform: Alluvial fans *Hydric soil rating:* No

Dixonville

Percent of map unit: 1 percent
Landform: Hillslopes
Hydric soil rating: No

16—Bashaw silty clay loam, nonflooded, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2vpq
Elevation: 200 to 500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bashaw, nonflooded, and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bashaw, Nonflooded

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Clayey alluvium derived from basalt

Typical profile

A1 - 0 to 5 inches: silty clay loam

A2 - 5 to 15 inches: silty clay
Bssg1 - 15 to 38 inches: clay
Bssg2 - 38 to 50 inches: clay *C - 50 to 60 inches:* clay
Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) *Depth to water table:* About 0 to 5 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: High (about 9.6 inches)
Interpretive groups
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Forage suitability group: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes
Minor Components
Witham
Percent of map unit: 5 percent
Landform: Alluvial fans *Hydric soil rating:* No
Bashaw
Percent of map unit: 3 percent
Landform: Flood plains *Hydric soil rating:* Yes
Gellatly
Percent of map unit: 2 percent
Landform: Hillslopes
Hydric soil rating: No
Mcalpin
Percent of map unit: 2 percent
Landform: Alluvial fans *Hydric soil rating:* No
Dixonville
Percent of map unit: 1 percent
Landform: Hillslopes
Hydric soil rating: No
51—Concord silt loam, 0 to 2 percent slopes
Map Unit Setting
National map unit symbol: 2vw5
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 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
Concord and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.
Description of Concord
Setting
Landform: Terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Silty and clayey glaciolacustrine deposits

Typical profile

Ap - 0 to 6 inches: silt loam
E1 - 6 to 9 inches: silt loam
E2 - 9 to 15 inches: silt loam
2ABg - 15 to 19 inches: silty clay
2Btg - 19 to 24 inches: silty clay
2BCtg - 24 to 29 inches: silty clay
3C - 29 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Forage suitability group: Poorly Drained (G002XY006OR) *Hydric soil rating:* Yes

Minor Components

Amity

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: No

Holcomb

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: No

Woodburn

Percent of map unit: 1 percent
Landform: Terraces
Hydric soil rating: No

81—Helmick silt loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2vwp
Elevation: 200 to 450 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

Helmick and similar soils: 86 percent
Minor components: 14 percent

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

Description of Helmick

Setting

Landform: Hillslopes
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Silty glaciolacustrine deposits over clayey residuum weathered from sandstone and siltstone

Typical profile

A - 0 to 5 inches: silt loam
Bw1 - 5 to 10 inches: silty clay loam
Bw2 - 10 to 16 inches: silty clay loam
2BC - 16 to 22 inches: clay *2C1 - 22 to 28 inches:* clay
2C2 - 28 to 36 inches: clay
2C3 - 36 to 50 inches: clay
2C4 - 50 to 62 inches: clay

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: More than 80 inches
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 10 to 16 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Hazelair

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Convex, linear *Hydric soil rating:* No

Helvetia

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Concave *Hydric soil rating:* No

Steiwer

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, toeslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Convex
Across-slope shape: Linear, convex *Hydric soil rating:* No

Willakenzie

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, toeslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear *Hydric soil rating:* No

Wellsdale

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, toeslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Concave, linear
Hydric soil rating: No

85—Holcomb silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2vrf
Elevation: 150 to 650 feet
Mean annual precipitation: 40 to 50 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

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

Description of Holcomb

Setting

Landform: Terraces
Parent material: Silty alluvium over silty and clayey glaciolacustrine deposits

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 18 inches: silt loam
E - 18 to 24 inches: silty clay loam
2Btg - 24 to 34 inches: clay
2BCtg - 34 to 50 inches: silty clay
3C - 50 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 15 to 30 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 18 to 24 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Dayton

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

Woodburn

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: No

Coburg

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: No

130—Pengra silt loam, 2 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2vs0
Elevation: 160 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Pengra and similar soils: 88 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pengra

Setting

Landform: Fan aprons
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Silty and clayey alluvium

Typical profile

Ap - 0 to 6 inches: silt loam
BA - 6 to 13 inches: silty clay loam
Bw - 13 to 21 inches: silty clay loam *2C1 - 21 to 36 inches:* clay
2C2 - 36 to 60 inches: clay

Properties and qualities

Slope: 2 to 12 percent
Depth to restrictive feature: More than 80 inches

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 0 to 13 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): 2e
Hydrologic Soil Group: D
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: Yes

Minor Components

Helvetia

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear, convex *Hydric soil rating:* No

Panther, hummocky

Percent of map unit: 4 percent
Landform: Earthflows
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear *Across-slope shape:* Concave *Hydric soil rating:* Yes

Carlton

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex *Hydric soil rating:* No

Goodin

Percent of map unit: 1 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

170—Willamette silt loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2vw3
Elevation: 140 to 230 feet
Mean annual precipitation: 40 to 50 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

Willamette and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.
Description of Willamette
Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Silty glaciolacustrine deposits
Typical profile
Ap - 0 to 6 inches: silt loam
A - 6 to 13 inches: silt loam
AB - 13 to 24 inches: silt loam
BA - 24 to 33 inches: silt loam
2Bt - 33 to 45 inches: silty clay loam
2BCt - 45 to 53 inches: silty clay loam
2C - 53 to 60 inches: silty clay loam
Properties and qualities
Slope: 3 to 12 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 45 to 53 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 12.2 inches)
Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Forage suitability group: Well drained < 15% Slopes
(G002XY002OR)
Hydric soil rating: No
Minor Components
Amity
Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, concave *Hydric soil rating:* No
Dayton
Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes
177—Woodburn silt loam, 0 to 3 percent slopes
Map Unit Setting

National map unit symbol: 2vq2
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 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

Woodburn and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces
Parent material: Silty glaciolacustrine deposits

Typical profile

Ap - 0 to 9 inches: silt loam
A - 9 to 17 inches: silt loam
2Bt1 - 17 to 25 inches: silty clay loam
2Bt2 - 25 to 32 inches: silty clay loam *2BCt1 - 32 to 39 inches:* silt loam
2BCt2 - 39 to 54 inches: silt loam
2C1 - 54 to 68 inches: silt loam
2C2 - 68 to 80 inches: stratified fine sandy loam to silt loam
3C3 - 80 to 92 inches: stratified fine sandy loam to silt 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 to high (0.20 to 1.98 in/hr)

Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 12.2 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Forage suitability group: Moderately Well Drained < 15% Slopes
(G002XY004OR)
Hydric soil rating: No

Minor Components

Amity

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: No

Dayton

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

Huberly

Percent of map unit: 1 percent
Landform: Terraces

Hydric soil rating: Yes
178—Woodburn silt loam, 3 to 12 percent slopes
Map Unit Setting
National map unit symbol: 2vq3
Elevation: 100 to 350 feet
Mean annual precipitation: 40 to 50 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
Woodburn and similar soils: 93 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.
Description of Woodburn
Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Silty glaciolacustrine deposits
Typical profile
Ap - 0 to 9 inches: silt loam
A - 9 to 17 inches: silt loam
2Bt1 - 17 to 25 inches: silty clay loam
2Bt2 - 25 to 32 inches: silty clay loam *2BCt1 - 32 to 39 inches:* silt loam
2BCt2 - 39 to 54 inches: silt loam
2C1 - 54 to 68 inches: silt loam
2C2 - 68 to 80 inches: stratified fine sandy loam to silt loam
3C3 - 80 to 92 inches: stratified fine sandy loam to silt loam
Properties and qualities
Slope: 3 to 12 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 to high (0.20 to 1.98 in/hr)

Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 12.2 inches)
Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Moderately Well Drained < 15% Slopes
(G002XY004OR)
Hydric soil rating: No
Minor Components
Amity
Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear, concave *Hydric soil rating:* No

Dayton

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Benton County, Oregon
Survey Area Data: Version 15, Sep 19, 2017

Phosphorus Index Report

OSU Dairy & Swine Centers - 2018

Corvallis

Field	Acres	Soil	Soil Test Date	Bray P (ppm)	Olsen (ppm)	K (ppm)	pH	TFS	SFS	Score	Rating
1	12.1	85, Holcomb	11/21/2018	35.3		237.0	6.72	2.0	4.576	6.58	Low
2	19.4	85, Holcomb	11/21/2018	11.1		189.0	5.92	2.0	4.302	6.3	Low
3	5.3	177, Woodburn	11/21/2018	14.2		146.0	5.86	2.0	1.844	3.84	Low
4	6.4	14, Bashaw	11/21/2018	7.9		317.0	5.68	5.0	3.054	8.05	Low
5	9.0	85, Holcomb	11/21/2018	22.1		173.0	5.47	2.0	2.171	4.17	Low
6	15.8	177, Woodburn	11/21/2018	12.7		83.0	5.37	2.0	2.385	4.39	Low
7	30.5	8, Amity	11/21/2018	22.1		173.0	5.47	2.0	5.989	7.99	Low
8	40.7	16, Bashaw	11/21/2018	35.3		237.0	6.72	2.75	5.600	8.35	Low
9	37.7	16, Bashaw	11/21/2018	14.2		146.0	5.86	2.75	9.882	12.63	Low

PI Interpretations

P-Index Rating	Interpretation for Oregon	Recommended Nutrient Limitation
West PI Score<=25 or East PI Score<=100	The site has a LOW potential for P movement from the site. If farming practices are maintained at current levels, the probability of an adverse impact to surface water resources from P losses from this site are low.Phosphorus can be applied at rates greater than crop requirement	Nitrogen
West PI Score 25.1 to 50 or East PI Score 100.1 to 400	The site has a MEDIUM potential for P movement from the site. The probability for an adverse impact to surface water resources is greater than that from a LOW vulnerability rated site. Some remedial action should be taken to lessen the probability of P movement. Phosphorus can be applied not to exceed the crop requirement rate.	Phosphorus
West PI Score 50.1 to 75 or East PI Score 400.1 to 600	The site has a HIGH potential for P movement from the site. There is a high probability for an adverse impact to surface water resources unless action is taken to reduce the risk of P movement and probable water quality degradation. Phosphorus can be applied not to exceed the crop removal rate if the following requirements are met: A soil phosphorus drawdown strategy has been implemented, and A site assessment for nutrients and soil loss has been conducted to determine if mitigation practices are required to protect water quality.	Phosphorus
West PI Score >75 or East PI Score >600	ZERO OUT- The environmental threshold above which the risk of P loss from a field is too great to warrant the application of P for plant production.	No Manure

ANIMAL WASTE MANAGEMENT PLAN

AMENDMENT/S TO THE ANIMAL WASTE MANAGEMENT PLAN

OSU Dairy Center	Larissa Lewis
CONFINED ANIMAL FEEDING OPERATION	CAFO OPERATOR'S NAME
4490 Harrison Blvd, Corvallis, OR 97330	503-867-4372
FACILITY STREET ADDRESS, CITY, STATE, ZIP	PHONE NUMBER

On_____, Charlene Olson_____
INSPECTOR'S NAME

of the Oregon Department of Agriculture discussed modifications to Animal Waste Management Plan (AWMP) #____20001_____.

The following modifications were made to this AWMP:

1) Liquid manure and wastewater will be picked up from the OSU dairy post separation. They will be utilizing the already existing pump between the holding tank and storage tanks. The liquid will be replaced equal or less volume with liquid digestate from Stahlbush's digester. Therefore, the transfer will not result in an increase in liquid storage capacity needs for the OSU Dairy Farm. See Stahlbush digester sample results. Imports will be monitored, and a log will be kept and recorded by the truck drivers of how much was dropped off and how much was picked up and those numbers will be recorded in the OSU Dairy CAFO calendar.
2) Solid manure may also be exchanged for solid digestate in equal or lesser volume with Stahlbush. Therefore, the transfer will not result in an increase in solid storage space capacity needs. See attached sample results for solid waste from Stahlbush. All pickup and drop off dates and amounts will be recorded in the CAFO Calendar.

CONCLUSION:

X The above amendment/s will be approved.

Charlene Olson
INSPECTOR'S SIGNATURE

_____ Date approved

OPERATOR'S SIGNATURE

Effective date

1/1/2025