Animal Waste Management Plan
July 2006

J & J Farm

Operated by:

Joe Duda
14243 Marquam Road
Mt. Angel, Oregon 97362
(503) 845-6017

Phos Index
??

Operation:

Heifer Operation
Medium Federal CAFO

MA# 63141
AWMP# 06120
Due 9-22-06

As owner and operator of **J & J Farm,** I intend to manage in accordance with the practices described in this Animal Waste Management Plan.

Signature Joseph F Duda
Joseph F. Duda

Date 8/7/06

RECEIVED
AUG 08 2006
NATURAL RESOURCES DIVISION

Oregon Department of Agriculture
ANIMAL INCREASE REQUEST
National Pollutant Discharge Elimination System
(NPDES PERMIT)

Statutory Authority
Oregon Revised Statutes (ORS) 468B.050 When permit required
ORS 468B.210 Maximum number of animals based on ability to contain, treat, hold and dispose of wastes as necessary to comply with all conditions of the permit.

A. General Information **Master Address #**

Name or Business Name J & J Heifers

Facility Location Address 14243 Marquam Rd.

City Mt. Angel OR Zip Code 97362 County Marion

B. Livestock Type: Circle the item that best represents your operation.

1. Beef Feedlot (Fattening) 2. Beef Cattle (Cow/calf) 3. Hogs 4. Sheep and Goats

[✓ 5. Dairy Farm, Heifer Replacement Farm] 6. Poultry/Broiler 7. Poultry/Eggs

7. Mink/Rabbits 8. Horses and Other Equine 9. Other__________

C. Current Permitted Animal Numbers: In the space below please describe your number of animals by herd composition or class. 200 @ 300# -500#, 150 @ 500# - 850#
150 @ 850# - 1150#, 150 @ 1150# - 1300#

D. Current Permitted CAFO Designation: Circle one. See reverse side for table.

Large Federal CAFO [✓ Medium Federal CAFO] State CAFO

E. Proposed increase in permitted animal numbers: In the space below please describe your increased animal numbers by herd composition or class.
270 @ 100#, 100 @ 100#, 160 @ 500#, 190 @ 675#, 130 @ 825#, 140 @ 1200#

F. New CAFO Designation based on increased animal numbers. Circle one. See reverse side for table.

Large Federal CAFO [✓ Medium Federal CAFO] State CAFO

G. Certification:
I understand that an approved animal waste management plan is required prior to permit increase. I agree to prepare and implement an animal waste management plan in accordance with the requirements and timelines specified in the permit.

Joseph F Duda

Signature (operator or owner) Date 8/7/06 Print Name Joseph F. Duda

Signature (operator or owner Date Print Name

GENERAL NARRATIVE DESCRIPTION

J & J Farm is located at **14243 Marquam Road Mt. Angel, Oregon** and is owned by **Joe Duda**. The operation is a heifer facility in Marion County. The facility is in full operation year round. The operation is located on 75 acres in Mt. Angel, Oregon. The current herd is composed of 650 dairy heifers and the operator would like to expand to 990 heifers. Six sets of animals make up the entire herd. The heaviest and oldest of the herd is 140 heifers that average 1200 pounds. Set two is made up of 130 heifers averaging 825 lbs, set three includes 190 heifers that average 675 lbs, set four is made up of 160 heifers averaging 500 lbs, set five is 100 heifers averaging 100 lbs and the youngest set is made up of 270 heifers averaging 100 lbs. All animals are confined year round. The facility uses a dry scrape system and scrapes the manures to a 20'x10'x8' reception tank where they are pumped over a sidehill separator. The solid manures are collected on a concrete pad housing the separator. Owner Joe Duda states that the solids will then be composted and used as a bedding source or exported. One hundred percent of the solid manures are transported off of the facility to neighboring crop growers. The liquid manures are pumped north of the facilities to a two-cell storage lagoon. Bedding materials consist of straw and grass seed screenings. The cropping system takes into account the 53 home piece acres. The home property is harvested as Ryegrass haylage and corn silage. All fields on site are tiled to Zellner Creek that runs east to west through the property north of the facilities.

Manure Storage and Application

Manure from the barns and outside concrete lot is scraped into a 20'x10'x8' deep concrete below ground collection tank. Manure is agitated and pumped over a separator with the liquid going into a two-cell storage pond. The settling cell is 2.5 acre-feet and the main cell is 9.2 acre-feet. Solids are stored on a 60'x80' concrete slab. The operation has the ability to add liquids to the below ground tank to aid in agitation. One calf barn and part of a second are straw pack. The third set of heifers has a combination straw pack and scrape system and the youngest/sixth set of heifers is 100% straw pack. These barns are cleaned of the pack a couple of times a year. The solids are moved directly to the solids pad for export. There are approximately 245 days of solid storage. The liquid manures after separation flow into the first settling pond measuring 2.5 acre-feet and then pumped north to the second lagoon measuring 9.2 acre-feet. Together these two lagoons equal approximately 11.7 acre-feet (AF). There are approximately 105 days of liquid storage. The silage bunker space equals approximately 18,000 square feet. All of the runoff from the bunker is directed to a drain in the NE corner where it is diverted to the ponds. All contaminated water from the barns and yard area will be directed to the waste storage pond. All barns will be guttered to divert clean water away from manure storage facilities. The operator will contain all wastewater within the facilities while diverting clean water out of the system.

There are two large exercise lots to the west of the facilities. These lots are used during the summer season to give the animals room to roam around. A couple of times during the season and before fall the lots are scraped and grass seed spread. The material scraped up is included in the solids exported.

Manure is applied to the acreage via the use of a liquid "big gun" traveler. Manure will be applied to the acreage via calibrated equipment to meet the expected nutrient uptake of the crop system. The average elevation is approximately 200 feet and the properties most noticeable change in elevation is at Zollner Creek. Application of manure will be done at appropriate times of the year as to utilize nutrients for maximal forage production. No manure will be applied to frozen or saturated soils. A minimum vegetative buffer of 35 feet will be maintained between application areas and waterways.

SPECIFIC DESCRIPTIONS AND CALCULATIONS

Land Application Areas

The operation manages 53 acres of its own land, which it applies liquid waste to. All of the manure not utilized on the facility's property is exported to neighboring operators land. None of the animals graze.

Manure and Waste Volumes

Calculated volumes of all manure, bedding, have been completed using the Oregon Animal Waste Management worksheet based from the NRCS Agricultural Waste Field Handbook. The worksheet is included in this Animal Waste Management Plan.

Roofs are guttered and clean water is diverted away to increase manure storage available.

Nutrient Content of Manure, Litter and Process Waste Water

The same worksheet was used to estimate nutrient content of manure. Annual on farm manure test results are available for customers.

Farm Nutrient Balance

Nutrient balances for manure application on the farm is also included in the Oregon Animal Waste Management worksheet.

Application Schedule and Limitations

All of the manure is applied at a time of year in which the nutrients will best be utilized. It is the dairies goal to have solid and liquid storage available at the end of fall for winter storage and to start applying in the spring. If emergency application is necessary the operation takes care not to spread on saturated or frozen ground and leaves at least a 100' buffer beside surface waters.

Animal Mortality Management

All of the mortalities are composted on site on the solids pad.

Record Keeping

a) Applications of manure, litter and process waste will be kept, including the date and the amount of N and P applied during each application.

b) Soil samples will be taken in each field where manure is applied, at least once every five years.
c) Records of exporting manure, litter and process waste will also be kept.

Reporting to the Oregon Department of Agriculture (ODA)

a) Any discharge will be reported orally to ODA within 24 hours. Within 5 days, a written statement describing this discharge will also be submitted to ODA.
b) The amount of manure, litter and process waste applied will be reported annually.
c) The amount of manure, litter and process waste exported will be reported annually.

Protocol for Sampling Manure

Solid manure compost will be sampled and tested prior to manure exports in the spring. Approximately 20 small grab samples from the manure pile will be taken to make on composite sample. After collection, the grab samples will be thoroughly mixed. About one quart of manure will be removed for nutrient analysis. The sample will be preserved for shipping to an analytical laboratory to be tested for Total Nitrogen (TKN), Ammonium Nitrogen (NH4-N), Phosphorus (P), Potassium (K) and moisture content (or dry matter).

ANIMAL WASTE MANAGEMENT PLAN
MINIMUM REQUIRED ELEMENT

OPERATION AND MAINTANENCE

J&J Heifers – Joe Duda
Name of Operation

Mark all that apply to your operation.

Above and/or Below Ground Liquid Tank

The tank serves as a collection point for effluent to drain to or be scraped from the animal feeding areas. If the tank will provide storage capacity to the waste management system it shall be completely emptied at the beginning of the storage period and the contents applied to cropland as weather and crop conditions permit. A 1-foot free board will be maintained to prevent spillage.

Continually maintain all pumps, agitators, piping valves and all other electrical and mechanical equipment in good operating condition by following manufacturer's recommendations. Float valves will be maintained in good working order. Perform daily inspections of waterlines including drinking water or cooling water lines. Repair leaking lines immediately to prevent excess water from entering the waste storage system. Depth markers are installed to assure maximum volume will be maintained and checked weekly. At least once every 5 years, the tank shall be emptied and inspected for structural damage and leakage. Any damage found shall be corrected before putting the tank back in service. Remove all foreign debris within the structure that may cause damage to pumps and agitator. If below ground, the tank lid will not be subjected to more than two, 8,000 pound wheel loads. Before entering a tank, for any reason whatever, proper ventilation shall be provided, and self-contained breathing apparatus shall be used, if required, when entering a covered tank. No one shall enter the tank unless safety ropes are used and someone else capable of providing assistance is outside of the tank. Warning: Entering Unventilated Tanks Is Extremely Dangerous.

Animal Access Lanes or Walkways

Damaged components will be repaired or replaced as needed. Debris and excess manure will be removed from roadway surfaces, road ditch and drainage areas. Maintain drainage area capacities. Maintain good vegetative cover on all slopes and watercourses.

Agitator

Preventative maintenance will be in accordance with the manufacturer's recommendations. Periodically examine the agitator for proper operation. Clean debris from the propeller and promptly replace any defective or damaged parts. Remove the agitator from the manure tank or pond and periodically clean and oil as needed to increase the life expectancy of the agitator. Immediately repair any vandalism or livestock damage. Do not allow livestock near the equipment during operation.

Concrete Gutters

Floor gutters and grates will be inspected periodically. All foreign material restricting flow will be removed. Damage will be repaired as needed.

Curbs

Curbs, gutters and slabs that are used to convey effluent will be inspected periodically. Broken sections will be repaired or replaced. Manure or other solids will be prevented from building up next to curbs or flowing over them. If over flow is a consistent problem the curb height should be increased.

Culverts

Inspect annually or after large rainfall event. All foreign objects restricting water flow will be removed. Damaged sections will be repaired or replaced. Erosion around inlet or outlet will be corrected.

Dry Stack Storage Facility

Solid manure storage facility will be inspected annually. Broken slabs and curbs will be repaired. Repair or replace rusted or damaged areas on roof structure. Broken gutters and/or downspouts will be repaired or replaced. Check for adequacy and function of drain away from downspouts. Check side and back walls for soundness. Manure solids and leachate will not escape through cracks in the facility.

Fencing

Fences will be inspected periodically. Broken or decayed posts will be replaced. Sagging wire will be tightened. Broken wire will be spliced or replaced. Broken or missing insulators for electric fencing will be replaced. Vegetation will be controlled under the fences. Electric fencing will be sufficiently charged to detour animals.

Filter Strips

Maintain vigorous growth of vegetative covering. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing, harvesting or grazing may also be needed to control height. Remove all foreign debris that hinders system operation. Limit the traffic from filter strip area. Limit livestock usage to vegetative growth periods when the animals will not damage vegetative root system or compact the soil. Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage.

Gutters and Downspouts

Gutters will be inspected annually to ensure all gutters are free of foreign materials. Broken gutters or downspouts will be replaced or repaired. Gutters will be connected to downspouts. Leaky gutters and downspouts will be repaired. Weeds and sediment will be removed from downspout outlets. All downspouts will be connected to outlets, which are kept free flowing. Outlets will be inspected for rodent guards and repaired or replaced as needed.

Irrigation Water Management

Irrigation water application will be at rates that minimize transport of sediment, nutrients, and chemicals to surface water and ground water. Equipment modifications and/or soil amendments such as polyacrylamides and mulches should be considered to reduce erosion if needed.

Manure Application Equipment

All manure application equipment (including but not limited to sprinklers, big gun irrigators, spreaders and/or tank wagons) will be operated and maintained according to the manufacturer's manual. Equipment found to be broken or worn will be replaced. Equipment will be calibrated to ensure recommended rates are applied. Liquids will be drained from sprinklers or big guns prior to freezing weather. When system is flushed, rinse water is used following waste, and liquid and sediment is applied agronomically. Nozzles will be checked periodically and if worn, nozzles will be replaced. Minimize exposure to animal and organic waters and manure gasses. Wear protective clothing when appropriate. When cleaning equipment after nutrient application, remove and save wastes in an appropriate manner. Avoid applying manure near surface water by establishing buffer strips and set backs, and use extreme care to avoid contaminating ground water.

Manure Effluent and Irrigation Transfer Lines.

Manure, effluent and irrigation lines shall be flushed with clean water periodically to prevent particle buildup and plugging. Manure flushed from the lines will be applied agronomically so that surface and groundwater will be protected. Manure, effluent and irrigation lines shall be inspected periodically for leaks or worn out nozzles, and repairs or replacements made as needed. Special inspection shall be done to pressure relief valves, risers and control valves. Shut off valves will be inspected annually. Avoid unnecessary travel over pipelines that will damage their integrity. Equipment found to be broken or worn will be replaced. Water will be drained during cold weather to prevent frozen or broken lines. These lines can explode if not properly maintained and may cause human injury.

Pumps

Pumps will be maintained in accordance with manufacturer's operation and maintenance manual. Effluent will be drained from pumps prior to freezing weather. Pumps will be inspected periodically to identify and remove debris wrapped around impeller or worn parts. Appropriate action will be taken to repair any worn parts. Liquids will be drained from pump prior to freezing weather to prevent breakage. It is recommended to have a spare pump or back up system in case a pump must be removed for an extended time for repair.

Roofs

Roofs will be inspected annually. Rusted sections will be replaced or repaired if needed. Loose sections will be secured. All broken trusses, beams, poles, gutters and downspouts will be repaired or replaced.

Solid Manure Separator

The separator should be inspected regularly for deterioration of protective coatings and repaired as necessary. All plumbing will be inspected annually and broken lines will be replaced or repaired. Loose connections will be tightened. If applicable, electric motors, pumps and gears should be routinely maintained. Separator will be operated and maintained according to manufacturer's manual.

Subsurface Drainage System

Subsurface drainage will be inspected annually. Fields will be checked for breaks or suck holes. Outlets will be kept free of vegetation and sediment. Erosion at outlets will be corrected with riprap or other means. Damage or broken lines will be repaired. Outlets from fields on which animal waste is being applied will be monitored daily. Animal waste applications will cease if the tile outflow contains any indication of animal waste.

Trough or Tank

Watering facility will be inspected periodically. Damaged tank/trough will be repaired or replaced. Float valves will be maintained in good working order. Area immediately surrounding the trough/tank will be maintained in a stable condition. Watering facility will be inspected periodically. Damaged tank/trough will be repaired or replaced. Float valves will be maintained in good working order. Area immediately surrounding the trough/tank will be maintained in a stable condition. Watering facilities will not be allowed to overflow if additional liquid will affect waste storage capacities.

Waste Storage Pond

Prior to the storage season, empty the pond to provide storage capacity for the accumulation of wastewater and precipitation during the winter storage period. Sludge and accumulated solids will be removed from the pond periodically when buildup limits storage capacity in the pond. Depth markers are installed to assure maximum volume will be maintained and checked weekly. A 2-foot free board will be maintained to prevent spillage.

Maintain all pumps, agitators, pipeline, valves, and electrical and mechanical equipment in good operating condition following the manufacturer's recommendations. Immediately repair any vandalism, vehicular, or livestock damage to any earth fill. Immediately remove any obstructions or blockage of spillways, trash racks or pipe inlets. Settlement or cracks in earthen sections should be investigated to determine cause and immediately repaired. Maintain vigorous growth of vegetative coverings on the dikes to eliminate soil erosion. Eradicate or otherwise remove all rodents or burrowing animals and repair any damage caused by their activity. Fences and/or warning signs should be maintained as necessary to unauthorized human or livestock entry. Operate systems in a manner that minimizes odor and drift.

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET
Version 2.4

7/19/06
STATE: OREGON

CLIENT: Joe Duda
ASSISTED BY: Micah Wells
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

ANIMAL INVENTORY

Type of Animal		Number of Animals	Average Weight (lbs.)	Animal Units (1,000 lb.)	Nutrient Production (lbs./day/1000 lb. Animal Unit) N	P	K	(lbs./day) N	P	K	Manure CF/D/AU	Annual Days Confined	Days Grazed
HEIFERS (12-24 Months)	⬍	140	1,200	168.0	0.31	0.04	0.24	52.08	6.72	40.32	1.30	365	0
CALVES (1-12 Months)	⬍	130	825	107.3	0.31	0.04	0.24	33.25	4.29	25.74	1.30	365	0
CALVES (1-12 Months)	⬍	190	675	128.3	0.31	0.04	0.24	39.76	5.13	30.78	1.30	365	0
CALVES (1-12 Months)	⬍	160	500	80.0	0.31	0.04	0.24	24.80	3.20	19.20	1.30	365	0
CALVES (1-12 Months)	⬍	100	100	10.0	0.31	0.04	0.24	3.1	0.40	2.40	1.30	365	0
CALVES (1-12 Months)	⬍	270	100	27.0	0.31	0.04	0.24	8.37	1.08	6.48	1.30	365	0
	⬍												
	⬍												
	⬍												
	⬍												
Totals/Averages-		990	567	520.5	0.31	0.04	0.24	161.4	20.8	124.9	1.3		

GRAZING PERIOD

Type of Animal	Percent of Month and Number of Animals Grazing OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	AU-YR.
HEIFERS (12-24 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	140	140	140	140	140	140	140	140	140	140	140	140	0
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	130	130	130	130	130	130	130	130	130	130	130	130	0
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	190	190	190	190	190	190	190	190	190	190	190	190	0
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	160	160	160	160	160	160	160	160	160	160	160	160	0
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	100	100	100	100	100	100	100	100	100	100	100	100	0
CALVES (1-12 Months)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
	270	270	270	270	270	270	270	270	270	270	270	270	0
													0
													0
													0
													0
Total AUM's Available>	99						102	102	102	101	101	101	708
Total AUM's Needed>>>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total AUM's>>>>>>>>>>>	99	0	0	0	0	0	102	102	102	101	101	101	708

ANIMAL WASTE MANAGEMENT WORKSHEET

Version 2.4

CLIENT: Joe Duda
ASSISTED BY: Micah Wells
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

WEATHER STATION

SILVERTON 4 SE

Month	25Yr-24Hr	4.00	Lot Runoff Factors as a Percent of Monthly Precipitation	
	Monthly Average in Inches			
	Precipitation	Evaporation	Paved	Unpaved
October	3.33	1.80	100%	15%
November	6.94	0.80	100%	20%
December	7.38	0.45	100%	15%
January	6.27	0.51	100%	20%
February	5.03	0.85	100%	15%
March	5.16	1.65	100%	10%
April	3.47	2.52	100%	10%
May	2.80	3.94	100%	10%
June	1.81	4.56	100%	10%
July	0.80	5.69	100%	0%
August	1.10	5.19	100%	10%
September	2.12	3.54	100%	15%
Annual	46.21	31.5		

AREAS CONTRIBUTING RUNOFF TO LIQUID STORAGE FACILITY

Description of Runoff Area	Area in SF
Paved Lot Area >> Is paved lot scraped daily? (Y/N) YES	1,670
Unpaved Lot Area >>	0
Roof Area >>	0
Surface Area of Silage Storage Facility>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Does Silage Seepage Drain to Storage Facility? (Y/N) YES	18,000
Total Runoff Area Contributing to Liquid Storage Facility>>>>>>>>>>>>>>>>	19,670

WATER USE THAT ENTERS LIQUID STORAGE FACILITY

Type of Water Use	Number of Animals	Number of Washes per Day	Gallons of Water Used per Wash-Day	Total Water Use per Day, Gallons	Total Water Use per Day, Cubic Feet
Animal Washwater	0.0	0	2.50	0	0.0
Equipment Wash		1	30.00	30	4.0
Flushwater		0		0	0.0
Miscellaneous		0	0.00	0	0.0
Total>>				30	4.0

CROP DATA

Field Number	Acres	Crop	Condition	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre		
						Nitrogen N	Phosphorous P_2O_5	Potassium K_2O
1	28.0	Corn, Silage(AH)	As Harvested	Ton	20.00	154	80	184
1	28.0	Ryegrass Haylage	As Harvested	Ton	10.00	250	92	257
2	25.0	Corn, Silage(AH)	As Harvested	Ton	20.00	154	80	184
3	25.0	Ryegrass Haylage	As Harvested	Ton	10.00	250	92	257
Off-Farm								

ANIMAL WASTE MANAGEMENT WORKSHEET
Version 2.4

CLIENT: Joe Duda
ASSISTED BY: Micah Wells
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

BEDDING VOLUME

Type of Animal	Type of Bedding Facility	Bedding Material	Unit Weight Lbs/CF	Amount Needed Lbs/Day/AU	Volume CF/Day/AU	Total Volume CF/Day	Total Weight Lbs/Day
HEIFERS (12-24 Months)	Free Stall ⬍	Sawdust ⬍	12.00	3.10	0.15	25	521
CALVES (1-12 Months)	Free Stall ⬍	Sawdust ⬍	12.00	3.10	0.26	28	332
CALVES (1-12 Months)	Loose Housing ⬍	Chopped Straw ⬍	7.00	11.00	1.57	202	1,411
CALVES (1-12 Months)	Free Stall ⬍	Chopped Straw ⬍	7.00	2.70	0.39	31	216
CALVES (1-12 Months)	Free Stall ⬍	Loose Straw ⬍	2.50	2.60	1.04	10	26
CALVES (1-12 Months)	Loose Housing ⬍	Chopped Straw ⬍	7.00	11.00	1.57	42	297
	⬍	⬍					
	⬍	⬍					
	⬍	⬍					
	⬍	⬍					

SOLIDS SEPARATION FACTOR

Type of Animal	Type of Separator	Separation Factor %	Volume of Solids Separated CF/Day	Volume of Solids in Liquids CF/Day	Volume of Manure in Liquids CF/Day	Volume of Manure in Solids CF/Day	Accumulated Sludge in Storage CF/Day	Density of Separated Solids Lbs/CF	Weight of Separated Solids Lbs/Day
HEIFERS (12-24 Months)	Static Inclined Screen(Side Hill Separator) ⬍	20%	10	39	214	5	94	36	350
CALVES (1-12 Months)	Static Inclined Screen(Side Hill Separator) ⬍	20%	9	34	136	3	60	36	307
CALVES (1-12 Months)	Static Inclined Screen(Side Hill Separator) ⬍	45%	99	121	159	8	49	36	3,554
CALVES (1-12 Months)	Static Inclined Screen(Side Hill Separator) ⬍	20%	8	34	102	2	45	36	302
CALVES (1-12 Months)	Static Inclined Screen(Side Hill Separator) ⬍	20%	2	9	13	0	6	36	85
CALVES (1-12 Months)	Dry Scrape System ⬍	100%	78	0	0	35	0	36	2,791
	⬍								
	⬍								
	⬍								
	⬍								
Total Solids>>>			205	237	623	53	253	▨	7,389

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET

Version 2.4

7/19/06
STATE: OREGON

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY VOLUMES

	Runoff in Cubic Feet					Manure									
	Roof Area Square Feet 0	Paved Slab Area Square Feet 1,670	Unpaved Lot Area Square Feet 0	Silage Pit Surface Area, SF 18,000	Facility Water Use Cubic Feet	Solids Cubic Feet	Liquids Cubic Feet	Bedding		Solids Separated		Solids in Liquids		Total Solids	Total Liquids
Month								Cubic Feet	Pounds	Cubic Feet	Pounds	Cubic Feet	Pounds	Cubic Feet	Cubic Feet
October	0	463	0	1,528	124	3,216	17,760	10,482	86,894	6,362	229,049	7,336	264,081	6,362	28,776
November	0	966	0	2,823	120	3,112	17,187	10,144	84,091	6,157	221,661	7,099	255,563	6,157	30,332
December	0	1,027	0	2,439	124	3,216	17,760	10,482	86,894	6,362	229,049	7,336	264,081	6,362	30,251
January	0	873	0	2,660	124	3,216	17,760	10,482	86,894	6,362	229,049	7,336	264,081	6,362	30,317
February	0	700	0	1,835	112	2,905	16,041	9,468	78,485	5,747	206,883	6,626	238,525	5,747	28,597
March	0	718	0	1,553	124	3,216	17,760	10,482	86,894	6,362	229,049	7,336	264,081	6,362	29,055
April	0	483	0	1,261	120	3,112	17,187	10,144	84,091	6,157	221,661	7,099	255,563	6,157	28,288
May	0	390	0	420	124	3,216	17,760	10,482	86,894	6,362	229,049	7,336	264,081	6,362	27,594
June	0	252	0	272	120	3,112	17,187	10,144	84,091	6,157	221,661	7,099	255,563	6,157	27,067
July	0	111	0	0	124	3,216	17,760	10,482	86,894	6,362	229,049	7,336	264,081	6,362	26,895
August	0	153	0	165	124	3,216	17,760	10,482	86,894	6,362	229,049	7,336	264,081	6,362	27,102
September	0	295	0	1,218	120	3,112	17,187	10,144	84,091	6,157	221,661	7,099	255,563	6,157	28,056
Annual	0	6,431	0	16,174	1,464	37,867	209,110	123,417	1,023,104	74,913	2,696,872	86,371	3,109,346	74,913	342,330

DAILY NUTRIENT PRODUCTION

	Pounds/Day of Nutrients from **LIQUIDS**			Pounds/Day of Nutrients from **SOLIDS**			Pounds/Day of Nutrients from **GRAZING**		
Type of Animal	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
HEIFERS (12-24 Months)	41.66	12.32	38.87	10.42	3.08	9.72	0.00	0.00	0.00
CALVES (1-12 Months)	26.60	7.86	24.81	6.65	1.97	6.20	0.00	0.00	0.00
CALVES (1-12 Months)	21.87	6.46	20.40	17.89	5.29	16.69	0.00	0.00	0.00
CALVES (1-12 Months)	19.84	5.86	18.51	4.96	1.47	4.63	0.00	0.00	0.00
CALVES (1-12 Months)	2.48	0.73	2.31	0.62	0.18	0.58	0.00	0.00	0.00
CALVES (1-12 Months)	0.00	0.00	0.00	8.37	2.47	7.81	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET

Version 2.4

7/19/06
STATE: OREGON

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY NUTRIENT PRODUCTION

	Pounds of Nutrients from **LIQUIDS**			Pounds of Nutrients from **SOLIDS**			Pounds of Nutrients from **GRAZING**			Pounds of Nutrients going **OFF-FARM**			Total Pounds of Nutrients from **ALL SOURCES**		
Month	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
October	3,486	1,030	3,252	1,516	448	1,414	0	0	0	0	0	0	5,002	1,479	4,666
November	3,373	997	3,147	1,467	434	1,369	0	0	0	0	0	0	4,841	1,431	4,516
December	3,486	1,030	3,252	1,516	448	1,414	0	0	0	0	0	0	5,002	1,479	4,666
January	3,486	1,030	3,252	1,516	448	1,414	0	0	0	0	0	0	5,002	1,479	4,666
February	3,149	931	2,937	1,369	405	1,277	0	0	0	0	0	0	4,518	1,336	4,215
March	3,486	1,030	3,252	1,516	448	1,414	0	0	0	0	0	0	5,002	1,479	4,666
April	3,373	997	3,147	1,467	434	1,369	0	0	0	0	0	0	4,841	1,431	4,516
May	3,486	1,030	3,252	1,516	448	1,414	0	0	0	0	0	0	5,002	1,479	4,666
June	3,373	997	3,147	1,467	434	1,369	0	0	0	0	0	0	4,841	1,431	4,516
July	3,486	1,030	3,252	1,516	448	1,414	0	0	0	0	0	0	5,002	1,479	4,666
August	3,486	1,030	3,252	1,516	448	1,414	0	0	0	0	0	0	5,002	1,479	4,666
September	3,373	997	3,147	1,467	434	1,369	0	0	0	0	0	0	4,841	1,431	4,516
Annual	**41,044**	**12,133**	**38,290**	**17,851**	**5,277**	**16,653**	**0**	**0**	**0**	**0**	**0**	**0**	**58,895**	**17,410**	**54,943**

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET
Version 2.4

7/19/06
STATE: OREGON

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**

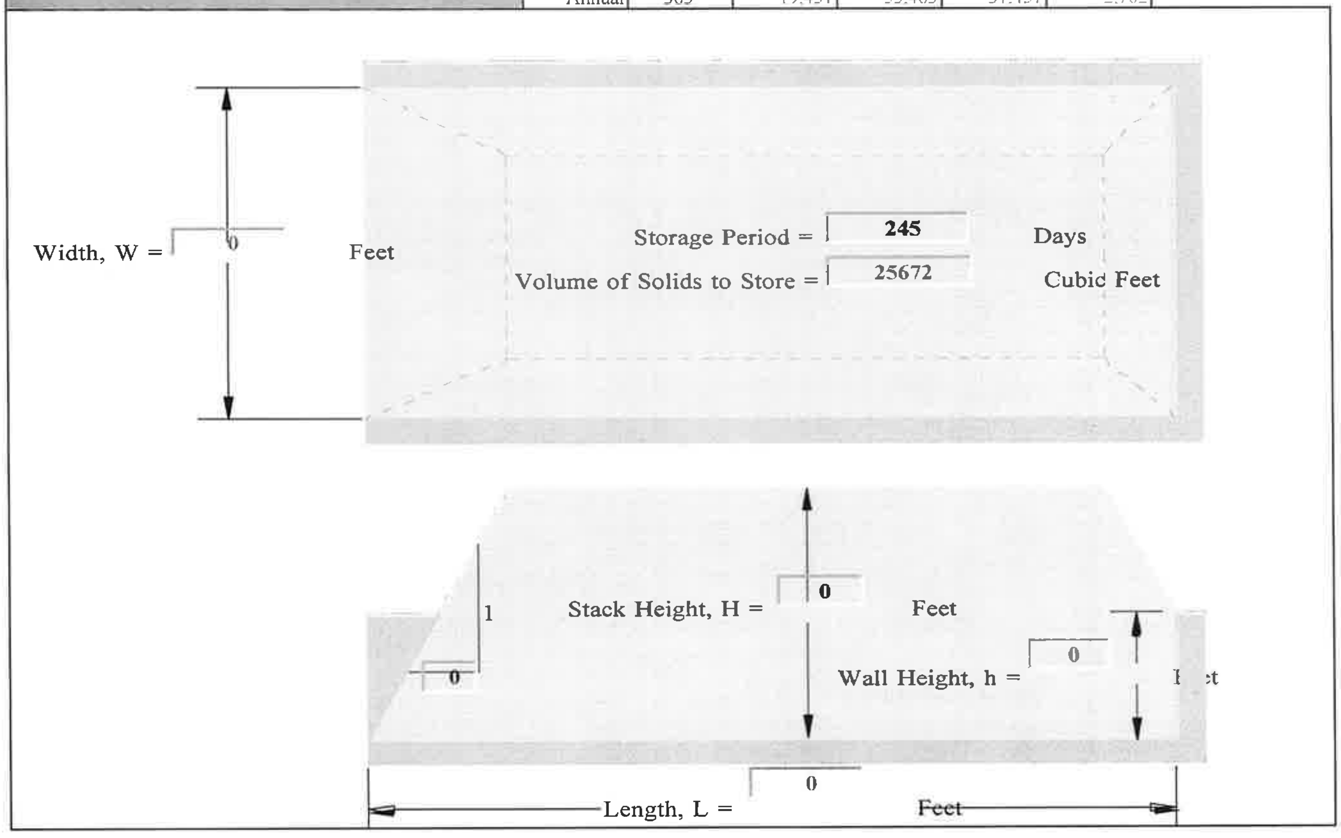
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

SOLIDS STACKING FACILITY

MONTHLY SOLIDS VOLUME STACKED IN FACILITY

Solids Storage Facility Parameters	Value	Month	Number of Days	Manure CF	Bedding CF	Solids to Store CF	Normal Runoff CF
Storage Period, Days=	245	October	31	1652	4,711	3,181	200
Stacking Width, W in Feet=	0	November	30	1599	4,559	3,079	555
Stacking Height, H in Feet=	0.00	December	31	1652	4,711	3,181	443
Wall Height, h in Feet=	0.00	January	31	1652	4,711	3,181	502
Stack Side Slope (X:1)=	0.00	February	28	1492	4,255	2,873	302
Existing Storage, Cubic Feet=	26,400	March	31	1652	4,711	3,181	206
Surface Area of Existing Storage, SF=	4,800	April	30	1599	4,559	3,079	139
25 Year-24 Hour Storm Runoff, CF=	1,600	May	31	1652	4,711	3,181	112
Volume Needed, Cubic Feet=	25,672	June	30	1599	4,559	3,079	72
Design Volume, Cubic Feet=	0	July	31	1652	4,711	3,181	0
Is Facility Covered?	YES ⬍	August	31	1652	4,711	3,181	44
		September	30	1599	4,559	3,079	127
		Annual	365	19,451	55,463	37,457	2,702


Storage Period = 245 Days
Volume of Solids to Store = 25672 Cubic Feet
Width, W = 0 Feet
Stack Height, H = 0 Feet
Wall Height, h = 0 Feet
Length, L = 0 Feet

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET
Version 2.4

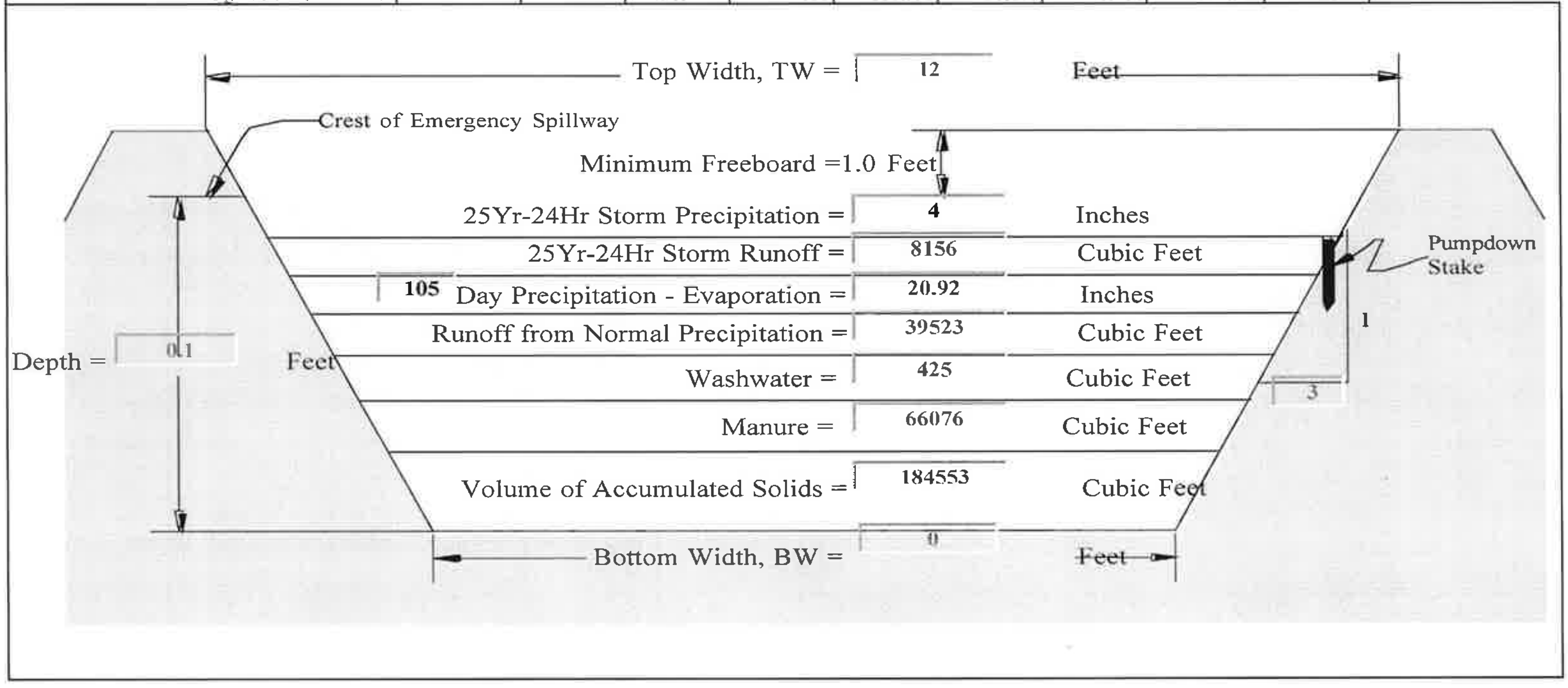
7/19/06
STATE: OREGON

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

WASTE STORAGE POND / **MONTHLY INFLOWS INTO WASTE STORAGE POND**

Pond Parameters	Value	Month	Number of Days	Rain-Evap on Pond CF	Rain-Evap on Existing Storage, CF	Normal Runoff CF	Washwater CF	Manure CF	Accum Solids CF
Storage Period, Days=	105	October	31	18	12,693	5,658	124	19,324	7,837
Side Slope (X:1)=	3.00	November	30	74	50,939	11,931	120	18,701	7,584
Bottom Width, BW, Feet=	0	December	31	83	57,493	12,540	124	19,324	7,837
Bottom Length, BL, Feet=	0	January	31	69	47,786	10,779	124	19,324	7,837
Accumulated Solids Duration, Years=	2	February	28	50	34,678	8,547	112	17,454	7,079
Existing Storage, Acre Feet=	11.70	March	31	42	29,120	8,665	124	19,324	7,837
Surface Area of Existing Storage, SF=	99,555	April	30	11	7,881	5,827	120	18,701	7,584
Minimum Soil Liner Depth, Feet=	1.00	May	31	-14	-9,458	4,702	124	19,324	7,837
25 Year-24 Hour Storm Runoff, CF=	8,156	June	30	-33	-22,815	3,039	120	18,701	7,584
Top Width, TW, Feet=	12	July	31	-59	-40,569	1,311	124	19,324	7,837
Top Length, TL, Feet=	12	August	31	-49	-33,932	1,847	124	19,324	7,837
Volume Needed, Acre Feet=	11.0	September	30	-17	-11,781	3,602	120	18,701	7,584
Design Volume, Acre Feet=	0.0	Annual	365	177	122,038	78,448	1,464	227,527	92,277



Top Width, TW = 12 Feet

25Yr-24Hr Storm Precipitation = 4 Inches

25Yr-24Hr Storm Runoff = 8156 Cubic Feet

105 Day Precipitation - Evaporation = 20.92 Inches

Runoff from Normal Precipitation = 39523 Cubic Feet

Washwater = 425 Cubic Feet

Manure = 66076 Cubic Feet

Volume of Accumulated Solids = 184553 Cubic Feet

Depth = 0.1 Feet

Bottom Width, BW = 0 Feet

ANIMAL WASTE MANAGEMENT WORKSHEET

Version 2.4

7/19/06
STATE: OREGON

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM APPLICATION

MANAGEMENT CRITERIA FOR TRACTOR SPREADER APPLICATION OF SOLIDS

To apply 74,913 cubic feet of solids generated from the operation it will take approximately 376 trips annually. Based on applying NITROGEN, N ⬍
at agronomic rate use the application depths, travel lengths, and loads per acre listed below for each crop.

Field Number	Acres	Crop	Tractor Spreader Capacity		Spread Width Feet	NITROGEN, N Concentration in Storage Facility		Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Inches of Solids to Apply	Travel Length per Load Needed in Feet	Loads per Acre
			Bushels	CF		PPM	Lbs/100CF					
1	28	Corn, Silage(AH)	160	199	15	2,482	15.49	154	1.00	0.5	338	9
1	28	Ryegrass Haylage	160	199	15	2,482	15.49	250	1.00	0.8	208	14
2	25	Corn, Silage(AH)	160	199	15	2,482	15.49	154	1.00	0.5	338	9
3	25	Ryegrass Haylage	160	199	15	2,482	15.49	250	1.00	0.8	208	14
0												
0												
0												
0												
0												

MANAGEMENT CRITERIA FOR BIG GUN SPRINKLER APPLICATION OF LIQUIDS

To apply 2,560,626 gallons of liquids generated from the operation it will take approximately 142 hours of pumping annually. Based on applying NITROGEN, N ⬍
at agronomic rate use the application depths, set times, and travel rates listed below for each crop.

Field Number	Acres	Crop	Sprinkler Flowrate GPM	Wetted Diameter Feet	Portion of Wetted Diameter Receiving Liquids	NITROGEN, N Concentration in Storage Facility		Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Inches of Liquids to Apply	Application Rate in Inches/Hour	Set Time Needed in Hours	Travel Rate Needed in Feet/Minute
						PPM	Lbs/1000Gal						
1	28	Corn, Silage(AH)	300	250	3/4 Circle ⬍	1,095	9.14	154	1.00	1.00	0.97	1.69	1.93
1	28	Ryegrass Haylage	300	250	3/4 Circle ⬍	1,095	9.14	250	1.00	1.62	0.97	2.75	1.19
2	25	Corn, Silage(AH)	300	250	3/4 Circle ⬍	1,095	9.14	154	1.00	1.00	0.97	1.69	1.93
3	25	Ryegrass Haylage	300	250	3/4 Circle ⬍	1,095	9.14	250	1.00	1.62	0.97	2.75	1.19
0					⬍								
0					⬍								
0					⬍								
0					⬍								
0					⬍								

ANIMAL WASTE MANAGEMENT WORKSHEET

Version 2.4

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**
CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM APPLICATION

MANAGEMENT CRITERIA FOR TANK WAGON APPLICATION OF LIQUIDS

To apply 2,560,626 gallons of liquids generated from the operation it will take approximately 640 trips annually. Based on applying NITROGEN, N at agronomic rates use the application depths, travel lengths, and loads per acre listed below for each crop.

Field Number	Acres	Crop	Tank Wagon Capacity Gallons	Spread Width Feet	NITROGEN, N Concentration in Storage Facility		Pounds of Nutrients to be Applied	Number of Applications Needed to meet Crop Demand	Inches of Liquids to Apply	Travel Length per Load Needed in Feet	Loads per Acre
					PPM	Lbs/1000Gal					
1	28	Corn, Silage(AH)	4,000	15	1,095	9.14	154	1.00	0.39	1,107	2.6
1	28	Ryegrass Haylage	4,000	15	1,095	9.14	250	1.00	0.63	682	4.3
2	25	Corn, Silage(AH)	4,000	15	1,095	9.14	154	1.00	0.39	1,107	2.6
3	25	Ryegrass Haylage	4,000	15	1,095	9.14	250	1.00	0.63	682	4.3
0											
0											
0											
0											
0											

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET
Version 2.4

7/19/06
STATE: OREGON

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation	Pounds of Nutrients Available			Percent Nutrients Retained After Storage			Pounds of Nutrients Retained After Storage		
	Dairy ⇕									
	Type of Storage Facility	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Liquids	Storage Pond (<50%) Dilution ⇕	41.044	12.133	38.290	57%	85%	85%	23.395	10.313	32.546
Solids	Solids Storage Facility (Unroofed) ⇕	17.851	5.277	16.653	65%	80%	80%	11.603	4.222	13.322
Grazing	NONE ⇕	0	0	0	100%	100%	100%	0	0	0

NUTRIENTS AVAILABLE AFTER APPLICATION

Nutrient Source	Type of Application System	Pounds of Nutrients Available			Percent Nutrients Retained After Application			Pounds of Nutrients Retained After Application		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Liquids	Sprinkling ⇕	23.395	10.313	32.546	75%	100%	100%	17.546	10.313	32.546
Solids	Broadcast (Incorporated 7 or more days after application) ⇕	11.603	4.222	13.322	70%	100%	100%	8.122	4.222	13.322
Grazing	Grazing ⇕	0	0	0	90%	100%	100%	0	0	0

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location	Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification		
	Between Coastal and Cascade Mountains Between Coastal and Cascade Mountains									
	Soil Drainage Class	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Liquids	Somewhat Poorly Drained ⇕	17.546	10.313	32.546	83%	100%	100%	14.563	10.313	32.546
Solids	Somewhat Poorly Drained ⇕	8.122	4.222	13.322	83%	100%	100%	6.741	4.222	13.322
Grazing	Somewhat Poorly Drained ⇕	0	0	0	83%	100%	100%	0	0	0

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET
Version 2.4

7/19/06
STATE: OREGON

CLIENT: **Joe Duda**
ASSISTED BY: **Micah Wells**

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

PERCENT OF MANURE TO BE APPLIED TO FIELD AND UTILIZATION ACRES NEEDED BASED ON

NITROGEN, N

Field Number	Acres	Crop	LIQUIDS			SOLIDS			GRAZING		
			Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients
1	28.0	Corn, Silage(AH)	19%	2,776	18	0%	0	0	19%	0	0
1	28.0	Ryegrass Haylage	31%	4,506	18	0%	0	0	31%	0	0
2	25.0	Corn, Silage(AH)	19%	2,776	18	0%	0	0	19%	0	0
3	25.0	Ryegrass Haylage	31%	4,506	18	0%	0	0	31%	0	0
0											
0											
0											
0											
0											
Off-Farm			0%	0		100%	6,741		0%	0	
		TOTALS-	100%	14,563	72	100%	6,741	0	100%	0	0

NUTRIENT BALANCE BASED ON AVAILABLE ACRES

Field Number	Acres	Crop	NUTRIENTS APPLIED			- NUTRIENTS REMOVED			= NUTRIENT BALANCE		
			Nitrogen, N Lbs/Acre	Phosphorous. P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous. P_2O_5 Lbs/Acre	Potassium, K_2O Lbs/Acre
1	28.0	Corn, Silage(AH)	99	70	222	154	80	184	-55	-10	38
1	28.0	Ryegrass Haylage	161	114	360	250	92	257	-89	22	103
2	25.0	Corn, Silage(AH)	111	79	248	154	80	184	-43	-2	64
3	25.0	Ryegrass Haylage	180	128	403	250	92	257	-70	36	146
0											
0											
0											
0											
0											
Off-Farm											

U.S. Department of Agriculture
Natural Resources Conservation Service

ANIMAL WASTE MANAGEMENT WORKSHEET
Version 2.4

7/19/06
STATE: OREGON

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Joe Duda

Tract(s): 1000

Field(s): 1

Assisted by: Micah Wells

Date: July 19, 2006

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Corn, Silage(All)	20

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC
NA	87-120	227-459	6.1-6.4		

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			
200		0		0				

Table 2. Nutrient Sources

Credits		N	P_2O_5	K_2O
		pounds per acre		
1. Nitrogen credits from previous legume crop				
2. Residual from long-term manure application				
3. Irrigation water				
4. Other (e.g., atmospheric deposition)				
5. Total Credits-		0	0	0

Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials (Source-)	Dairy	99	0	70	0	222	0
9.	Subtotal (sum of lines 6, 7 and 8)	99	0	70	0	222	0
10.	Nutrients Recommended (from Table 1)	200	0	0	0	0	0
11.	Nutrient Status (subtract line 10 from line 9)	-101	0	70	0	222	0

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS

Amount to be Applied (lb/ac)	N	206	P_2O_5	177	K_2O	340

Method, Form, and Timing of Application

Recommended application rates are based on OSU Extension Recommendations.
No commercial fertilizer should be applied as all nutrients can be supplied by manure applications except for Sulfur, Magnesium, Zinc and Boron which should be applied in accordance with the fertilizer guide and soil tests.
Use nutrient concentrations in storage to determine big gun travel rates to apply 100 pounds per acre of nitrogen in March or April and again in May.
Use nutrient concentration in storage to determine solids spreader loads per acre to apply 200 pounds per acre of nitrogen in March or April. No more than a total of 200 pounds of nitrogen per acre should be applied.
Score card soil testing should be done in the fall to insure excessive nitrates are not available for leaching.
Manure should be reduced or not applied if soil tests show Phosphorous and Potassium concentrations continue to increase over time and approach very high levels as determined by OSU Extension.

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Joe Duda

Tract(s): 1000

Field(s): 1

Assisted by: Micah Wells

Date: July 19, 2006

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Ryegrass Haylage	10

CURRENT SOIL TEST LEVELS (ppm or lb/ac)

N	P	K	pH	S.O.M.%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD

N (lbs/ac)		P₂O₅ (lbs/ac)		K₂O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			

Table 2. Nutrient Sources

Credits	N		P₂O₅		K₂O	
	pounds per acre					
1. Nitrogen credits from previous legume crop						
2. Residual from long-term manure application						
3. Irrigation water						
4. Other (e.g., atmospheric deposition)						
5. Total Credits-	0		0		0	
Plant-Available Nutrients Applied to Field	N		P₂O₅		K₂O	
(Circle column that is landuser's decision)	Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)	0	0	0	0	0	0
7. Fertilizer — Starter						
7. Fertilizer — Other						
8. Manure / Organic Materials (Source-)	161	161	114	114	360	360
9. Subtotal (sum of lines 6, 7 and 8)	161	161	114	114	360	360
10. Nutrients Recommended (from Table 1)	0	0	0	0	0	0
11. Nutrient Status (subtract line 10 from line 9)	161	161	114	114	360	360

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS

Amount to be Applied (lb/ac)	N		P₂O₅		K₂O	

Method, Form, and Timing of Application

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Joe Duda

Tract(s): 1000

Field(s): 2

Assisted by: Micah Wells

Date: July 19, 2006

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Corn, Silage(All)	20

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop							
2. Residual from long-term manure application							
3. Irrigation water							
4. Other (e.g., atmospheric deposition)							
5. Total Credits-		0		0		0	
Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials (Source-)		111	111	79	79	248	248
9.	Subtotal (sum of lines 6, 7 and 8)	111	111	79	79	248	248
10.	Nutrients Recommended (from Table 1)	0	0	0	0	0	0
11.	Nutrient Status (subtract line 10 from line 9)	111	111	79	79	248	248
If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.							
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.							

PLANNED NUTRIENT APPLICATIONS						
Amount to be Applied (lb/ac)	N		P_2O_5		K_2O	

Method, Form, and Timing of Application

NUTRIENT MANAGEMENT DESIGN AND SPECIFICATIONS

Producer: Joe Duda

Tract(s): 1000

Field(s): 3

Assisted by: Micah Wells

Date: July 19, 2006

PURPOSE (Check all that apply)			
Budget and supply for plant production	x	Utilize manure/organic materials as a nutrient source	x
Minimize agricultural non-point source pollution (water quality)	x	Maintain or improve soil condition	x

Table 1. Field Conditions and Recommendations

CROP SEQUENCE/ROTATION (circle current crop)	EXPECTED YIELD
Ryegrass Haylage	10

CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M.%	EC

RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD								
N (lbs/ac)		P_2O_5 (lbs/ac)		K_2O (lbs/ac)		LIME	Other	Other
Trial A	Trial B	Trial A	Trial B	Trial A	Trial B			

Table 2. Nutrient Sources

Credits		N		P_2O_5		K_2O	
		pounds per acre					
1. Nitrogen credits from previous legume crop				▨		▨	
2. Residual from long-term manure application				▨		▨	
3. Irrigation water							
4. Other (e.g., atmospheric deposition)							
5. Total Credits-		0		0		0	
Plant-Available Nutrients Applied to Field		N		P_2O_5		K_2O	
(Circle column that is landuser's decision)		Trial A	Trial B	Trial A	Trial B	Trial A	Trial B
6. Credits (from row 5, above)		0	0	0	0	0	0
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials (Source-)		180	180	128	128	403	403
9. Subtotal (sum of lines 6, 7 and 8)		180	180	128	128	403	403
10. Nutrients Recommended (from Table 1)		0	0	0	0	0	0
11. Nutrient Status (subtract line 10 from line 9)		180	180	128	128	403	403

If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.

If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.

PLANNED NUTRIENT APPLICATIONS						
Amount to be Applied (lb/ac)	N		P_2O_5		K_2O	

Method, Form, and Timing of Application

PNW 549
August 2001

Keeping Track of Manure Nutrients in Dairy Pastures

T. Downing

Keeping track of nutrient levels in dairy pastures has become an important part of farm management plans. The current recommendation is to fertilize pastures at a level to replace, in equal measure, the nutrients removed through grazing or cutting each year.

The Confined Animal Feeding Operations Program (CAFO) run by the Oregon Department of Agriculture assumes that most livestock facilities apply manure at agronomic rates for nitrogen. Thus, they expect CAFO operations to make sure the amount of nitrogen applied to a field each year equals the amount removed.

For operations with grazing animals, determining manure application rates and forage consumption can be challenging. This publication will help you work through this process.

In concept, tracking nitrogen balance is simple: the grazing animal adds nitrogen in the form of manure and urine and removes it in the form of protein in the grass grazed. To quantify these values, you need to determine both how much manure was applied and the amount and quality (percentage nitrogen content) of grass grazed.

The variables include:

- Manure generated: number of animals and the amount of time spent in each field
- Quantity of forage removed through grazing and cutting
- Quality of forage removed: percent protein (i.e., percent nitrogen)
- Amount of manure stored and spread from the confinement facility
- Acreage of each pasture unit
- Calibration of waste-handling equipment

Estimating manure generated

The nitrogen content of dairy manure is well documented, but these values vary depending on feed intake. Table 1 shows the direct relationship between nutrient intake and excretion.

By estimating the percentage of the day cows spend in the field, you can calculate the amount of the day's waste applied as fertilizer. Note in Table 1 that the amount of nutrients excreted by a cow can be estimated based on her milk production or feed intake.

Table 1. – Estimated daily nitrogen (N) and phosphorus (P) excretion.

Milk Production	100 lb/day	70 lb/day	50 lb/day	Dry
Intake/day	56 lb	46 lb	39 lb	25 lb
Total N, lb/day waste	0.9 lb/day	0.8 lb/day	0.65 lb/day	0.4 lb/day
Total P, lb/day (diet 0.45% P)	0.151 lb/day	0.138 lb/day	0.126 lb/day	0.113 lb/day

Source: H.H. Van Horn et al., 1999.

Troy Downing,
Extension agent,
Tillamook County,
Oregon State
University.

Yard stick

The third method for calculating standing forage uses a yardstick. By measuring the standing height of the forage, you can make an educated estimate of the total pounds of dry matter. This method does not account for stand density, so the more uniform your pastures, the more accurate your estimate will be.

To use this method, measure the height of the pasture (Figure 3). Use the clipping and weighing method to determine how many pounds of dry matter are in the standing forage per acre. Divide this value by the number of inches in height to calculate an estimated per-inch value. For example, if your pasture measures on average 12 inches tall and you calculate that there are 3,000 lb of dry matter per acre, your pasture averages 250 lb of dry matter per acre-inch.

It is important to complete these steps several times to account for variations in your technique and in the fields. Common values for good ryegrass pastures range from 250 to 300 lb DM per inch for well-established pastures. In our clipping and weighing example, Field 1 had 2,400 lb of dry matter per acre before grazing, so the pasture would have been around 8 inches tall. After grazing, we had 1,200 lb of dry matter left, so the pasture should have been around 4 inches tall.

Capacitance meter

The fourth method for calculating standing forage is with a capacitance meter (Figure 4), an electronic device that measures dry matter in standing forage as you walk across the field. Take at least 30 to 40 measurements before turning the animals into the field and immediately after the period of grazing. Like the rising plate meter, the capacitance meter provides measurements in pounds of dry matter per acre or kilograms per hectare. This equipment also is available from many New Zealand companies.

Testing protein levels

If you periodically test the protein level of the forage grazed, you can use this value to determine nitrogen content. For example, if Field 1 tests 20 percent protein, a ton of dry matter (2,000 lb) contains 400 lb of protein.

Nitrogen is a significant component of protein, and nitrogen levels can be determined with a simple calculation. If you divide the protein content (in this case, 400 lb) by 6.25, the resulting figure represents the approximate amount of nitrogen removed per dry matter ton, or 64 lb. Therefore, extending our earlier example of 4,800 lb of forage dry matter removed, we can make the following calculation: 2.4 tons x 64 lb nitrogen per ton = 154 lb of nitrogen removed from the 4-acre Field 1, or 38 lb of nitrogen per acre. Table 2 (page 4) shows the relationship between percentage of protein and pounds of nitrogen content in dry matter.

Determining the net N balance

In our example, the grazing cows deposited 120 lb of nitrogen and removed 154 lb in the 4-acre field. Therefore, there was a net loss of 34 lb of nitrogen from the field during this grazing session, an 8.5-lb loss per acre.

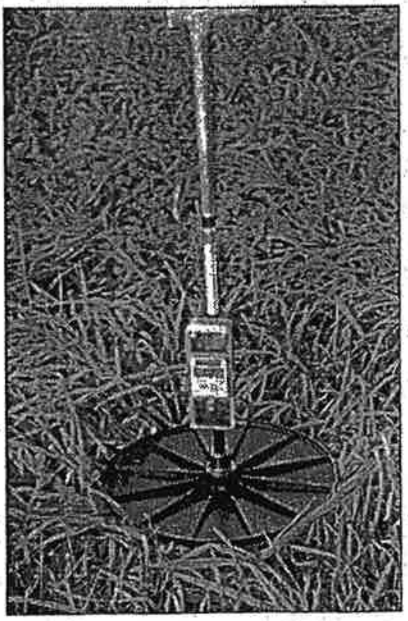


Figure 2.—The electronic rising plate meter estimates standing forage dry matter, accounting for pasture height and density.

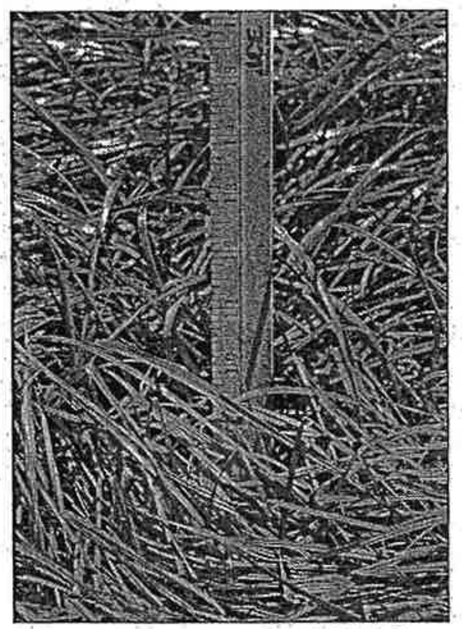


Figure 3.—By measuring the height of forage, you can estimate the total pounds of dry matter in a pasture.

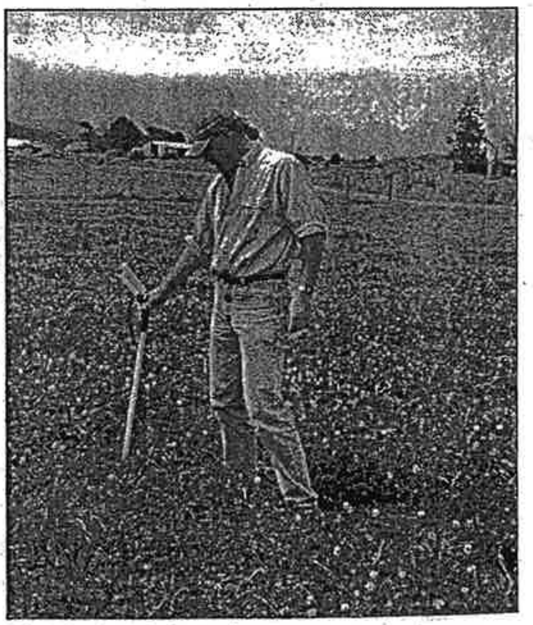


Figure 4.—A capacitance meter measures dry matter in standing forage as you walk across the field.

Fact Sheet

NO. 12 JANUARY 1999

Fertilizing for Profit

Tips for Small Acreages in Oregon

USDA Agricultural Research Service

"Watch earnestly over every acre."

- Clarence Poe

Make the Most of Your Fertilizer

In 1900, each American farmer produced enough food and fiber for 10 people. Today, with advances such as synthetic fertilizers, that number is 129 people. This abundance of food and fiber brings with it the responsibility to keep fertilizers on the land and out of the water. **Nutrient management** is a practice that applies fertilizers efficiently without polluting water. The benefits are:

High crop yields with lower fertilizer costs.

In one study, Oregon dairy farmers applied manure as a fertilizer. They saved $30 to $70 in commercial fertilizer costs per acre without decreasing yield.

Healthy animals.

Horses, cattle, sheep, and goats can get nitrate poisoning from forage grown on overfertilized soils. Taking a soil test and applying the right rates of fertilizer and manure can reduce this health problem.

Clean water for healthy people and fish.

When fertilizers reach surface water and groundwater, nitrate in well water may harm infants. Excess phosphorous may cause algae blooms, reduce oxygen, and kill fish. Applying fertilizers correctly has reduced nitrate in groundwater in Ontario, Oregon.

Fertilize at the Right Rate: Soil Tests

A soil test is the simplest way to manage fertilizers for a healthy crop and environment. A soil test will tell you the level of nutrients in your soil and how much fertilizer to apply to the crop. Follow these steps to take a soil test:

1. **Draw a map of your farm.**
   Assign a name or code for each area to be soil tested. Use this map to record fertilizer applied, crops grown, and yields. This will help you to identify your soil samples and to record the results of your nutrient management program.
2. **Use the right equipment.**
   Take soil samples with a soil probe, garden spade, or shovel. Collect the samples in a clean plastic pail or paper bag. Soil sampling tools should be chrome-plated or stainless steel when testing for micronutrients.
3. **Establish sampling areas.**
   Identify areas that have different soils, crops, or manure histories and test these separately. Avoid taking samples from unusual areas like fence rows, manured areas, and old building sites. Stay at least 150 feet from gravel roads.
4. **Sample in the spring or fall.**
   Send in soil samples at least 3 to 6 weeks before planting. This should give labs enough time to test soils and send you the results in time for planting. Consider sending samples in the fall when labs are less busy. Test at the same time of year to compare results from year to year. Follow lab fertilizer and lime recommendations or use OSU Fertilizer Guides.
5. **Take 15 to 20 subsamples per area.**
   The area should be less than 20 acres. Scrape plant litter from the soil surface and sample the top 8 inches of soil (depths for special situations are in the table on page 2). If using a shovel, dig an 8-inch-deep hole and slice a 1-inch-thick slab from the side. Trim soil away on each side, leaving a 1-inch-thick strip for the subsample.
6. **Mix subsamples together in pail and dry in a clean area.**
   Do not use an oven or the hot sun to dry soils.
7. **Send at least 1 cup of soil for each sample to a lab.**
   Ask the lab about costs and mailing instructions. Include information on past cropping history, crop to be grown, and yield goal. Label soil samples and key them to your map. For a list of labs, see the Oregon State University (OSU) Extension Service publication A List of Analytical Laboratories Serving Oregon (EM8677). To get this publication, see the website listed in the "For Help" section at the end of this fact sheet or visit your local Extension Service office.

This fact sheet was produced by the Washington County Soil and Water Conservation District (SWCD) and the Small Acreage Steering Committee. The Governor's Watershed Enhancement Board, the Oregon Association of Conservation Districts, and the USDA Natural Resources Conservation Service funded the project. Media Works of Bozeman, Montana designed the fact sheet. You may reproduce or copy any portion of the text by notifying the Washington County SWCD at (503) 648-3174. Please acknowledge this publication as the source. Additional permission is needed to reproduce credited pictures.

Fertilizers in the Right Place, Right Time

To get the most bang for your fertilizer buck and avoid pollution, follow these strategies:

Ada Soil Conservation District

Use the right amount.

This is where "an ounce of prevention is worth a pound of cure." Avoid applying excess levels of nutrients to the soil. Otherwise, nitrate may leach and pollute groundwater, phosphorus runoff may cause algae blooms, and high nitrate levels in forages may poison horses, goats, sheep, and cattle. Fertilize based on a soil test and realistic crop yield goals. Calibrate fertilizer spreaders. If manure cannot be worked into the soil, avoid spreading manure more than one-half inch thick on the ground each year. This will reduce the potential for polluted runoff.

Put it in the right place and work it into the soil.

Most phosphorus is immobile in soil. This means plant roots must grow to the source of phosphorus. If phosphorus is needed, band the fertilizer 2 inches to the side and 2 inches below the seed to give seedlings a good start. Beware of banding fertilizers too close as banded nitrogen, potash, and boron may burn the seed. Manure that is broadcast should be worked into the soil within 3 days. Otherwise, up to a third of the available nitrogen in manure may be lost as gas. Know your field limitations. When nutrients cannot be worked into the soil, avoid spreading in areas where water flow may concentrate, in floodplains, or within 50 feet of streams.

Apply it at the right time.

Water can dissolve nitrogen and carry phosphorus attached to soil particles. This means rain, snow, or floods can move nitrate into groundwater and nitrogen and phosphorus over land and into lakes and streams. Apply fertilizer and manure during the growing season when crops will use the nutrients. Split the applications of nitrogen on pastures, lawns, and crops for maximum plant uptake and minimum loss to runoff. Avoid applying fertilizer or manure during fall rains, in the winter, or on saturated soils. This may require manure storage, depending on your situation. For more about manure storage, see the fact sheet *Managing Mud and Manure* in this series.

Follow the right conservation practices.

Phosphorus is held tightly to soil and is moved mostly by loss of soil due to erosion. Reduce phosphorus losses using erosion control practices such as conservation tillage, contour strip cropping, and grass waterways. Capture phosphorus and nitrogen with winter cover crops, grass filter strips at field borders, and streamside buffers. Manage irrigation water to reduce leaching and erosion losses and excessive runoff.

Take Credit for Legumes

Grow legumes to add nitrogen naturally to the soil. Legumes include alfalfa, clovers, beans, peas, and birdsfoot trefoil. Reduce your nitrogen application by 40 pounds when following clover and up to 100 pounds per acre after alfalfa. Even grass may add a flush of nitrogen to the soil.

Fertilizing Pastures

Pastures need less fertilizer than row crops because grazing animals return manure nutrients to the soil. Rotational grazing will distribute manure more evenly. Take a soil test to find out the nutrient levels and pH in your soil. For more information, see the OSU Extension Service publication *Pastures: Western Oregon and Western Washington* (FG63).

CONSTRUCTION NOTES & SPECIFICATIONS

The owner is responsible for obtaining all permits related to the construction and operation of this project.

No representation as to existence or non-existence of utilities, public or private is made. It is the responsibility of the contractor to comply with provisions of ORS 757.541 and 757.571 and to determine the location of utilities (1-800-332-2344). The contractor will be liable for any damage resulting from disruption of service caused by construction activities.

The following items must be documented during construction in order to show the installed concrete slab meets the requirements of the drawings and specifications and can be approved for NRCS cost share funding:

1. The spacing and size of steel rebar used in the construction of the slab.
2. Length, width and thickness of the concrete slab.
3. Documentation of the size of aggregate, bags of cement, volume of water added and air entrainment used per cubic yard of concrete.

All work will be done in accordance with these drawings and the following specifications:

The concrete shall be proportioned, transported and placed in accordance with ACI 301-89, Specifications for Structural Concrete for Buildings. The concrete shall have a minimum compressive strength at 28 days of 3,000 psi. Minimum cement content shall be 6 bags per cubic yard, the maximum net water content shall be 7 gallons per sack, and the air content shall be 5 to 8 percent. The allowable slump of the concrete shall be 2 to 4 inches.

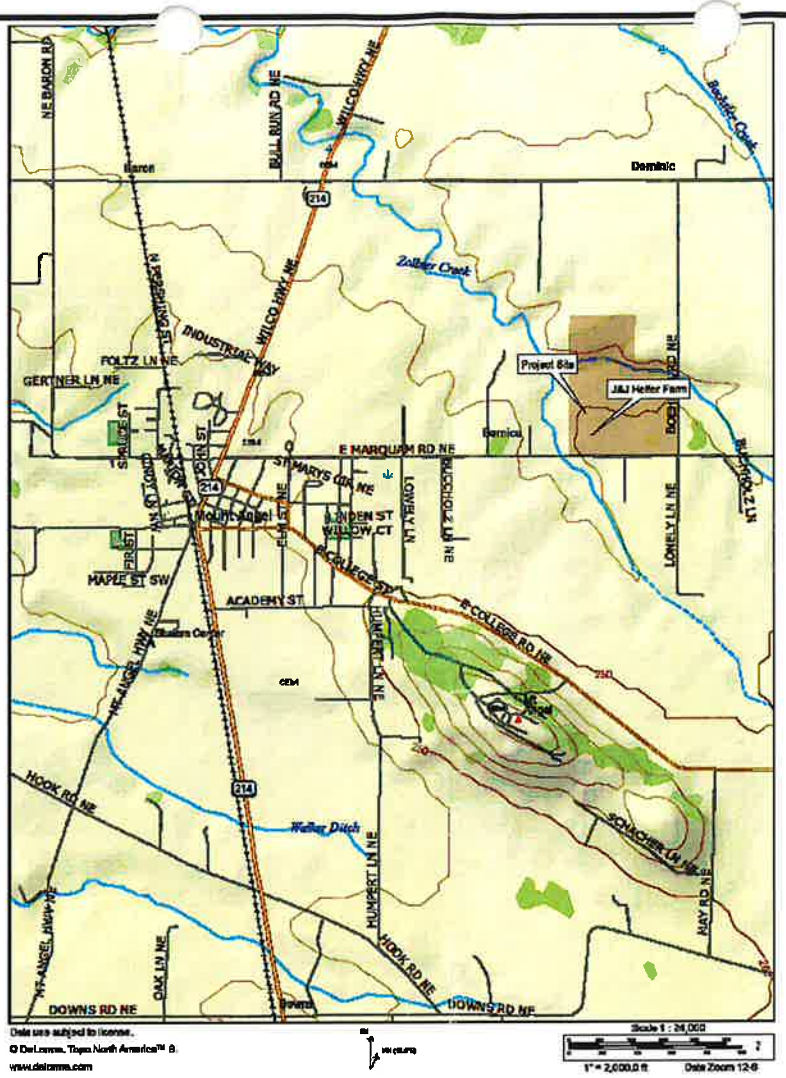
Forms shall be Mortar tight and constructed such that the finished concrete will conform to the dimensions shown on the drawings.

Reinforcement bars shall be ASTM designation A-615, grade 60.

The concrete shall be placed as closely as possible to it's final position in the forms and shall be worked into the corners of the forms and around all reinforcement bars. The concrete shall not be dropped more than 5 feet vertically unless suitable equipment is used to prevent the aggregate from separating. Forms shall not be removed before 24 hours have elapsed after placement of the concrete.

The concrete shall be prevented from drying for a curing period of at least 7 days after it is placed. The concrete shall be kept continuously moist for the curing period or until curing compound is applied. Moisture shall be maintained by sprinkling or flooding with water and then covering with plastic sheeting or using moistened cloth, canvas coverings or other approved methods. If curing compound is used it shall meet the requirements of ASTM C 309, Type 2.

Crack control joints shall be installed in the surface of the concrete to a depth of 1 ¼ inch using a hand tool or saw-cut on hardened concrete within 4 to 12 hours after concrete placement. Crack control joints shall be placed every 15 feet and primarily form a square. Hand tooled joints shall be ¼ inch wide and sawed joints shall be ⅛ inch wide. Crack control joints shall be cleaned and a filled with a flexible epoxy or "Zip Strip" after 28 days have elapsed from placement of the concrete. Crack control joints may be eliminated if steel reinforcement is placed on 8 inch centers both ways in the slab.



LOCATION MAP

Section 2, T6S, R1W W.M.

INDEX OF DRAWINGS

Sheet Number	Subject
1	Construction Notes, Specifications and Location Map
2	Plan View and Details of Concrete Slab

REGISTERED PROFESSIONAL ENGINEER 12,954
OREGON
JULY 26, 1985
BRUCE D. WILSON
Bruce D. Wilson

SIGNED: 08/28/2013

EXPIRATION DATE: 6/30/2014

J&J Heifers
DRY STACK SLAB PROJECT
Marion County, Oregon

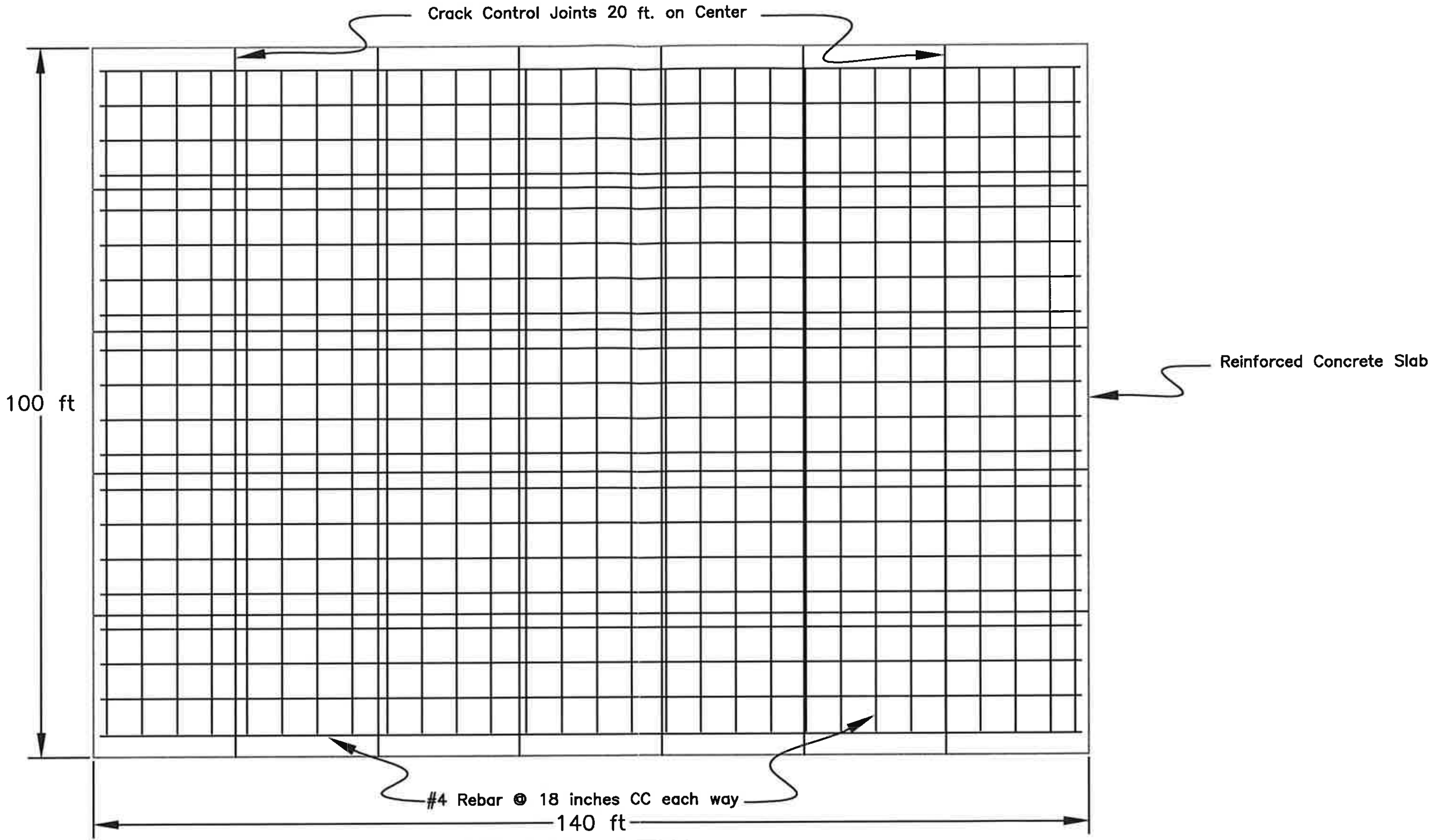
H & R Engineering, LLC
KEIZER, OREGON

DESIGNED BY: B. Wilson
DRAWN BY: B. Wilson

DRAWING NO.: JJ01

Duda #63141 Marion

August 2013
Sheet 1 of 2



PLAN VIEW

(Not to Scale)

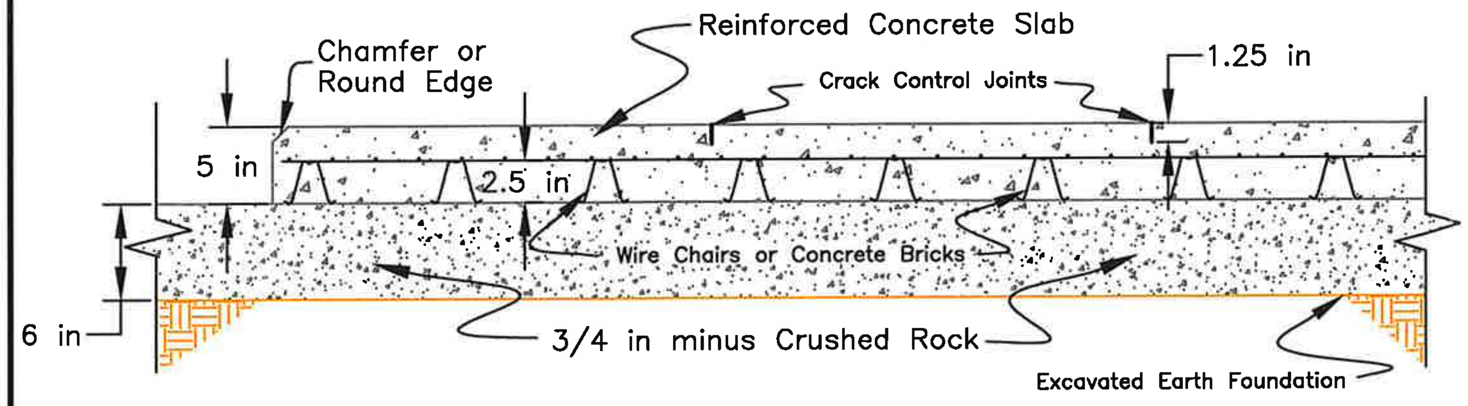
Materials:
Volume of Concrete Needed: cubic yards.

Volume of Steel Needed: 1,070–20 foot long sections or 21,400 feet of Grade 60–#4 bars.

Construction Notes:
Use metal chairs or concrete bricks that are the appropriate height and spaced 5 feet apart to support steel reinforcement during concrete placement.

Use 12 inch lap splices to join lengths of reinforcing steel together and stagger splices so they do not all occur at the same distance from the edge of the slab.

Chamfer or round exposed edges of the concrete slab to prevent spalling.



SLAB DETAIL

(Not to Scale)

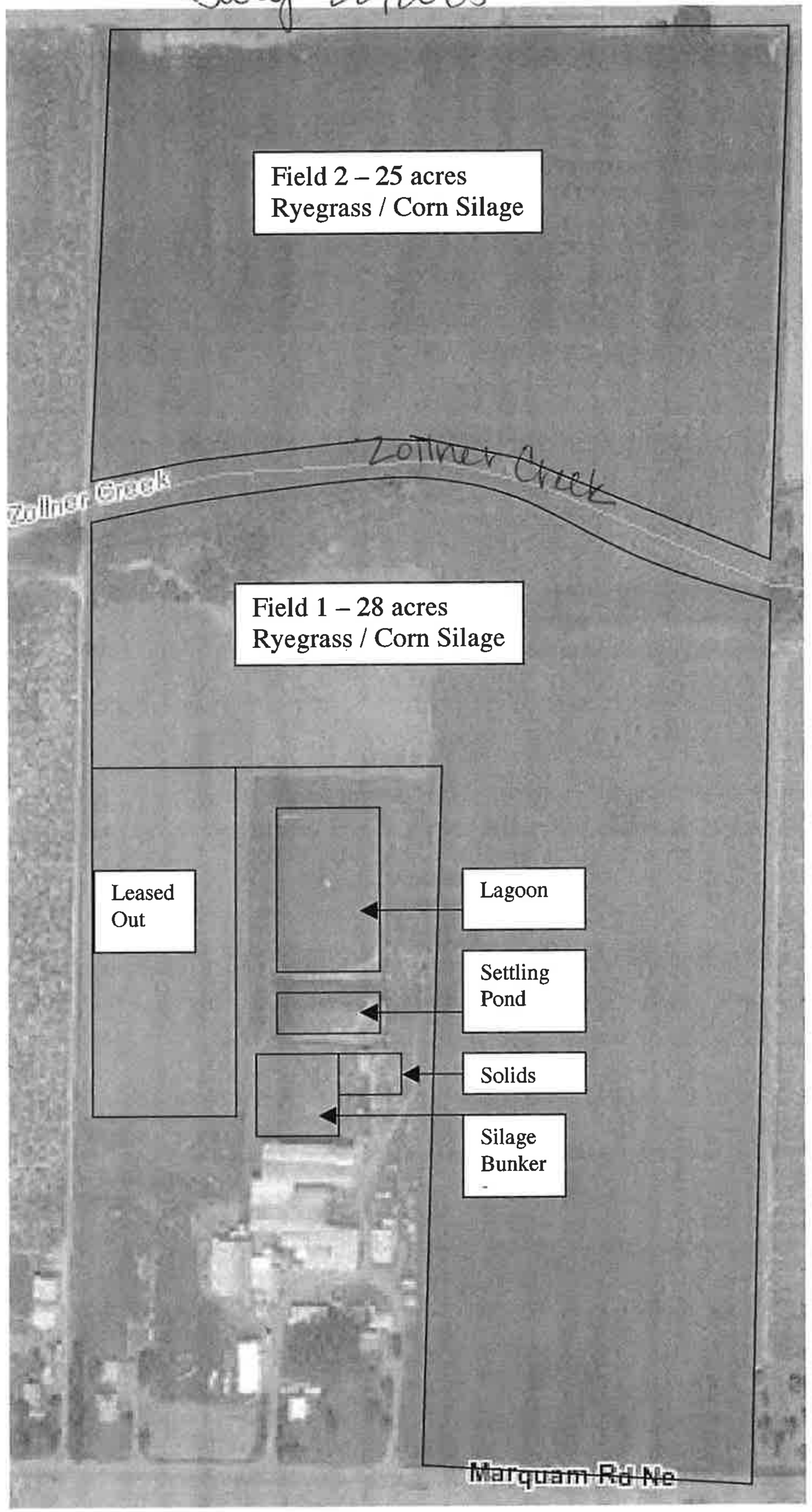
12,954
Bruce D. Wilson
JULY 26, 1985
BRUCE D. WILSON
SIGNED: 08/28/2013
EXPIRATION DATE: 6/30/2014

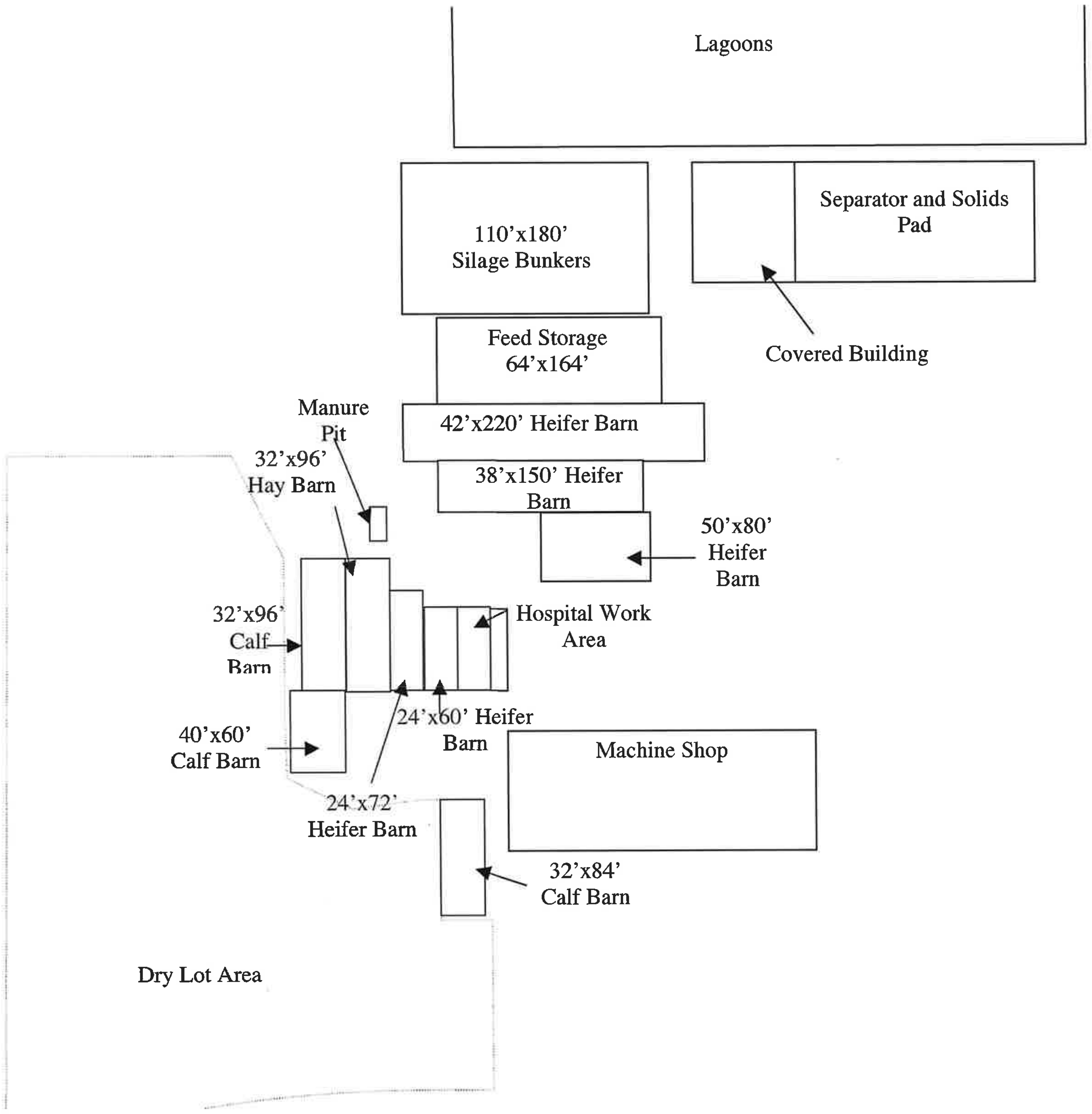
J&J Heifers
DRY STACK SLAB PROJECT
Marion County, Oregon

H & R Engineering, LLC
KEIZER, OREGON

DESIGNED BY: B. Wilson
DRAWN BY: B. Wilson
DRAWING NO.: JJ02
August 2013
Sheet 2 of 2

Joe Duda – Mt. Ang?
July 22, 2005



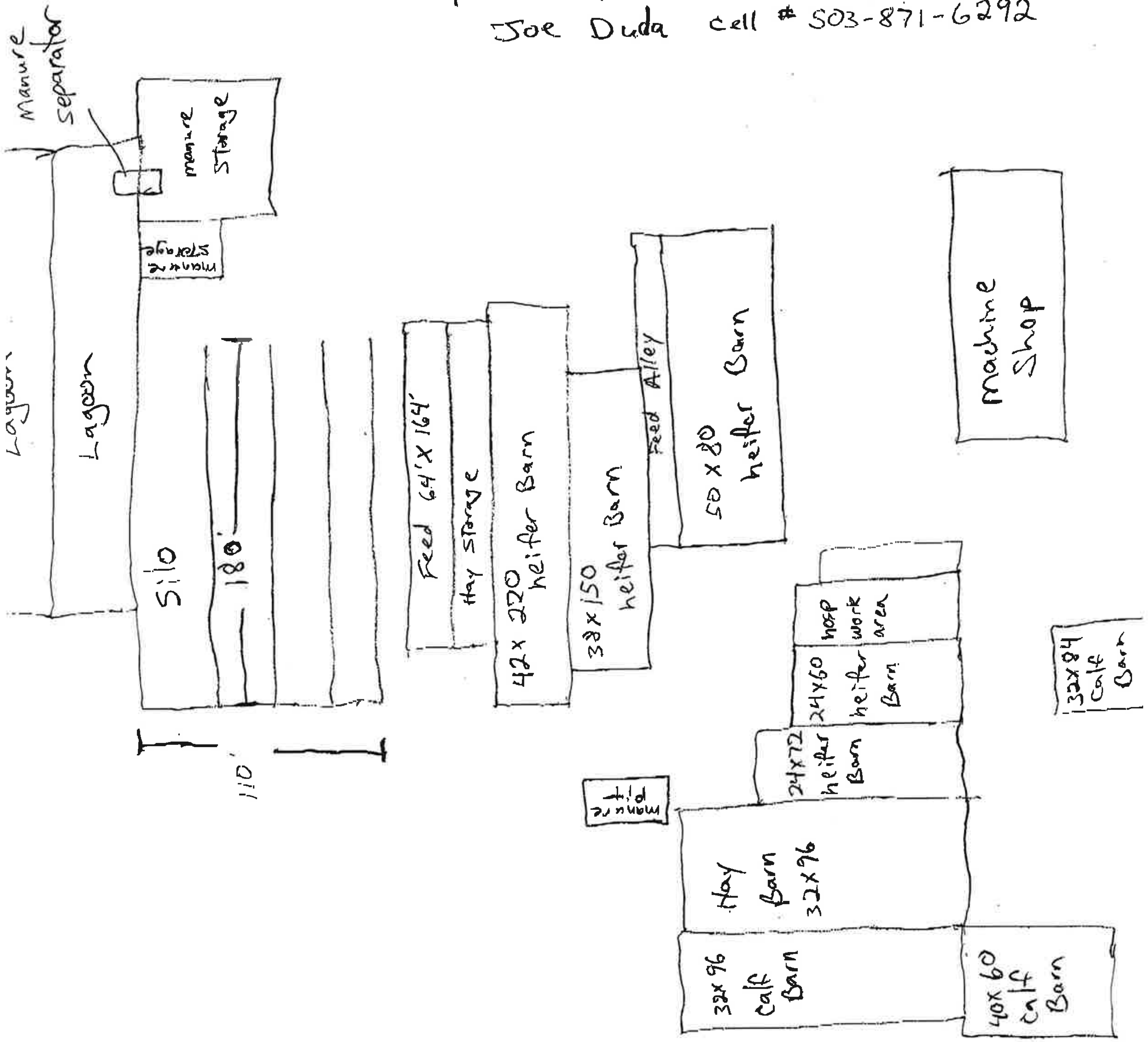

Lagoons
110’x180’ Silage Bunkers
Separator and Solids Pad
Covered Building
Feed Storage 64’x164’
Manure Pit
42’x220’ Heifer Barn
32’x96’ Hay Barn
38’x150’ Heifer Barn
50’x80’ Heifer Barn
32’x96’ Calf Barn
Hospital Work Area
24’x60’ Heifer Barn
40’x60’ Calf Barn
Machine Shop
24’x72’ Heifer Barn
32’x84’ Calf Barn
Dry Lot Area

Atten: Sarah

map of facilities for

J & J Heifers

Joe Duda cell # 503-871-6292



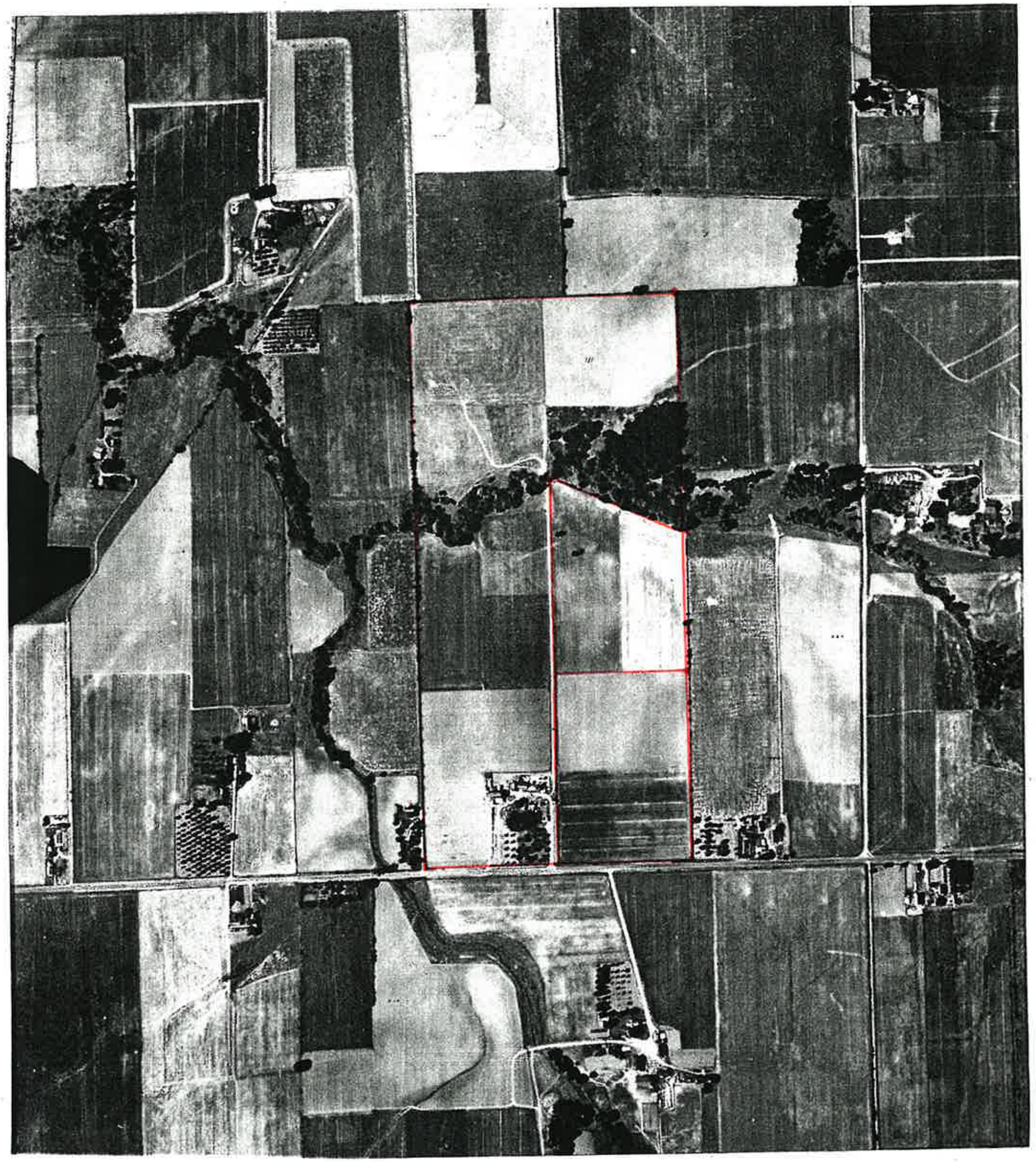
OUR SOIL ★ OUR STRENGTH

Prepared by **UNITED STATES DEPARTMENT of AGRICULTURE ★ SOIL CONSERVATION SERVICE**
cooperatin

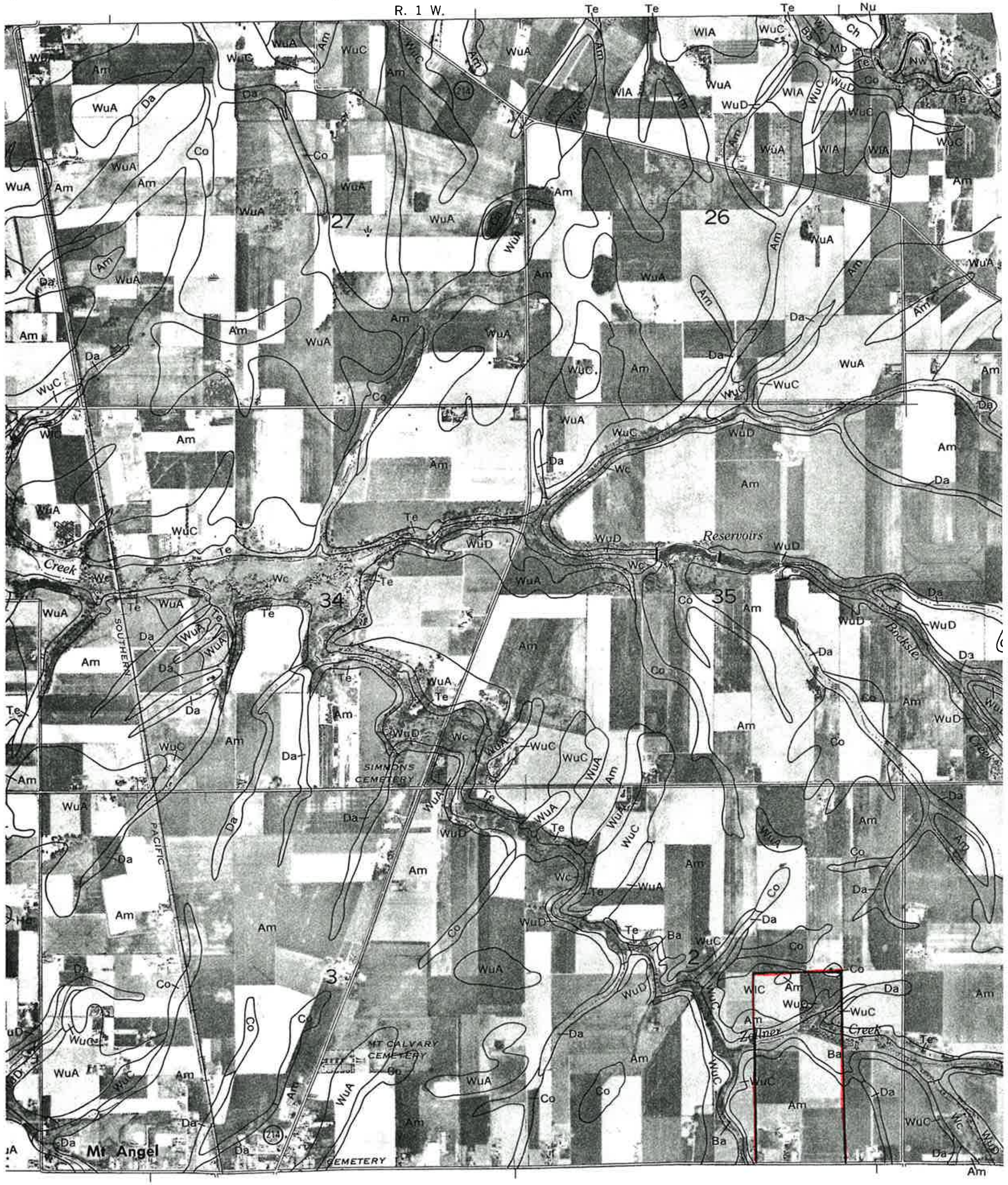
S. C. DISTRICT

OWNER
OPERATOR
COUNTY , STATE

FARM No. DATE
SCALE: APPROXIMATE ACRES
PHOTO No.



MARION COUNTY A OREGON — SHEET NUM



Amity Series

The Amity series consists of somewhat poorly drained soils that have formed in mixed alluvial silts. These soils have slopes of 0 to 2 percent. They occur on broad valley terraces at elevations of 150 to 350 feet. The average annual precipitation is between 40 and 45 inches. The average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly grasses, shrubs, hardwoods, :and scattered, Douglas-firs. Amity soils are associated with Dayton and Concord soils.

In a typical profile, the surface layer is very dark grayish-brown silt loam that is mottled in the lower part and is about 17 inches thick. The subsurface layer is mottled dark-gray silt loam about 7 inches thick. The subsoil is mottled grayish-brown silty clay loam about 13 inches thick. A substratum of mottled olive-brown silt loam underlies the subsoil.

The Amity soils are used mainly for cereal grains, grass grown for seed, and pasture. When irrigated, areas that are drained can be used for all the crops commonly grown in the survey area.

Amity silt loam (Am).-This is the only soil of the Amity series mapped in the survey area. It occupies slightly convex or nearly level areas on terraces consisting of Willamette silts. Representative profile 30 feet east of a paved road (SW1/2SE1/4 sec. 10, T. 5 S., R. 2 W.)

Included with this soil is mapping were small areas of soils that are in drainageways and depressions and that have slopes of 2 to 5 percent. Also included were small areas of Woodburn and Concord soils.

The available water capacity ranges from 9 to 12 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and erosion is not a hazard or is only a slight hazard. The depth to which roots can penetrate is moderately restricted by wetness, partly caused by a high water table that is near the surface during winter and spring. Workability is good, but this soil compacts easily if it is cultivated when wet.

Undrained areas of this soil are used for small grains, pasture, and grasses grown for seed, but drainage is needed for berries, vegetables, and specialty crops. If this soil is drained and irrigated, it can be used for all the crops commonly grown in the survey area. Evan after drainage is installed, however, there are slightly restrictions to use of this soil for deep-rooted crops that cannot tolerate excessive moisture. Nevertheless, response to drainage and fertilizer is generally good. (Capability unit IIw-2; not placed in a woodland suitability group)

Included with this soil in mapping were small areas of moderately fine textured soils that have a very dark grayish-brown surface layer. Also included were areas of clayey soils that have a thin, black surface layer.

The available water capacity ranges from 8 to 10 inches. Permeability is very slow, and fertility is moderate. Runoff is very slow to ponded, and the hazard of erosion is slight. Some material is deposited on the surface each year in areas not water table. This soil is easily worked, but it tends to compact if it is cultivated when too moist.

Areas of this soil that are neither drained nor irrigated are used for spring small grains, pasture, hay, and grass grown for seed. When irrigated, drained areas are used for berries and vegetables. This soil is well suited to vegetables, small grains, pasture, and hay. (Capability unit IIIw-2; not placed in a woodland suitability group)

Dayton Series

The Dayton series consists of soils that are poorly drained. These soils have formed mainly in old mixed alluvium, but their upper layers may have been influenced, to some extent, by loess. The soils are on broad valley terraces, and they occur in drainageways and in shallow depressions. Slopes range from 0 to 2 percent, and elevations range from 125 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly annual and perennial grasses, wild rose, and scattered ash trees. Dayton soils are associated with Amity and Concord soils.

In a typical profile, the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsurface layer is mottled dark-gray silt loam about 6 inches thick. The subsoil is mottled and consists of a layer of clay about 33 inches thick. It is dark gray in the upper part and is grayish brown in the lower part. The substratum is mottled grayish-brown silty clay loam that extends to a depth of 60 inches or more.

The Dayton soils are used mainly for small grains, pasture, hay, and grass grown for seed.

Dayton silt loam (Da).-This soil is on terraces, where it occupies small areas in drainageways and depressions. It is the only soil of the Dayton series mapped in the survey area. Representative profile (SW1/4NE1/4 sec. 16, T. 6 S., R. 2 W.).

Included with this soil in mapping were small areas of a Concord soil. The included areas make up as much as 5 percent of the acreage in the mapping unit.

The available water capacity above the clay subsoil is 3 to 6 inches. Permeability is very slow, and fertility is low. Runoff is very slow to ponded, and the hazard of erosion is slight. Roots can penetrate to the claypan, which is at a depth of only 12 to 24 inches. Workability is good, but this soil tends to puddle and compact if it is cultivated when too moist.

Undrained areas of this soil are used for small grains, pasture, hay, and grass grown for seed, and the drained areas are used for corn and for winter and spring small grains. When irrigated, this soil is used for sweet corn and bush beans. Even where it is drained, it is not suited to deep-rooted crops, many perennial crops, and crops that cannot tolerate excessive moisture. (Capability unit IVw1; not placed in a woodland suitability group) and berries. This soil is less suitable for vegetables and berries than Willamette silt loam, 0 to 3 percent slopes. Mechanical harvesting of crops is difficult on slopes steeper than 5 percent. (Capability unit IIe-2; not placed in a woodland suitability group)

Woodburn Series

The Woodburn series consists of moderately well drained soils that have formed in silty alluvium and loess of mixed mineralogy. These soils are on broad valley terraces. They have slopes of 0 to 20 percent. Elevations range from 150 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly grass and Douglas-fir. Woodburn soils are associated with Willamette soils.

In a typical profile, the surface layer is about 17 inches thick and is very dark brown silt loam in the upper part and dark-brown silt loam in the lower part. The subsoil is about 37 inches thick. It is dark yellowish-brown silty clay loam in the upper part; mottled dark-brown silty clay loam in the middle part; and mottled, dark-brown silt loam in the lower part. The substratum is dark-brown silt loam that extends to a depth of 68 inches or more.

The Woodburn soils are used mainly for small grains, pasture, hay, orchards, berries, and vegetables.

Woodburn silt loam, 0 to 3 percent slopes (WuA).-This soil is on broad terraces of Willamette silts.

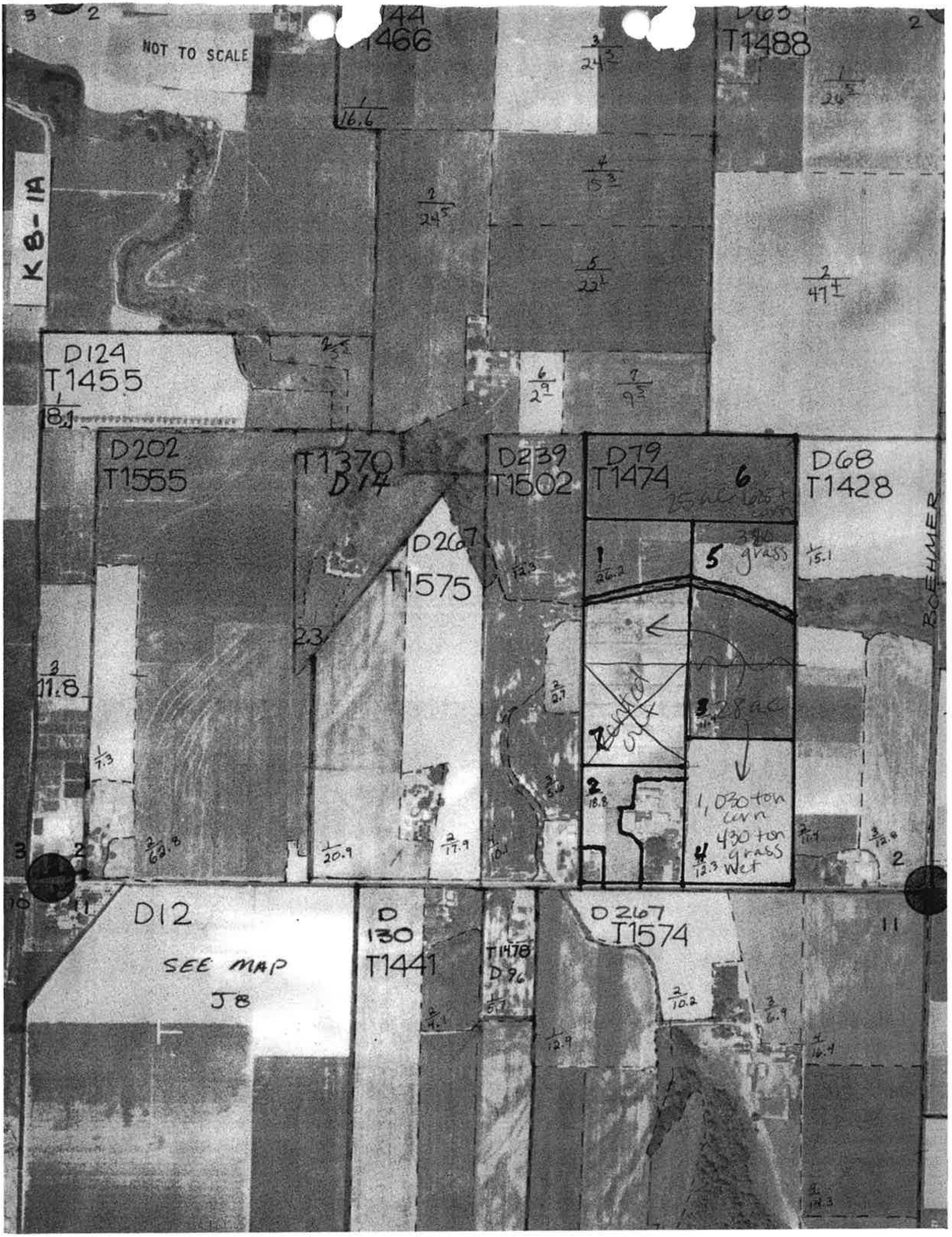
Representative profile about 200 feet west of the paved road to Champoeg (SW1/4SE1/4SE1/4 sec. 2, T. 4 S., R. 2 W.; profile No. 5 in table 9 in the section "Laboratory Data.") .

Included with this soil in mapping were small areas of Amity and Willamette soils, and small areas of a somewhat poorly drained soil. The areas of Amity soils occupy less than 5 percent of the acreage in this mapping unit. The areas of Willamette soils occupy as much as 10 percent.

The available water capacity is 11 to 13 inches. Permeability is moderate in the upper part of the subsoil, and it is slow in the lower part. Fertility is high. Depth to which roots can penetrate is restricted by a seasonal perched water table and as the result of the type of structure. Runoff is slow, and no apparent erosion has taken place.

This soil is used mainly for small grains, field corn, orchards, pasture, hay, caneberries, and vegetables. Areas that are drained are used for all the crops commonly grown in the survey area. Because of the perched water table, drainage is needed for crops that cannot tolerate excessive moisture. (Capability unit IIw-1; not placed in a woodland suitability group)

Woodburn silt loam, 3 to 12 percent slopes (WuC).-This soil has slopes of 3 to 5 percent in about 60 percent of the acreage. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

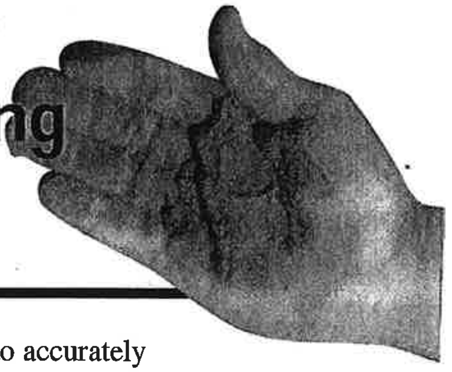

NOT TO SCALE
K8-1A
T1466
T1488
D124
T1455
D202
T1555
T1370
D74
D239
T1502
D79
T1474
6
25 ac
D68
T1428
D267
T1575
BOEHMER
1
26.2
5
grass
3
28ac
2
18.8
1,030 ton
corn
430 ton
grass
wet
4
12.3
D12
SEE MAP
J8
D
130
T1441
T1478
D96
D267
T1574

EM 8716 • August 1998

Simple irrigation scheduling

Using the "look and feel" method

F. Niederholzer and L. Long



Why schedule irrigation?

Accurate irrigation scheduling maximizes the benefits of irrigation while minimizing potential negative impacts of over-irrigation or under-irrigation.

Over-irrigation **(too much water):**

- Drowns roots, thus stressing plants
- Encourages root diseases
- Reduces nutrient uptake
- Cools soil, thus reducing root growth
- Leaches nutrients and pesticides from the root zone to groundwater
- Reduces crop quality
- Wastes money

Under-irrigation **(too little water):**

- Reduces crop yield
- Reduces crop quality (fruit and vegetable size)
- Reduces plant growth
- Weakens plants

Many people schedule irrigation by the calendar rather than by plant need. Calendar-based scheduling can be very inaccurate since plant water needs and the amount of soil water available to plants are affected by factors such as climate, plant size, soil type, and rooting depth.

The goal of accurate irrigation scheduling is to replace soil water lost by evaporation and plant use as precisely as possible. To accomplish this goal, you need to accurately assess soil moisture content. Then you can determine the need for irrigation and how much water to deliver.

Irrigation scheduling can seem complicated. It doesn't have to be. Anyone can use a simple, effective method known as the "look and feel" (or "soil appearance and feel") method to determine when to irrigate.

How does it work?

This method is based on three simple ideas:

- Soil is at "field capacity" when it is holding as much water as possible after the excess has drained away. (A wet sponge is at "field capacity" when it holds all the water it can without any dripping away.)
- It's best to irrigate when half of this water is depleted.
- Your goal when irrigating is to return the soil to field capacity.

So, all you need to know to schedule irrigation is:

- How much water will the soil hold within the plants' rooting zone when it's at field capacity?
- What does the soil look like when half of that water is gone?
- How much water should be applied to return the soil to field capacity?

OREGON STATE UNIVERSITY
EXTENSION SERVICE

Franz Niederholzer, Extension horticulture agent, Hood River County; and Lynn Long, Extension horticulture agent, Wasco County; Oregon State University. Photos are from Estimating Soil Moisture by Feel and Appearance, *and are reproduced courtesy of USDA/NRCS. Special thanks to Mr. Diego León for his excellent work with English/Spanish translation.*

Published August 1998.

EM 8724 • January 1999

$2.00

Annual Manure Application Schedule for Western Oregon

M. Gangwer, B. Wilson, and M. Gamroth

The overall objective of manure management should be to take as many excretable manure nutrients to the soil and have them used by plants for optimal crop yield. This reduces the need to purchase feed and inorganic fertilizer. The usual outcome of manure management is finding as many acres as possible for manure application. Manure application scheduling depends on the type of manure.

Apply *liquid manure* on a schedule that provides nutrients in the soil root zone in anticipation of crop growth. Apply when soils are at field capacity or less moisture content, i.e., some air space exists in the topsoil. (See Figure 1.) There are several ways to measure soil moisture. You can squeeze a handful of soil and see whether it clumps together. If it does, it probably is at least at field capacity. If water runs out of your hands, then the soil probably is near or at complete soil saturation. You also can measure soil moisture with portable soil meters, tensiometers, watermarks, or other sensory devices.

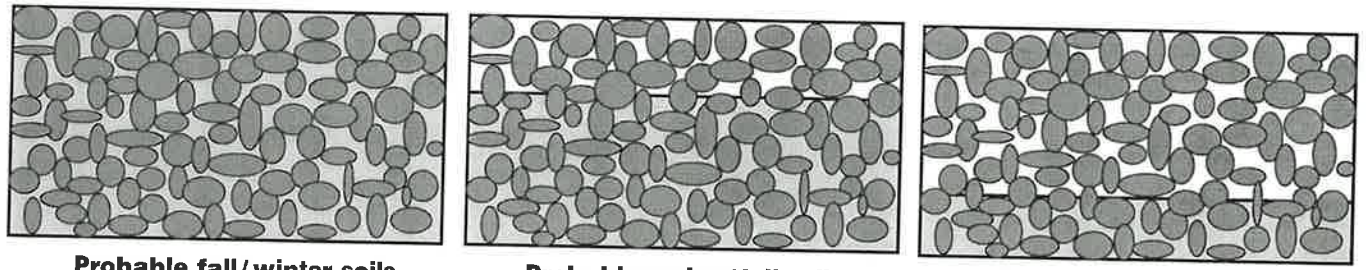
Apply *solid manure* in such a manner that it will not leave the field surface during rainfall events or flooding.

Spring and summer are the best times for manure application. Empty all storage facilities by October 1 of every year in preparation for the winter storage season.

Soil testing is an important part of manure application scheduling. A fall test is especially important as it serves as a report card to evaluate crop yield during the previous growing period in relationship to plant-available nutrients, especially nitrate-N. If excessive soil nutrients (N, P, K) are measured, plan a strategy for reducing these values by reducing manure application, changing crop variety, and/or increasing yield.

Soil tests also help you decide where to apply manure. They help show whether you are distributing manure on enough crop acres to result in optimal crop yield per acre. Placing too many manure nutrients on too few acres results in excess soil concentrations and reduced nutrients used for crop growth.

Figure 1.—*Topsoil profile:* ***blue*** *indicates soil moisture,* ***white*** *indicates air space (capacity for liquid to fill), and soil particles are* ***brown.***



Probable fall/winter soils
- 100% saturated
- Apply minimal solids.
- **Do not apply liquid.**

Probable spring/fall soils
- Typical field capacity
- Apply solids.
- **Apply minimal liquid/ application.**

Probable summer soils
- Typical wilting coefficient
- Apply solids.
- **Apply liquid.**

OREGON STATE UNIVERSITY EXTENSION SERVICE

Mike Gangwer, Extension agent, Marion County; Bruce Wilson, conservation planning engineer, USDA-NRCS; and Mike Gamroth, Extension dairy specialist; Oregon State University.

Agronomic considerations

Nitrogen (N)

Take a fall soil sample from manured fields. Any concentration of 100 lb (27 ppm) nitrate-N or higher is excessive and indicates less agronomic uptake than the sum of organic mineralization, fertilizer input, and manure application. A goal for this report card test is 55 lb (15 ppm) soil nitrate-N in the top foot. Reduce manure application the following year and increase crop yield (or change the crop) in order to reduce fall nitrate-N.

A spring nitrate-N analysis generally is not required because winter rainfall, high water tables, and denitrification leach nitrate-N out of the soil. A cover/relay/double crop or permanent grass will scavenge some of this leftover nitrate-N.

A spring application of manure-N is highly recommended due to the winter losses. This application is especially important for annual and perennial grass. In corn fields, the pre-sidedress soil nitrate test (PSNT) will indicate whether further manure is required.

Manure excretion N is half organic and half ammonium. There is no nitrate in manure.

Phosphorus (P)

You can take a soil test for P at any time. The soil test for P shows extractable P, or plant-available P. It indicates the amount of P in the soil that can be used for plant growth at a given time. Heavily manured fields usually have higher levels of soil test P than do nonmanured fields.

Any concentration of 100 ppm or higher of soil test P is excessive. Do not add P to these fields. However, storage pond supernatent contains very little manure P; applications can be made based on N or K requirement.

If soil test P is excessive, reduce manure application the following year so P can be mined out of the soil by plants. However, fields with high levels of organic matter can buffer P so that soil test P does not drop rapidly. Mining will occur slowly in these fields.

Excessive P in the soil in any form can have a negative impact on water quality if soil erosion moves topsoil into surface waters, carrying with it all forms of soil P. Excessive P in surface water increases aquatic plant growth and reduces the amount of oxygen in the water available for fish.

Potassium (K)

You can take a soil test for K at any time. The soil test for K indicates plant-available K. Heavily manured fields usually have a higher level of K, especially fields receiving liquid manure.

Any concentration of 800 ppm or higher of plant-available K is excessive. Problems with excessive K in the soil can cause high plant K concentrations that can have a negative impact on herd health, especially in fresh and early lactating cows. Excessive K, if leached into groundwater, can increase the salt concentration of water. Also, like sodium, excessive K can reduce water infiltration through soil by hanging onto water.

Therefore, managing K on the basis of ration makeup is a good strategy. If feeds low in K are needed for a particular ration, you may need to avoid applying liquid manure on one field until K is mined out.

For more information

See page 3 for ordering instructions.

Assessing the Risk of Groundwater Contamination from Livestock Manure Management Worksheet, EM 8596 (1995). $1.00

Calculating the Fertilizer Value of Manure from Livestock Operations, EC 1094 (revised 1991, reprinted 1993). $1.00

Date, Rate, and Place: The Field Book for Dairy Manure Applicators, PNW 506 (1998). $5.50

Manure Management in Small Farm Livestock Operations: Protecting Surface and Groundwater, EM 8649 (published 1996, reprinted 1997). $1.75

Manure Management Practices to Reduce Water Pollution, FS 281 (published 1982, reprinted 1993). No charge.

Nutrient Management for Dairy Production: Assessing Your Manure Management for Water Quality Risk, EM 8646 (1996). 75¢

Nutrient Management for Dairy Production: Dairy Manure as a Fertilizer Source, EM 8586 (published 1995, reprinted 1997). $1.00

Nutrient Management for Dairy Production: Manure Application Rates for Forage Production, EM 8585 (published 1996, reprinted 1997). $1.00

Nutrient Management for Dairy Production: The Pre-Sidedress Soil Nitrate Test (PSNT) for Western Oregon and Western Washington, EM 8650 (published 1996, reprinted 1997). 75¢

Nutrient Management for Dairy Production: Which Test Is Best? Customizing Dairy Manure Nutrient Testing, PNW 505 (1997). $2.00

Reducing the risk of Groundwater Contamination from Livestock Manure Management, EM 8597 (1995). $1.25

Ordering instructions

To order copies of the publications listed under "For more information," send the publication's complete title and series number, along with a check or money order for the amount listed (payable to Oregon State University), to:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119
Fax: 541-737-0817

You may order up to six no-charge publications without charge. If you request seven or more no-charge publications, include 25 cents for each publication beyond six.

If you would like additional copies of this publication, *Annual Manure Application Schedule for Western Oregon*, EM 8724, send $2.00 per copy to the above address.

We offer discounts on orders of 100 or more copies of a single title. Please call 541-737-2513 for price quotes.

World Wide Web

You can access our Publications and Videos catalog and many of our publications through our Web page at eesc.orst.edu

---

This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties.

Published January 1999.

Summary

- Apply liquid manure on a schedule that provides nutrients in the soil root zone in anticipation of crop growth.
- Apply liquid manure when soils are at field capacity or less moisture content, i.e., some air space exists in the topsoil. A soil moisture sensor/meter or field hand-grab sample is useful.
- Apply solid manure in such a manner that it will not leave the field surface during rainfall events or flooding.
- Empty all storage facilities of any size by October 1 of every year.
- Use soil testing, especially the fall test, as a report card to evaluate crop yield during the previous growing period in relationship to plant-available nutrients, especially nitrate-N.
- If excessive soil nutrients (N, P, K) are measured, plan a strategy for reducing these values by reducing manure application, changing crop variety, and/or increasing yield.
- Soil tests will help you decide where to apply manure. They will help show whether you are distributing manure on enough crop acres to result in optimal crop yield per acre. Placing too many manure nutrients on too few acres results in excess soil concentrations and reduced nutrients used for crop growth.
- The overall objective of manure management should be to take as many excretable manure nutrients to the soil and have them used by plants for optimal crop yield. This reduces the need to purchase feed and inorganic fertilizer. The usual outcome of manure management is finding as many acres as possible for manure application.

Example Manure Application Calendar

Sample liquid manure application dates are indicated with orange. Solids application dates are underlined. Actual application dates will be determined by weather and soil conditions.

Winter

January

					1	2
3	**4**	5	6	7	8	9
10	11	12	**13**	14	15	16
17	18	**19**	20	21	22	23
24	25	26	**27**	28	29	30
31						

February

	1	2	**3**	4	5	**6**
7	8	**9**	10	11	**12**	13
14	**15**	16	17	**18**	19	20
21	22	23	**24**	25	**26**	27
28						

March

	1	**2**	**3**	**4**	5	6
7	**8**	9	10	11	**12**	**13**
14	15	**16**	17	18	19	20
21	**22**	**23**	24	25	26	**27**
28	**29**	**30**	31			

- Apply liquid when soil is at field capacity or less moisture content.
- Apply solids when application will not leave the surface during heavy rainfall.
- Do not apply liquid to bare fields.
- Do not apply liquid to fields with a high or perched water table.
- Do not apply liquid to fields with soggy soils or to flooded fields.
- Identify "go-to fields" every winter that are better drained and have crop biomass.

Likely application days

	Liquid	Solid
January	6	15
February	10	18
March	15	24

Spring

April

				1	**2**	**3**
4	**5**	**6**	**7**	**8**	**9**	10
11	12	**13**	**14**	**15**	16	17
18	**19**	**20**	**21**	22	23	24
25	**26**	**27**	**28**	**29**	**30**	

May

						1
2	**3**	**4**	**5**	**6**	**7**	8
9	**10**	**11**	**12**	**13**	**14**	**15**
16	**17**	**18**	**19**	**20**	**21**	22
23	**24**	**25**	**26**	**27**	**28**	**29**
30	31					

June

		1	2	**3**	**4**	5
6	7	8	**9**	**10**	**11**	12
13	**14**	**15**	**16**	**17**	**18**	**19**
20	**21**	**22**	**23**	**24**	**25**	**26**
27	28	**29**	**30**	31		

- Apply liquid when soil is at field capacity or less moisture content.
- Apply solids any time.
- Use this season for liquid pumping on all crop ground.
- Liquids can be applied to bare ground.
- Liquids can be applied to fields with high or perched water tables and to fields that have soggy soils but have drained.
- Use this season for emptying accumulated manure fines-solids in all ponds.
- This is the season for more frequent, but light-rate, applications.

Likely application days

	Liquid	Solid
April	20	30
May	24	30
June	24	27

Summer

July

				1	**2**	3
4	**5**	**6**	**7**	**8**	9	10
11	**12**	**13**	14	15	16	17
18	**19**	**20**	**21**	**22**	23	**24**
25	**26**	27	28	29	30	31

August

1	**2**	**3**	**4**	5	6	7
8	9	10	**11**	**12**	**13**	14
15	16	**17**	18	19	20	21
22	**23**	**24**	**25**	26	27	**28**
29	30	31				

September

			1	**2**	**3**	4
5	6	**7**	**8**	9	10	11
12	**13**	14	15	**16**	17	18
19	20	21	**22**	**23**	24	25
26	**27**	28	29	30		

- Apply liquid when soil is at field capacity or less moisture content.
- Apply solids any time.
- Use this season for liquid pumping on grass and corn (use PSNT).
- Liquids can be applied to postharvest fields of any kind, especially nonmanured fields of grains or grass seed.
- All storage facilities should be drawn down (pumped out) in preparation for the winter storage season.

Likely application days

	Liquid	Solid
July	15	27
August	12	20
September	10	15

Fall

October

					1	2
3	4	**5**	6	7	8	9
10	11	12	13	14	**15**	16
17	18	19	**20**	21	22	23
24	**25**	26	27	28	29	**30**
31						

November

	1	2	3	4	5	6
7	8	9	**10**	11	12	13
14	15	16	17	18	19	**20**
21	22	23	24	25	26	27
28	29	**30**				

December

			1	2	3	4
5	6	7	8	9	**10**	11
12	13	14	15	16	17	18
19	**20**	21	22	23	24	25
26	27	28	29	**30**	31	

- Apply liquid when soil is at field capacity or less moisture content.
- Apply solids when application will not leave the surface during heavy rainfall.
- Do not apply liquid to bare fields.
- Do not apply liquids to fields with high or perched water tables.
- Do not apply liquids to fields with soggy soils or those that are likely to flood.
- Apply liquids to fields with plant biomass such as a double crop.
- Use this season primarily for liquid storage.

Likely application days

	Liquid	Solid
October	6	6
November	3	6
December	3	4

EM 8832-E
May 2003
$2.00

Post-harvest Soil Nitrate Testing

for Manured Cropping Systems West of the Cascades

D.M. Sullivan and C.G. Cogger

Contents

What's in this publication?

This publication describes the use of post-harvest soil nitrate testing as a tool for assessment of nitrogen (N) management in manured cropping systems west of the Cascade Mountains in Oregon, Washington, and south coastal British Columbia.

The first section of this publication gives general information on the test and is designed for use by growers and dairy operators. This section gives a brief introduction to soil sampling, but does not provide all of the technical details. The focus is on how to use the post-harvest test to improve nutrient management. This section describes:

- What the post-harvest test measures
- How to collect soil samples
- Units used in soil nitrate testing
- How to interpret soil nitrate test results for grass and silage corn crops

In addition, background information explains the rationale for the test:

- How to use the post-harvest test as a management tool (page 3)
- Crop and soil response to excess plant-available N (page 4)

Dan M. Sullivan, Extension soil scientist, Oregon State University, and Craig G. Cogger, Extension soil scientist, Washington State University.

OREGON STATE UNIVERSITY
EXTENSION SERVICE

The second section of this publication is designed primarily for use by conservation planners and other agricultural professionals working with farmers to implement nutrient management plans. This section is also designed for dairy operators who do their own soil sampling. This section includes detailed suggestions for the following:

- ◆ Collecting, preserving, and analyzing the soil sample
- ◆ Developing a long-term soil sampling plan

The post-harvest test and how to use it

What the post-harvest test measures

The post-harvest soil nitrate test measures the quantity of plant-available nitrogen present in the nitrate form in the surface foot of soil in the late summer or early fall. The test measures nitrate-N not utilized by the recently harvested crop. Because crops differ in their ability to remove nitrate-N from the soil, test interpretation is crop-specific.

The test looks backward in time. It evaluates the balance between N supply and crop uptake for the crops produced during the summer. Nitrate-N accumulates in the soil when more plant-available N is supplied than can be utilized by the summer crop (see "Crop and soil response to excess plant-available N," page 4).

Use the post-harvest test to:

- ◆ Get a general idea of balance between N supply from manure and other sources and crop N demand
- ◆ Identify imbalances in N supply among fields on a farm
- ◆ Identify fields that may respond to changes in timing or amount of manure application or other agronomic practices

Soil sampling protocols

Sampling depth

Sample the 0- to 12-inch depth for the post-harvest test. This shallow sampling depth is a good predictor of nitrate in the rest of the soil profile when (1) in-season irrigation is not excessive, and (2) samples are taken prior to heavy rains in the fall.

Composite soil sample

Collect a composite soil sample consisting of a mixture of 15 to 30 soil cores from each field or management unit. See "Collecting, preserving, and analyzing the soil sample" (page 9) for detailed sampling instructions and suggestions for special situations.

What fields to sample

In general, it is not necessary to sample every field on a farm every year. Consult with your farm advisor to determine any regulatory requirements for sampling frequency. We recommend that you sample selected fields that represent typical manure and crop management practices each year to track long-term trends in post-harvest soil nitrate values. See "Developing a sampling plan" (page 11) for more information.

When to sample

In general, samples for the post-harvest test should be collected as soon as possible after a crop harvest. Avoid sampling a field that has had manure application within the past 30 days.

Samples must be taken before heavy fall rains move nitrate below the 12-inch depth. Because the timing of fall rainfall is unpredictable, the best strategy is to sample fields before October 1 whenever possible.

Collect samples from medium- to fine-textured soils (loams, clay loams, and clays) prior to 5 inches of cumulative fall rainfall. Sandy soils (sand, loamy sand, or sandy loam soil texture) have lower water-holding capacities and should be sampled prior to

continues on page 5

How to use the post-harvest test as a management tool

Sampling depth and timing are critical. Interpretation tables for this test apply only to samples taken to a 12-inch depth. Surface soil (0 to 12 inches) typically contains the highest nitrate-N levels and requires the least time and effort for sample collection. Samples must be taken before heavy fall rains move nitrate below the 12-inch depth. The target sampling period generally is August 15 to October 15.

To get the most value from this test, it is important to understand:

- How the test fits into an overall nutrient management program
- Limitations to interpretation of test results
- How *not* to use the test

Using the test as part of a nutrient management program

The post-harvest test is but one measure of success in nutrient management. Post-harvest nitrate test data should be assessed in the context of the current N management plan and records of manure application. Successful N management involves a number of components, including:

- Assessing crop N needs
- Planning manure application to meet crop N needs
- Applying manure according to the plan
- Recording manure application amount and estimated plant-available N amount
- Measuring crop yield and N content
- Monitoring success of the plan

All components of the nutrient management system should be evaluated together.

Limitations to test results

Interpretive values for post-harvest soil nitrate are:

- Calibrated only for high-rainfall portions of the Pacific Northwest (west of the Cascades). Extrapolation to other environments is not recommended.
- Provided only for corn silage and grass hay/silage crops. Field research has been used as the basis for interpretive levels for these crops. Applicable research data are not available for other crops to determine post-harvest nitrate-N levels associated with good crop and nutrient management practices. However, the test may be used for relative comparisons among fields planted to another crop (e.g., comparisons among grass pasture fields).
- Based on the assumption that summer irrigation is less than, or close to, evapotranspiration to ensure that significant nitrate leaching does not occur before the fall test.
- Designed for fields with a history of applied manure (more than 3 consecutive years of regular manure application). Lower post-harvest soil nitrate test values are attainable where only fertilizer N is used, or where manure is applied infrequently.
- Based on good management of the crop and normal yields. Crop moisture stress, insect damage, or plant disease will reduce crop yield and crop uptake of nitrogen, thus increasing post-harvest soil nitrate test levels.

How *not* to use the post-harvest test

The test will *not*:

- Detect a shortage of plant-available nitrogen for crop production. Continual mineralization of nitrogen (conversion of organic N forms to plant-available N forms in the soil) can provide enough plant-available nitrogen for a crop without accumulation of nitrate-N in soil.
- Determine the source(s) of excess plant-available N. Sources of N may include manure slurry, lagoon water, fertilizer, soil organic matter, or previous crop residues.
- Predict crop response to fall manure or N fertilizer applications. The test does not predict the amount of plant-available N that will be mineralized from soil organic matter or crop residues in the fall.

Crop and soil response to excess plant-available N

Crop response to applied N. Crop N uptake is controlled by the environment, crop N uptake potential, and management. Crops respond to plant-available nitrogen supply (ammonium + nitrate-N) by the law of diminishing returns (Figure 1). Without added N, some crop yield is produced from N supplied by soil organic matter, residual plant-available N, and other non-fertilizer sources (e.g., mineralization of crop residues). Additional N supplied from manure or fertilizer increases crop yield until site yield potential is reached.

The application rate of manure or N fertilizer needed to reach near-maximum yield is termed the *agronomic rate*. Rather than a single agronomic rate, the crop response to N is best described as an agronomic rate range (Figure 1). The agronomic rate range concept allows for variability in crop performance among years and for crop uptake of N beyond the yield maximum (increased protein).

Post-harvest soil nitrate test measures nitrate-N not used by the crop. At excessive plant-available N supply levels, crop yield and crop N uptake do not respond to further N additions. The extra soil N not used by the crop accumulates as nitrate-N.

Elevated post-harvest soil nitrate-N concentrations are an indicator of one or more of the following: (1) excess plant-available N, (2) N supplied too late in the season for crop utilization, or (3) poor crop growing conditions due to insect infestation, moisture/heat stress, plant disease, or other cultural problems. If crop yields are acceptable and crop protein is at typical levels, then the most likely explanation is that plant-available N was supplied in excess of crop needs.

Because grass is more efficient than corn at N uptake, target post-harvest soil nitrate levels given in this publication are lower for grass than for corn. There are two key reasons that grass is more efficient than corn in N removal.

◆ Grass has a greater capacity to take up N supplied in excess of that needed for maximum yield. After enough N has been supplied for maximum yield, grass protein content increases in response to increased N supply. With grass, soil nitrate increases only when the available N supply exceeds that required to produce near-maximum protein. Corn does not take up additional N after the maximum yield is reached. Corn silage protein does not increase much in response to excess N supply.

◆ Grass utilizes N mineralized late in the growing season more efficiently. Grass managed for silage or hay continues to take up N until harvest. Corn grown for silage completes its N uptake approximately 4 weeks before harvest. Some of the soil nitrate measured after corn harvest is produced by mineralization of soil organic N to available forms during the final weeks of the growing season.

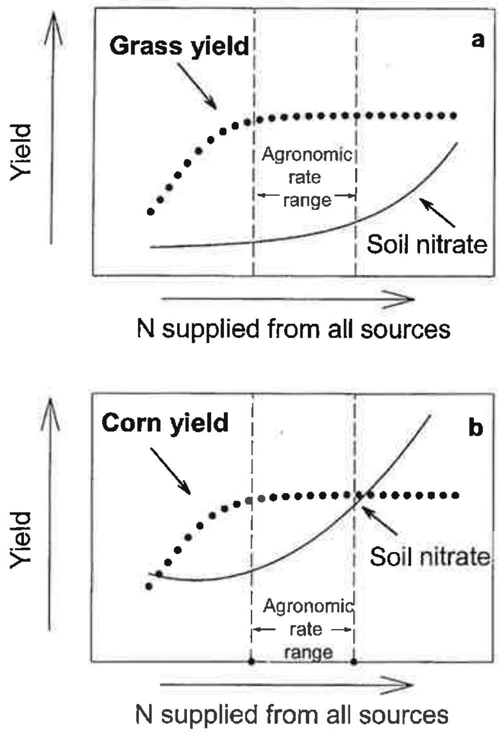


Figure 1.—Crop yield and soil nitrate response to increased N supply. Agronomic rate range = range of N supplied from all sources that results in near-maximum crop yield with acceptable post-harvest nitrate accumulation. Above the agronomic rate range, excess N accumulates as nitrate in soil. More nitrate accumulates in the agronomic rate range with corn (b) than with grass (a).

Table 1.—Average calendar date when cumulative rainfall (after September 1) reaches 5 inches west of the Cascades.[a]

Cumulative rainfall after Sept. 1	Medford (OR)	Salem (OR)	Tillamook (OR)	Coupeville (WA)	Centralia (WA)	Lynden (WA) Abbotsford (BC)	Agassiz (BC)	Comox (BC)
	Calendar date to reach specified cumulative rainfall							
(inches)								
3	10 Nov	20 Oct	26 Sep	31 Oct	8 Oct	1 Oct	26 Sep	10 Oct
5	29 Nov	1 Nov	8 Oct	24 Nov	23 Oct	15 Oct	9 Oct	25 Oct
7	16 Dec	13 Nov	18 Oct	15 Dec	4 Nov	27 Oct	19 Oct	6 Nov

[a] Average daily precipitation data for many other locations is available at: Western Regional Climate Center (http://wrcc.dri.edu) or Environment Canada (http://www.msc-smc.ec.gc.ca/climate/climate_normals/index_e.cfm).

3 inches of cumulative fall rainfall. The starting date for calculating cumulative fall rainfall is September 1. Include inches of irrigation water applied after September 1 in your estimate of cumulative rainfall.

Table 1 shows the average calendar date when cumulative fall rainfall (after September 1) reaches 5 inches at a variety of locations. For most locations, sampling prior to October 15 is acceptable in an average year. In high rainfall areas (coastal areas and the Cascade foothills), plan to sample earlier. A late October sampling date usually is acceptable in lower rainfall areas of southern Oregon, the Puget Sound islands, Olympic Peninsula, or Vancouver Island.

Units used in soil nitrate testing

In this publication, interpretation of a post-harvest soil nitrate test (Tables 3 and 4) is based on units of parts per million (ppm). Some labs report soil test nitrate-N in units of lb/acre by assuming a standard value for soil bulk density. If the lab reports nitrate-N results in pounds per acre, ask them to provide a conversion factor to express data in units of ppm. The conversion factor assumed by laboratories usually is between 3 and 4, because 1 acre-foot of dry soil usually weighs about 3.5 million pounds (3.5 lb per acre-foot = 1 ppm).

Table 2.—Units used to report soil nitrate analyses.

Name	Interpretation	Equivalent units
nitrate-N or NO_3-N	N present in the nitrate form, soil dry weight basis	mg/kg or ppm (dry weight basis)

Interpreting soil nitrate test results

Data quality and variability

The first step in evaluating your soil nitrate data is to verify data quality. Determine whether the sample collection method, timing of sample collection, sample preservation, and laboratory analysis methods are acceptable. Reject data that did not result from reasonable protocols. For example, Tables 3 and 4 should not be used for soil samples collected in November after heavy fall rains.

Make sure that you understand the units used to report test results. See Table 2 for an explanation of units found in soil test reports.

Response of post-harvest soil test N to changes in management

Success in N management is indicated by long-term trends in post-harvest soil nitrate (at least 3 to 5 years). **Because of the large pool of readily mineralizable N in manured soils, fall soil nitrate values may not decline for 3 to 5 years in response to improved management.** For multiyear comparisons, sampling methods and timing must be consistent.

Some portions of a crop rotation will have higher fall nitrate values because of rapid N mineralization stimulated by tillage or incorporation of crop residues. For example, soil nitrate concentrations typically are high, regardless of overall N management, after a perennial grass sod is plowed down and reseeded.

Reductions in fall soil N are most likely to be measured when (1) commercial N fertilizer amounts are reduced or eliminated, (2) cropping systems that maximize N removal in late summer and fall (August to October) are used, and (3) manure or N application is eliminated after August 1. It is more difficult to attain post-harvest soil nitrate-N values of less than 20 ppm for corn than for grass (see "Crop and soil response to excess plant-available N," page 4).

Interpretation for individual fields

Interpretations of soil test nitrate-N should be made first at the field level. You may be able to discover a probable cause for differences in test values among fields. Questions to ask include:

- Are relationships present between known management factors (e.g., manure application rate or timing, crop yield and quality, irrigation frequency, distance to the barn) and soil test values?
- Is a large amount of variation present between fields? Is there a logical explanation for unusual values?
- Are values for grass and corn fields similar?

Annual averages across grass and corn crops

After looking at test values for individual fields, it may be useful to look at averages across all grass or corn fields. You may want to calculate averages only for fields under similar management.

Average nitrate-N test values are most useful for consideration of changes in whole farm nutrient management. Tables 3 and 4 present interpretive information separately for grass and corn fields.

If a few fields have unusual test values, you may be justified in excluding those fields from an average. Although you may want to exclude unusually high test values from the farm average, you definitely should evaluate those fields further to determine the probable cause of the high soil test values. The unusually high test values may reflect the need for management changes or may reflect a soil sampling or analytical error.

Using the interpretive tables (Tables 3 and 4)

Interpretations and management suggestions given in Tables 3 and 4 (pages 7–8) are general in nature and should serve as only one portion of a nutrient management plan evaluation. Some of the management suggestions can be implemented for individual fields, while others need to be implemented on a whole farm basis.

Remember not to focus solely on post-harvest nitrate-N in evaluating N management. Include other important aspects of N management in your evaluation, such as success in following a plan for manure application, calibration of manure application equipment, maintaining good manure application records, and effective irrigation management.

Table 3.—Silage corn. Suggested interpretation for post-harvest soil nitrate-N (0- to 12-inch depth).[a]

If post-harvest nitrate-N is less than 20 ppm (less than approximately 70 lb N per acre)

◆ Continue present N management.

If post-harvest nitrate-N is 20 to 45 ppm (approximately 70 to 160 lb N per acre)

◆ Reduce or eliminate sidedress N fertilizer application. Use the pre-sidedress nitrate test (PSNT). Apply sidedress N only when PSNT indicates a need.

◆ Reduce lagoon water application after August 1.

◆ Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.

◆ Reduce manure application on fields where corn follows grass sod plow-down.

◆ Plan to reduce manure-N application by 10 to 25 percent.

◆ Improve whole farm N balance.

If post-harvest nitrate-N is greater than 45 ppm (greater than approximately 160 lb N per acre)

◆ Apply only starter N (20 to 40 lb N/acre at planting).

◆ Plan not to sidedress N fertilizer in June. Apply sidedress N only when PSNT indicates a need.

◆ Eliminate lagoon water application after August 1.

◆ Keep records to document crop yield, dry matter, and crop N removal. Apply manure N at a rate less than or equal to crop N removal (approximately 200 lb total N per acre).

◆ Eliminate manure application on a few fields or a few strips within a field next year to determine the contribution of mineralized N vs. current-season application of manure.

◆ Plan to reduce manure-N application by 25 to 40 percent.

◆ Consult experts to improve whole farm nutrient balance.

---

[a] The post-harvest test values listed above are for the *end* of a growing season. Management changes (if needed) should be implemented in future years. Interpretive values assume near-optimum crop yields. If yield is below average, improve agronomic practices to increase crop yield and crop N uptake.

Table 4.—Grass for hay or silage. Suggested interpretation for post-harvest soil nitrate-N (0- to 12-inch depth).[a]

If post-harvest nitrate-N is less than 15 ppm (less than approximately 55 lb N per acre)

- Continue present N management.

If post-harvest nitrate-N is 15 to 30 ppm (approximately 55 to 105 lb N/acre)

- Apply manure earlier in the growing season.
- Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.
- Check protein levels in forage. Grass crude protein greater than 21 percent is associated with increased potential for nitrate toxicity to cows.
- Plan to reduce manure-N application by 10 to 25 percent.
- Improve whole farm nutrient balance.

If post-harvest nitrate-N is greater than 30 ppm N (greater than approximately 105 lb N/acre)

- Apply manure earlier in the growing season. Reduce manure application after August 1.
- Keep records to document crop yield, dry matter, and crop N removal. Total manure-N + fertilizer-N should be less than or equal to crop N removal. Even if calculated crop removal exceeds 400 lb N per acre, apply manure-N + fertilizer-N not to exceed 400 lb N per acre per year.
- Consider reseeding or interseeding if grass yield is limited by poor stand or undesirable species.
- Check protein levels in forage. Grass crude protein greater than 21 percent is associated with increased potential for nitrate toxicity to cows.
- Plan to reduce manure-N application by 25 to 40 percent.
- Consult experts to improve whole farm nutrient balance and reduce danger of nitrate toxicity to cows.

---

[a] The post-harvest test values listed above are for the *end* of a growing season. Management changes (if needed) should be implemented in future years. Interpretive values assume near-optimum crop yields. If yield is below average, improve agronomic practices to increase crop yield and crop N uptake.

Detailed suggestions for soil sampling and planning

Collecting, preserving, and analyzing the soil sample

Tools for field sampling

Collect a sample that is representative of the entire sampling depth. For example, a representative sample for a 0- to 12-inch depth has the same amount of soil from the soil surface (0 to 6 inches) and from the bottom of the sampling depth (6 to 12 inches).

Always use a tool specifically designed for soil sampling. Don't use a shovel, because the samples won't be uniform with depth. Tools for soil sampling often are called soil probes or augers. There are several kinds available.

Push probes are tubes that you push into the soil. They have a T-shaped handle attached to a cylindrical tube (about 1 inch diameter) with a beveled tip. The tube collects a cylinder, or "core," of soil. Push probes work well in soft, uncompacted soils.

Hammer probes are designed for hard or compacted soils. They have a sliding weight (hammer) instead of a T-handle to drive the probe into soil.

Soil test consultants often use hydraulic probes mounted on a tractor or pickup to sample soils. These reduce the time and effort of sampling in hard soils. Gravelly and rocky soils are difficult to sample. A hydraulic probe with a rotating auger can sample some gravelly soils.

A mud auger or bucket auger is the best tool for hand-sampling at sites that are difficult to sample with push probes. Use an auger for compacted, muddy, rocky, or dry soils. Augers can be purchased from several manufacturers. A 2- to 4-inch diameter mud auger (open-sided) works best for most situations because it is easy to remove the sample from the bucket. Use a larger diameter auger for soils with large rocks. Augers sample a 4- to 6-inch depth. You will need to take several bites from the same hole to sample to 12-inch depth. You will collect a larger sample volume, about 5 to 10 times that collected with a push tube. Because of the extra effort required for auger sampling, use this method only if other sampling methods are difficult or impossible.

Field sampling protocol

Plan ahead. Use field maps and soil maps to divide the farm into different management units. A management unit is usually a field, but you may want to subdivide a large field if sections can be managed separately for nutrient application. The simplest approach is to collect a composite sample from the entire management unit. You may choose to restrict sampling to the dominant soil type if the management unit has soils that differ markedly in visual appearance (soil color, texture, organic matter).

Alternatively, you can restrict your sampling to a representative area (usually about an acre in size) within the management unit. Choosing a representative area within the field where manure application rate, timing, and uniformity are well documented is essential. If you use the "representative area" sampling approach, record the sampling location using a GPS receiver or record the distance from a fixed location (e.g., fenceline).

Avoid large buffer zones that are sometimes present adjacent to water bodies or roads, especially with big gun manure applicators. Avoid small atypical areas such as:

- Swales
- Very rocky or shallow soil (less than 12 inches deep)
- Site of an old manure pile or a feeding, watering, or resting area for livestock
- Abandoned field roads
- Field edges

Collect 15 to 30 soil cores from each management unit or representative sampling area with a push probe or similar tool. If you use an auger, 10 holes per management unit or zone is sufficient.

Choose sampling locations in a zigzag pattern across the field. Your general route of travel should be across rows, rather than down one row in the field. Make sure you sample within the part of the field where manure is routinely applied. For grazed pastures, choose sampling locations that have average crop growth and productive forage species.

Scrape away loose crop residues or manure present on the soil surface. Sample only the soil. Including the accumulated organic debris from the soil surface in the soil sample will increase variability in test results.

Once you are satisfied with a sampling strategy, repeat the same procedure each year. This will increase the validity of year-to-year comparisons of results.

Obtaining a representative sample from fields where manure has been injected into soil or placed in bands on the soil surface is difficult. The depth of manure injection, the width of injection zone, and the spacing between bands depend on equipment, soil, and the applicator. Some injection equipment can place manure below the 12-inch sampling depth used for the post-harvest nitrate test. Manure may be injected or banded more than one time per year, with several orientations in a field (e.g., north–south or east–west). Because of the added variability associated with manure injection or banding, plan to collect a larger number of soil cores to obtain a representative composite sample.

Sample handling

Mixing. If it is not too hard to break up the soil cores, break them, mix them all together, and homogenize thoroughly. Take a 1-cup subsample for shipment to the lab. If the soil cores are too hard to break apart, send the entire sample to the lab, where they can pass the sample through a mechanical grinder. Check with the lab to make sure they will grind and mix the *entire* sample before subsampling.

Preservation. Soils kept moist and warm continue to accumulate nitrate via biological activity after sampling. The simplest way to limit biological activity is to cool the soil after collection. Put the samples in plastic bags and place them in a cooler on ice while still in the field. Refrigerate them when you return from the field. Freeze the samples if they will be held longer than 48 hours before analysis.

Shipment. Keep the samples refrigerated or frozen until you deliver them to the lab. Contact the lab before you sample, so they will be prepared to receive the samples. Use a shipping method that will get the samples to the lab within 48 hours. You may want to freeze the samples before shipping to make sure they remain cool in transit.

Working with an analytical laboratory

Choose a laboratory that has experience with agricultural samples. Ask if they participate in the North American Proficiency Testing Program or a similar quality assurance program for agricultural testing labs. Find out what extraction and analytical procedures they use. Procedures should be consistent with those recommended for the western states (Gavlak et al., 1994).

Labs may use one of several colorimetric (color-based) lab procedures or they may use an electrode method to measure nitrate. Sample comparisons have shown that the colorimetric procedures usually are more precise than the electrode method.

Some testing labs also have sampling and consulting services. This can be convenient for people who have little experience in sampling or need help with sampling.

Find out how the lab reports soil test data. Standard units for soil nitrate-N are parts per million (ppm, Table 2). If you aren't familiar with the lab, it's a good idea to obtain a copy of a sample laboratory report.

Because you will use sample results to compare post-harvest soil nitrate across years, laboratory consistency over time is a major issue. A standard reference sample (soil sample with known concentration of nitrate) can help you assess laboratory variability. Consider submitting a standard reference sample (approximately 50 to 100 g dry weight) with a nitrate-N concentration of 20 to 45 ppm with each batch of soil samples. Keep track of test results for the standard reference sample over time. If you note a major error in the nitrate concentration reported for the standard reference sample, then the test data is questionable.

Standard reference samples are available from the North American Proficiency Testing Program (see "For more information," page 15). Standard reference samples must be dried, ground, and thoroughly mixed.

We do not recommend that you split a field sample to check laboratory consistency. The one-time nature of such comparisons, the uncertainty of obtaining a homogeneous sample, and the uncertainty of sample preservation in-transit to the lab limit the interpretation of split-sample data.

Developing a sampling plan

Nutrient management plans can be voluntary, required by regulatory agencies, or a part of an agreement with a conservation planning agency (e.g., Natural Resources Conservation Service or conservation district). If your nutrient management plan is not voluntary, consult the agency that supervises your nutrient management plan to determine whether they have specific requirements for how often fields must/should be sampled. Suggestions given here for sampling frequency are general in nature and are not intended to serve as policy for any agency.

Representative fields for long-term monitoring

Representative fields are fields that you sample every year to track trends in sample values over time. Select fields that represent typical management practices. Criteria that can be used to choose representative fields include: (1) records or estimates of annual manure application rate, (2) number of years of continuous manure application, (3) soil test values for P and K. On dairies where P and K fertilizers are not routinely applied, soil test values above 75 ppm P (Bray P1 method) and 400 ppm K (ammonium acetate method) usually reflect substantial manure application in the past.

Sample the representative fields every year to assess trends over time. If you grow corn silage and perennial grass forage, plan to sample at least four grass fields and four corn fields each year. At a small dairy (fewer than four fields), sample all fields each year.

Other fields

Periodically, you will need to evaluate the fields not designated as "representative" fields. Consider sampling all fields every 3 years. Compare whole farm soil data to representative field data.

If you have only a few fields with elevated soil test N, then focus management on those fields. If all fields on the farm give similar test data, then focus your N management efforts at the whole farm level. If representative fields consistently have test values of less than 15 ppm (grass) or less than 20 ppm (corn) over a 3-year period, and all other fields sampled have similar test values, consider reducing the number of post-harvest soil nitrate tests.

Sampling priority

Prioritize fields for fall sampling ahead of time so that you get high-priority fields sampled at an appropriate time. Highest priority should be given to representative fields used to track long-term trends. Fields with high manure application rates or elevated soil test N the previous year should also have a high priority.

Corn fields can be sampled for soil nitrate in June (PSNT, pre-sidedress nitrate test) or in the fall (post-harvest test described in this publication). You will get the most management information by sampling your high-priority representative corn fields both in June (PSNT) and after harvest. You also may want to sample fields with PSNT values greater than 45 ppm nitrate-N again in the fall.

For other corn fields where only one soil test per year is planned, we recommend using the PSNT in preference to the post-harvest soil nitrate test. The PSNT is preferred because test results are applicable to in-season N management. Growers can save money and reduce post-harvest nitrate by omitting sidedress N fertilizer application on fields where sufficient soil nitrate-N is present in June.

Sampling corn fields at PSNT time also will reduce the number of post-harvest samples that need to be collected during the short interval between harvest and the end of the fall sampling window (approximately October 15). If you miss a planned fall sampling on a corn field, consider sampling next year using the PSNT.

Grass fields are best sampled in the fall, using the protocols described in this publication. Think carefully about the best way to achieve consistent timing of sample collection for your fields. The timing of manure application and the timing of grass harvest are key variables to consider.

Samples collected shortly after manure application are not a good indicator of the balance between N supply and crop N demand over the entire growing season. If manure is applied late in the year, postpone soil sampling until after a fall grass harvest. Wait at least 30 days after a late-season manure application before sampling. Sampling need *not* be postponed until after the last manure application or until after the last grass harvest in the fall.

Questions and answers

Why is it difficult to achieve post-harvest nitrate-N less than 15 to 20 ppm with organic sources such as manure?

First, the timing and rate of application for organic sources is less flexible than for fertilizer N. Second, environmental processes that control the quantity and timing of N availability from organic sources are difficult to manage. The biggest factors controlling N availability are soil temperature and moisture. The timing of crop N uptake usually does not match the timing of N supplied from manure and other organic sources. Soil temperature and moisture often support continued release of available N after crop N uptake is complete.

Is there a relationship between soil organic matter content and potential N mineralization?

Research west of the Cascades has demonstrated a lack of correlation between soil organic matter content and N mineralization potential for soils having 3 to 8 percent organic matter. The active fraction of soil organic matter that controls annual N mineralization rates is a small proportion of total organic matter (usually less than 10 percent of total). Recent site management affects soil N mineralization potential; it does not have much effect on soil organic matter content. Because most soil total N is contained in soil organic matter, soil total N is also an unreliable indicator of mineralization potential.

What other soil tests can be used to provide information to guide N management for corn?

Soil nitrate testing in spring and early summer can assist with N management for silage corn. Test soil ammonium + nitrate-N several weeks after a spring manure application to track early-season N availability. Test soil nitrate when corn is at the four- to six-leaf stage (pre-sidedress nitrate test, PSNT) to determine the need for sidedress N application to corn.

How much variability should I expect in post-harvest nitrate-N test values for the same grass field sampled between August 15 and October 15?

It all depends on weather, soil biology, and crop management. A good stand of actively growing grass can maintain nitrate-N concentrations of less than 15 ppm throughout the post-harvest sampling period. Where soil is dry in late summer, increased N availability may occur for 2 or 3 weeks following the first heavy rain. It may be useful to take several soil nitrate tests from the same field in the fall to document changes in nitrate concentration with time. Soil nitrate values given in the interpretive table in this publication are for typical precipitation and sampling date.

Ammonium-N is plant-available. Why doesn't the post-harvest test include ammonium-N analysis?

Post-harvest ammonium-N analyses cost money, and they do not yield reliable interpretive information. Ammonium-N does not accumulate in soils supplied with an excess of plant-available N. It is rapidly converted to nitrate. Soil samples taken at least 30 days after manure application usually have negligible ammonium-N concentrations unless soil has remained dry.

Drying of soils after sampling releases ammonium-N from microbial biomass. Most dried soils have 2 to 20 ppm ammonium-N that is caused by the soil drying process. Dry soil ammonium-N concentrations are poorly correlated with other indices of N availability in controlled experiments.

Should post-harvest nitrate tests be used for fields with organic soils?

Other methods should be used to assess the success of nutrient management plans on organic soils. Goals for post-harvest nitrate-N of less than 20 ppm are difficult if not impossible to attain on organic soils, which contain more than 20 percent organic matter. These soils formed as organic matter accumulated under natural poorly drained conditions. Soil organic matter decomposition and N mineralization processes are greatly accelerated under typical farming practices such as artificial drainage and tillage.

Should I measure or estimate soil bulk density to estimate post-harvest nitrate-N in units of pounds per acre?

The variation in bulk densities among soils typically is less than the variation associated with soil nitrate sampling and testing. Interpretive information in this publication is based on units of parts per million (ppm; mg per kg dry soil). You can approximate soil nitrate-N in the surface foot of soil by assuming typical bulk density (ppm x 3.5 = lb/acre). This conversion factor is based on the weight of 1 acre-foot of soil at a bulk density of 1.3 g cm^3 (1 acre-foot = 3.5 million lb). Organic soils (more than 20 percent organic matter) have lower bulk density (0.6 to 0.8 g cm^3).

What is whole farm nutrient management?

The goals of whole farm management are: (1) to move toward a balance of nutrient imports and exports, and (2) to utilize nutrients on the farm at agronomic rates that minimize nutrient losses to the environment. Managing nutrients at the whole farm level requires knowledge of the major nutrient imports, major nutrient exports, crop utilization of nutrients on the farm, and nutrient losses to air and water.

The Livestock and Poultry Environmental Stewardship (LPES) Curriculum, available through the Midwest Plan Service, includes a Web presentation of whole farm nutrient management principles and a worksheet for evaluating whole farm nutrient balance. See "For more information" (page 15) for details.

What is the role of post-harvest nitrate testing in connection with Comprehensive Nutrient Management Plans (CNMPs)?

CNMPs, developed by the Natural Resources Conservation Service (NRCS) or other nutrient management professionals under NRCS supervision, are broader than just nutrient management. Other components of a CNMP are: (1) manure and wastewater handling and storage, (2) land treatment practices, (3) record-keeping, (4) feed management, and (5) other waste utilization options.

Post-harvest nitrate test values may be used as part of a process to develop a new CNMP or to update an existing CNMP. The CNMP typically includes a plan for regular soil testing. Appropriate timing of the post-harvest nitrate test is critical (see "When to sample," page 2), while soil samples for P and K analysis may be collected any time of the year. Soil samples collected for the post-harvest nitrate test can be analyzed by routine agronomic soil testing procedures and used in developing plans for P and K utilization in a CNMP.

What are the implications of high nitrate concentrations in forages?

Nitrate in ensiled forages can interfere with normal fermentation processes, resulting in poor-quality forage. Forage nitrate affects the distribution of nitrogen compounds in silage. It is difficult to use the silage to formulate rations that meet cow needs for specific protein fractions. Enough nitrate is sometimes present in the silage itself to create a health risk to the animal. Grass silage that is greater than 21 percent crude protein should be tested for the level of nitrate-N. See Johnson et al. (2002) for interpretation of forage nitrate concentrations.

For more information

OSU Extension Service publications

Hart, J. 2002. A List of Analytical Laboratories Serving Oregon, EM 8677.

Marx, E.S., J. Hart, and R.G. Stevens. 1996. Soil Test Interpretation Guide, EC 1478.

Marx, E.S., N.W. Christensen, J. Hart, M. Gangwer, C.G. Cogger, and A.I. Bary. 1996. The Pre-sidedress Soil Nitrate Test (PSNT) for Western Oregon and Western Washington, EM 8650.

Sullivan, D.M., C.G. Cogger, and A.I. Bary. 1997. Which Test Is Best? Customizing Dairy Manure Nutrient Testing, PNW 505.

Sullivan, D.M., C.G. Cogger, and A.I. Bary. 1997. Date, Rate, and Place: The Field Book for Dairy Manure Applicators, PNW 506.

Many OSU Extension Service publications, as well as additional gardening information, may be viewed or downloaded from the Web (http://eesc.oregonstate.edu).

Copies of many of our publications and videos also are available from OSU Extension and Experiment Station Communications. For prices and ordering information, visit our online catalog (http://eesc.oregonstate.edu) or contact us by fax (541-737-0817), e-mail (puborders@oregonstate.edu), or phone (541-737-2513).

WSU Cooperative Extension publications

Bary, A.I., C.G. Cogger, and D.M. Sullivan. 2000. Fertilizing with Manure, PNW 533.

Daniels, C.H. 2002. Analytical Laboratories and Consultants Serving Agriculture in the Pacific Northwest, EB1578E.

Visit the WSU Cooperative Extension publications Web site at http://pubs.wsu.edu

Other resources

Gavlak, R.G., D.A. Horneck, and R.O. Miller. 1994. Plant, Soil and Water Reference Methods for the Western Region, WREP 125 (University of Alaska-Fairbanks).

Johnson, L., J. Harrison, F. Hoisington, and M. Bueler. 2002. Nitrate levels in grass silage. Washington State Dairy News 11(2). Available at: http://www.puyallup.wsu.edu/dairy/. Verified 1 August 2002.

Mahler, R.L. and T.A. Tindall. 1994. Soil Sampling, Bulletin 704 (University of Idaho Cooperative Extension System, Moscow, ID).

Midwest Plan Service. Livestock and Poultry Environmental Stewardship (LPES) Curriculum. Available at: http://www.lpes.org/. Verified 14 January 2002.

North American Proficiency Testing Program. Standard Reference Soil Samples (Soil Science Society of America, 677 S. Segoe Rd., Madison, WI 53711; phone: 608-273-8080; Web: http://www.soils.org).

Acknowledgments

This publication is a product of the Western Integrated Nutrient Management Education (WINME) project. Financial support for WINME is provided by the USDA Western Region Sustainable Agriculture Research and Education (SARE) Program.

This publication reflects a collaborative effort among organizations and individuals. Major ideas in the publication were proposed by participants at the Fall Soil Nitrate Workshop facilitated by Washington State University Cooperative Extension on 28 February 2002 in Puyallup, WA.

The authors acknowledge the involvement of the following individuals in development of portions of the publication:

Andy Bary, WSU Cooperative Extension, Puyallup, WA

Don Horneck, OSU Extension Service, Hermiston, OR

Joe Harrison, WSU Cooperative Extension, Puyallup, WA

John Gillies, Washington State NRCS, Lynden, WA

John Hart, OSU Extension Service, Corvallis, OR

Mary Staben, OSU Extension Service, Corvallis, OR

Orlando Schmidt, BC Ministry of Agriculture, Food and Fisheries, Abbotsford, BC

Robert Dyk, Thurston Conservation District, Tumwater, WA

Robert Stevens, WSU Cooperative Extension, Prosser, WA

Steve Campbell, Oregon NRCS, Portland, OR

Tom Gohlke, Oregon NRCS, Portland, OR

Valerie Oksendahl, Washington State NRCS, Spokane, WA

Review comments on a draft of the publication were provided by:

Aria Baker, Linn Conservation District, Tangent, OR

Brad Brown, University of Idaho, Parma, ID

Chris Clark and Chuck Timblin, Whatcom Conservation District, Lynden, WA

Dean Moberg, Oregon NRCS, Hillsboro, OR

Fred Likkel, David Haggith, and Joy Hawley, N3 Consulting, Lynden

Glenn Gately, Jefferson Conservation District, Port Hadlock, WA

Jerry Lemunyon, NRCS, Fort Worth, TX

Lee Ko, Oregon NRCS, Oregon City, OR

Marty Chaney, Washington State NRCS, Olympia, WA

Mike Gamroth, Animal Science, OSU, Corvallis, OR

Mike Gangwer, OSU Extension Service, Salem, OR

Shabtai Bittman, Agriculture and Agri-Food Canada, Agassiz, BC

Troy Downing, OSU Extension Service, Tillamook, OR

Wym Matthews, Oregon Department of Agriculture, Tillamook, OR

Published May 2003.