

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN

Schoch Dairy
24335 NW West Union Road
Hillsboro, OR 97124
(503) 647-2638



Prepared by:
Dave and Casey Schoch

with assistance from:
Jennifer Zwicke

MA# 63216
AWMP# 06145
11/12/2006

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- Which Test is Best? (PNW 505)
- Annual Manure Application Schedule for Western Oregon (EM 8724)

SIGNATURE PAGE

OWNER/OPERATOR:	Dave and Casey Schoch
Address & Phone:	24335 NW West Union Road Hillsboro, OR 97124 (503) 647-2638
Farm and Tract No:	USDA Tract 3375 and 3376

I certify the Manure and Wastewater Handling and Storage Element meets the requirements of a CNMP.

Signature: <i>Jennifer L. Zwick</i>	Date: 9/14/06
Name: Jennifer L. Zwick	
Title: Agricultural Engineer/EIT	

I certify the Nutrient Management Element meets the requirements of a CNMP.

Signature: <i>Jennifer L. Zwick</i>	Date: 9/14/06
Name: Jennifer L. Zwick	
Title: Agricultural Engineer/EIT	

I certify the Land Treatment Practices Element meets the requirements of a CNMP.

Signature: <i>Jennifer L. Zwick</i>	Date: 9/14/06
Name: Jennifer L. Zwick	
Title: Agricultural Engineer/EIT	

As the Owner/Operator and Decision-Maker, I certify that I have been involved in the planning process for the development of this CNMP. I understand my responsibilities for implementing and updating this CNMP in a timely manner and for keeping all necessary records.

Signature: <i>David Adair</i>	Date: 9/15/06
--------------------------------------	----------------------

As a Certified Conservation Planner, I certify that I have reviewed this plan and have determined that it contains the deliverable items described in the NRCS Statement of Work for a CNMP and appears to be in conformance with NRCS planning policy.

Signature:	Date:
Name:	
Title:	

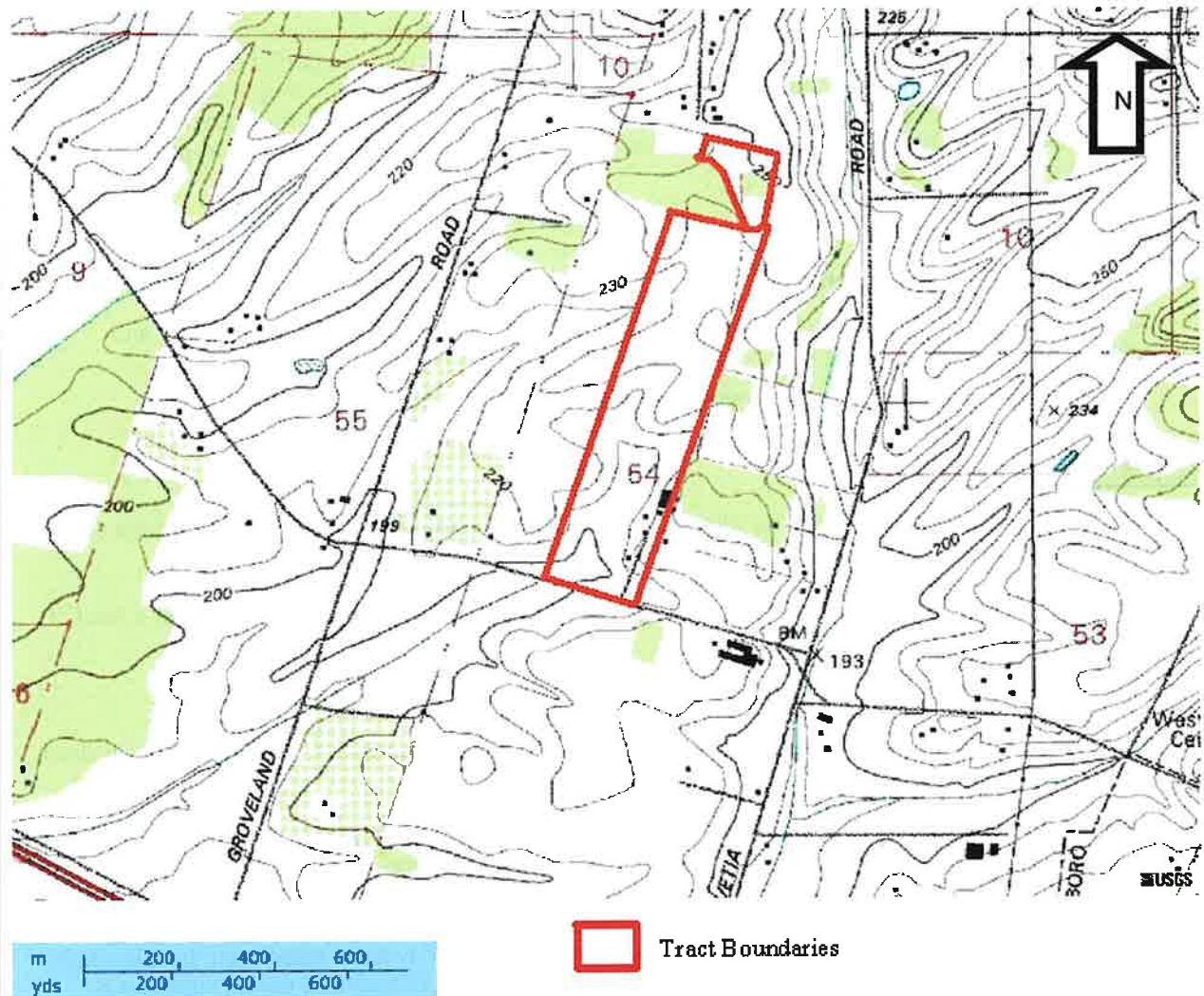
MA #: 63616
 ANMP #: 06145
 Due Date: 11/12/06

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 NATURAL RESOURCES
 DIVISION

Location Map for Schoch Dairy

Client: Dave and Casey Schoch
Approximate Acres: 64
Legal Description: T2N R2W Section 10

Date: September 2007
State and County: OR, Washington
Tracts: 3375 and 3376



PLAN SUMMARY

This Comprehensive Nutrient Management Plan (CNMP) was developed in accordance with the USDA Natural Resources Conservation Service's Field Office Technical Guide and provides guidance for the wise use of the soil, water, air, plants and animal resources in order to minimize degradation of these resources such that public health and safety is protected. The plan provides guidance on what structural and management practices are needed to prevent the discharge of pollutants to surface or ground water by recycling wastes through the soil and plants to the fullest extent possible.

As owner of the Schoch Dairy, Dave and Casey Schoch are responsible for the proper application of management practices and the Operation and Maintenance (O&M) of the structural practices. It is also the responsibility of Dave and Casey Schoch to comply with all of the provisions and conditions outlined in the Confined Animal Feeding Operation (CAFO) permit administered by the Oregon Department of Agriculture located in Section 9 of this plan. Any modifications to the operation which are not within the provisions and conditions of the CAFO permit must be reviewed and approved by the Oregon Department of Agriculture prior to implementation.

OBJECTIVES

Dave and Casey Schoch have the following objectives:

1. Apply liquid and solid manure to obtain maximum nutrient benefit while eliminating runoff and minimizing leaching of nutrients.
2. Operate the farm in a socially and environmentally acceptable manner.

ANIMAL NUMBERS

The Schoch Dairy is currently operating with 150 milking and dry cows and 100 heifers for a total of 250 animals.

This plan was written based on an expansion to 190 milking and dry cows and 109 heifers for a total of 299 animals.

WASTE MANAGEMENT SYSTEM

Following is a description of the waste management system for the Schoch Dairy shown on the facilities plan map in Section 4:

Collection- Manure and wastewater collected in the holding area and milk house during milking periods is washed to the flush alley which drains to the reception tank.

The calves are confined in the calf barn and manure/bedding is scraped and collected twice a week. The milking cows are confined and manure is scraped twice a week from the alleyways. The heifers and dry cows are grazed and confined. During confinement periods manure is scraped from the alleyways. Manure from the freestall barns is scraped on a weekly basis. During non-confinement periods, dry cows and heifers are grazed on Field #1.

Leachate from the silage storage area is directed to the second cell of the waste storage pond via perforated tiles. Rainfall runoff from roofed structures and graveled access roads are directed to Field #3 via tile drainage.

The planned improvements to the collection system include grazing all dry cows and 30 heifers on neighboring acreage during non-confinement periods. The remaining heifers will be grazed on Field #1 of the Schoch Dairy.

Treatment- When the wastewater in the 12 foot by 12 foot reception tank reaches a present level, the manure and wastewater temporarily stored in the reception tank is pumped to a drag chain, roller press screen where approximately 15% of the solids are removed. Hay or straw will be added to the solids as necessary to create a stack.

There are no additional designed treatment facilities other than what composting naturally occurs in the solids storage facility and naturally occurring anaerobic treatment in the waste storage pond.

No additional treatment facilities are planned for the Schoch Dairy.

Transfer- All manure and wastewater collected from the dairy facilities with the exception of the calf barn is transferred to the 12 foot by 12 foot reception tank via a concrete lined ditch extending from the animal housing and milking parlor to the reception tank. Manure and wastewater stored in the reception tank is pumped to a solid/liquid separator where solids are collected on a concrete slab used as the long term solids storage area. Manure and wastewater from the solid/liquid separator are directed to long term storage ponds.

The solids stored in the roofed solids storage facility are exported off site. Liquids stored in the waste storage ponds are pumped to hayland and neighboring properties using an aluminum handline and 1000 foot hard hose reel.

No additional improvements to the transfer system are planned for the Schoch Dairy.

Storage- The short term storage facility consists of a 12 foot by 12 foot by 10 foot deep reinforced concrete tank. Short term storage for this facility is only a few hours depending on the amount of wastewater and contaminated runoff being produced from the facility. The storage capacity of the short term storage tank does not meet long term storage requirements because it is considered short-term and does not have a secondary containment of cell #1 of the waste storage pond. During the site visit, the short term storage was not being used as intended. The lack of available flush water during the summer months causes poor or no separation, therefore, the reception tank was allowed to overflow into the first cell of the waste storage pond.

The long term storage facilities for liquid manure, wastewater, and contaminated rainfall runoff consist of two storage ponds. The first cell of the waste storage pond is approximately 3.5 acre-ft and the second cell of the waste storage pond is approximately 4.9 acre-ft. A weir box controls flow from the first cell to the second cell of the waste storage pond. The capacity of the liquid waste storage facility will provide 154 days of storage which meets the recommended minimum storage period of 154 days computed using Worksheet OR10A-7 found in Section 4. There is no record that the liquid waste storage facility was constructed in accordance with the NRCS Waste Storage Facility practice standard 313 (PS313).

The planned improvements to the manure storage facilities at the Schoch Dairy include a plan for removing solids from the first cell of the storage pond, repairing the current separator for proper use, and adding more solids storage. During the dry summer months, a plastic liner will be placed around the edge of the first cell of the waste storage pond and using a backhoe, accumulated solids will be removed from the first cell. They will be placed on the liner and allowed to dry. The plastic liner will protect the soil from excess nutrients and drain rainfall runoff into the waste storage pond. After drying, the solids will be placed on the stacking slab until taken off-site. This method will be repeated over the course of several years in order to reduce the volume of solids that were allowed to build up in the first cell of the waste storage pond. The current drag chain, roller press separator will be repaired and used as intended. An agitator will be placed in the second cell of the waste storage pond to allow wastewater to be pumped from the waste storage pond.

Decreasing the volume of solids in the first cell of the waste storage pond will decrease the amount of solids entering the second cell making the wastewater more available for use as flush water. With more flush water available during the summer months, the current separator will work as intended and the reception tank will not be allowed to overflow.

PLAN SUMMARY

The long term storage for the solids generated from the dairy operation is a covered stacking slab next to the first cell of the waste storage pond. The capacity of the current solid waste storage facility provides 71 days of storage which does not meet the recommended minimum storage period of 154 days computed using Worksheet OR10A-7 found in Section 4. There is no record that the solid waste storage facility was constructed in accordance with the NRCS Waste Storage Facility practice standard 313 (PS313). Based on observation the waste storage facility is serving as intended and continue to do so as long as operation and management guidelines are followed.

The planned improvement to the solids storage is to add a second facility for storing solids to meet the 154 days of storage. A 40 by 45 portion of the hay storage building will be used for stacking solids. The hay storage structure is covered and solids can be stacked at least 8 feet high. The sidewalls of the hay storage structure are at least 15 feet tall allowing for 8 feet of stacking height. The combined capacity of the current solids stacking facility and the area of the hay barn will provide for 21,059 cubic feet or 526 tons of storage which meets the minimum storage period of 154 days computed using Worksheet OR10A-7 found in Section 4.

It is noted the concentration of phosphorus could be decreased from the waste storage pond with better solids separation because 50-80% of phosphorus from manure is contained in the solids. Since soil phosphorus levels are of concern at Schoch Dairy, it is noted that a newer more efficient separator will remove more solids causing the wastewater in the waste storage pond to contain less phosphorus and become more capable of meeting the nitrogen needs of the crop. It is also noted that treatment of manure with a geotube will greatly reduce the concentration of phosphorus in liquids allowing more liquid to be applied to the fields. Mr. Vic Johnson from Kemiron Company was brought on-site to discuss treatment with a geotube. However, a new separator and/or nutrient treatment is not considered as feasible as hauling the majority of solids and liquids off-site and applying a nitrogen fertilizer to meet the nutrient demands of the crop.

Application- For all applications of manure, bedding and runoff from the waste storage structure, the liquid irrigation system is to be calibrated in accordance with guidance for Nutrient Management and Waste Utilization specification in Section 11 to ensure the applications are in accordance with the Nutrient Application Plan given in Section 6.

The emergency application area shown on the plan map was selected based on topography, soil type, proximity to open water courses, and risk of flooding. Specifically, the emergency winter application area was chosen based on a greater than 1000 foot distance from a water body and drainage (moderately well) of soil 19B compared to other soils on the property. Soil type 19B is also characterized by a smaller slope than other soil type choices on the property. This area should always have a growing crop on it during the fall and winter months in case weather conditions force emergency applications of wastewater to draw down storage facilities. See the Nutrient Management and Waste Utilization specification in Section 11 of this plan for guidance on making applications to the emergency application area.

No application of wastewater or solids containing manure is to be made to the 30 foot vegetated field buffer shown on the plan map. Applications of wastewater and manure solids after August 31st are allowed only if permanent pasture or a cover crop is being grown. Applications in after August 31st should follow the recommendations of the Nutrient Application Plan found in Section 6 of this plan.

The medium site vulnerability class for the crop land fields are based on the Western Oregon Phosphorus Index. Due to the lack of available flush water and the predicted high concentration of phosphorus in the waste storage pond, wastewater from the waste storage pond will be applied at a 2 times phosphorus removal rate.

Utilization- There is approximately 58.7 acres of crop land area at Schoch Dairy and approximately 40 acres of crop land at the neighboring property available for utilization of the nutrients and organics contained in the wastewater and solids produced from the livestock operation. Another 85 acres of neighboring property has potential to be used for liquid application

of manure. Approximately one third of this acreage (or 28 acres) will be used on a three year rotation for this liquid application. It is estimated that it will take approximately 102 acres of crop land to utilize all of the nitrogen and 400 acres to utilize all of the phosphorus produced from the Schoch Dairy.

Nutrient utilization rates for the waste application area can be found Section 6 of this plan.

CROPPING SYSTEM

There is currently no cropping system at Schoch Dairy. Commercial fertilizer and/or pesticides have not been applied in three in years in anticipation of operating an organic dairy. However, the lack of available irrigation water and use of paper pulp as bedding has canceled current plans to operate organically. Continuous pasture and hayland is the planned cropping system. The planned cropping system will generate feed and utilize nutrients and organics. The production period for the pasture and hayland cropping system will be from March to November which is expected to produce 3 to 6 tons/acre of forage and hay.

IRRIGATION SYSTEM

A stationary "big gun" sprinkler on an aluminum handline and 1000 foot hard hose reel is used to irrigate the hayland fields during the production period to supply moisture for plant evapotranspiration. The "big gun" irrigator is also used to apply liquid waste generated from the dairy for utilization.

PLAN SUMMARY

EMERGENCY RESPONSE PLAN

Section 3

In Case of a Storage Facility Spill, Leak, or Failure

- Stop all other activities to address the emergency.
- Stop all flow into the storage facility.
- If the storage facility is at maximum capacity or overtopping, draw the waste level in the facility down by making an application to the emergency application area shown on the plan map in accordance with the Waste Utilization specifications found in the Section 11 of this plan.
- Assess the extent of the emergency and determine how much help is needed to correct the problem.
- Call for help & excavator if needed.
- If possible, use a skid loader or tractor with blade to contain or divert spill or leak away from environmentally sensitive areas.
- If containment material is needed, excavate soil from appropriate areas away from the storage facility.
- If possible, begin applying the stored waste to the utilization fields at the prescribed application rates described in Section 6 of this plan.
- Complete the clean-up and repair the necessary components.

In Case of a Manure/Waste Discharge

- Stop all other activities to deal with the emergency.
- Call for help if needed.
- Call sheriffs office if spilled on road for traffic control and clean the spill immediately from the road and roadside if needed.
- Contain the spill or runoff from entering the stream or waterway using straw bales, saw dust, or soil material.
- If flow is coming from a tile, plug the tile with a tile plug immediately.
- Assess the extent of the emergency and determine how much help is needed.

Contacts to be made within 24 Hours of a Discharge

(SEE NEXT PAGE FOR REQUIREMENTS FOR FILING A WRITTEN REPORT)

Organization	Phone
Oregon Department of Agriculture	1-800-282-9378
Oregon Emergency Response System (ORES)	1-800-452-0311

Be prepared to provide the following information:

- Your Name (See next page)
- Farm Identification (See next page)
- Description of emergency.
- Estimate of the amounts, area covered, and distance traveled.
- Has manure reached surface waters or major field drains?
- Is there any obvious damage: employee injury, fish kill, or property damage?
- What is currently in progress to contain situation?

EMERGENCY RESPONSE PLAN

Emergency Contact Information

Farm Name	Schoch Dairy
Address	24335 NW West Union Road Hillsboro, OR 97124
Farm Phone	(503) 647-2638
ODA CAFO Permit #	63616
DIRECTIONS TO FARM	From highway 26 take the Shute Rd/Helvetia Rd exit and go North on Helvetia Road. Turn West on West Union Road and Schoch Dairy is located on the North side of West Union Road near the intersection of West Union Road and Helvetia Road.
Emergency Phone Numbers:	
Farm Owner	(503) 647-2638
Farm Manager	Dave and Casey Schoch
FIRE or AMBULANCE	911

If a Discharge Occurs a Written Report is to be made by Owner or Operator to Oregon Department of Agriculture within 5 Days that contains the following information:

- A description and cause of the discharge.
- The period of discharge including exact dates, times and duration of discharge.
- An estimate of discharge volume.
- Name or location of receiving water.
- Corrective steps taken, if appropriate, to reduce, eliminate or prevent reoccurrence of the discharge.

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

CLIENT: Dave and Casey Schoch
ASSISTED BY: Jennifer Zwicke

CHECKED BY:

Worksheet OR10A-7--Waste storage period determination

Basic Storage Period, SPb = **213** Days

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

Climatic Station- **HILLSBORO**

Day of Year	MONTH	Crop ET, Inches	Accum ET, Inches	Ppt, Inches
1-31	January	0.39	0.39	5.76
32-59	February	0.79	1.18	4.72
60-90	March	1.61	2.79	3.93
91-120	April	3.43	6.22	2.46
121-151	May	4.65	10.87	1.90
152-181	June	5.79	16.66	1.46
182-212	July	5.59	22.25	0.61
213-243	August	5.00	27.25	0.93
244-273	September	3.78	31.03	1.61
274-304	October	2.28	33.31	2.68
305-334	November	0.39	33.70	6.03
335-365	December	0.28	33.98	6.44

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

$$3/4 \text{ of Annual ET} = 0.75 \times 33.98 = 25.49 \text{ Inches}$$

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

$$L = 243 \text{ Days}$$

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

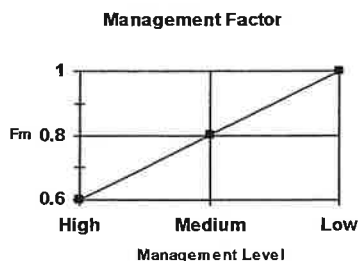
E = First Day of Month ET >= Ppt

$$E = 91 \text{ Days}$$

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

Management Factor, Fm =

0.8



Low Level, Fm = 1.0

...The operator does not utilize a waste management plan.
...Proper operation and maintenance may not be performed.

Medium Level, Fm = 0.8

...The operator utilizes an up-to-date waste management plan.
...Manure application equipment is calibrated for nutrient applications.
...Maintains adequate soil moisture for crop growth.
...Agronomic treatments which would maximize crop nutrient uptake are not fully utilized.
...Proper operation and maintenance is planned.

High Level, Fm = 0.6

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

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

Soils Factor: $F_{s\text{LIQUID}} = 0.9$ $F_{s\text{SOLID}} = 0.7$

Soils must meet the following criteria for F_s to be less than 1.0-

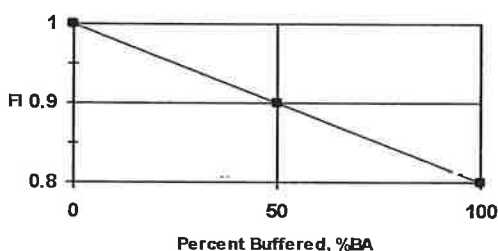
- ... The average water holding capacity for the profile greater than 3.0 inches.
- ... A cation exchange capacity greater than 5 meq/100g of soil.
- ... Depth to a thin layer/cemented pan greater than 20 inches.
- ... Depth to high water table greater than 2 feet.
- ... A permeability greater than 0.06 inches/hr but less than 6 inches/hr.
- ... Cobbles less than 35% by weight in the surface layer.
- ... Stones and boulders less than 15% by weight in the surface

HSG	Soils Factor (F_s)			
	Consistency of Waste			
	Liquid	Slurry	Semi-Solid	Solid
A	1	0.95	0.9	0.8
B	0.8	0.75	0.7	0.6
C	0.9	0.85	0.8	0.7
D	1	1	0.95	0.85

HSG	Area	$F_{s\text{LIQUID}}$	Wtd $F_{s\text{LIQUID}}$	$F_{s\text{SOLID}}$	Wtd $F_{s\text{SOLID}}$
C	100	0.9	90	0.7	70
Total Weighted $F_{s\text{LIQUID}} =$		0.9	Total Weighted $F_{s\text{SOLID}} =$		0.7

Location Factor: $FI = 0.83$

Location Factor



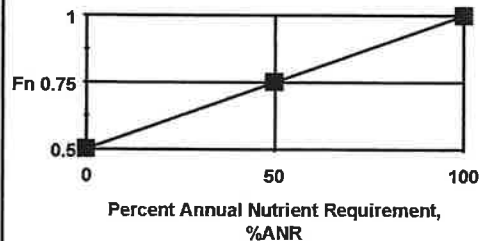
For an application area to be considered buffered there must be a 0 to 5 percent chance of flooding and the area must be at least 50 feet from water bodies, ground water sources(wells), and areas of concentrated flow. The percent buffered area(%BA) is determined by taking the total buffered area(TBA)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

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

$$\%BA = \frac{50}{58} \times 100\% = 87\%$$

Nutrient Loading Factor: $F_n = 0.85$

Nutrient Loading Factor



In order for the Nutrient Loading Factor, F_n to be less than 1, the Location Factor, FI must be 0.95 or less.

The percent of annual nutrient requirement(%ANR) is determined by taking the total nutrients applied(TNA) annually and dividing it by the total nutrient requirements(TNR) of all of the crops grown.

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

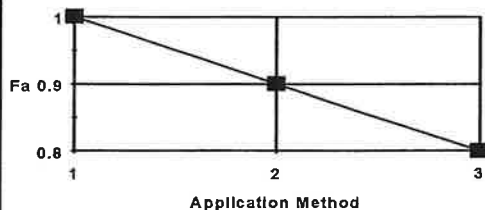
$$\%ANR = \frac{1,018}{1,467} \times 100\% = 69\%$$

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

Application Method Factor:

$$Fa_{LIQUID} = \underline{0.90} \quad Fa_{SOLID} = \underline{1.00}$$

Application Method Factor



Method 1 - Surface applied solid manure, no incorporation.

Method 2 - Surface applied liquid manure, no incorporation.

Method 3 - Injection or immediate incorporation.

Adjusted Storage Period: $ASP_{LIQUID} = 97$ Days $ASP_{SOLID} = 83$ Days

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

$$ASP_{LIQUID} = 213 \times 0.8 \times 0.9 \times 0.826539462272333 \times 0.846795038061536 \times 0.9$$

$$ASP_{SOLID} = 213 \times 0.8 \times 0.7 \times 0.826539462272333 \times 0.846795038061536 \times 1$$

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

$$E_a_{LIQUID} = -25$$

$$E_a_{SOLID} = -39$$

Storage Period: $SP_{LIQUID} = 154$ Days $SP_{SOLID} = 154$ Days

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

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

$$L = 243 \text{ Days} \quad L_f = 365 \text{ Days}$$

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

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

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

$$E_f = 32 \text{ Days}$$

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

$$E_{sp_{LIQUID}} = 32 \text{ Days} \quad E_{sp_{SOLID}} = 32 \text{ Days}$$

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

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

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

$$E_{sp_{LIQUID}} = \underline{\text{February 4}}$$

$$E_{sp_{SOLID}} = \underline{\text{February 1}}$$

e. Latest date (L_{sp}) for manure application (month-day) = * September 31

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

Worksheet OR10A-7- Waste storage period determination

Day of Year Calendar

Day of month	Jan	Feb	Mar	Apr	May	Month Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	32	60	91	121	152	182	213	244	274	305	335
2	2	33	61	92	122	153	183	214	245	275	306	336
3	3	34	62	93	123	154	184	215	246	276	307	337
4	4	35	63	94	124	155	185	216	247	277	308	338
5	5	36	64	95	125	156	186	217	248	278	309	339
6	6	37	65	96	126	157	187	218	249	279	310	340
7	7	38	66	97	127	158	188	219	250	280	311	341
8	8	39	67	98	128	159	189	220	251	281	312	342
9	9	40	68	99	129	160	190	221	252	282	313	343
10	10	41	69	100	130	161	191	222	253	283	314	344
11	11	42	70	101	131	162	192	223	254	284	315	345
12	12	43	71	102	132	163	193	224	255	285	316	346
13	13	44	72	103	133	164	194	225	256	286	317	347
14	14	45	73	104	134	165	195	226	257	287	318	348
15	15	46	74	105	135	166	196	227	258	288	319	349
16	16	47	75	106	136	167	197	228	259	289	320	350
17	17	48	76	107	137	168	198	229	260	290	321	351
18	18	49	77	108	138	169	199	230	261	291	322	352
19	19	50	78	109	139	170	200	231	262	292	323	353
20	20	51	79	110	140	171	201	232	263	293	324	354
21	21	52	80	111	141	172	202	233	264	294	325	355
22	22	53	81	112	142	173	203	234	265	295	326	356
23	23	54	82	113	143	174	204	235	266	296	327	357
24	24	55	83	114	144	175	205	236	267	297	328	358
25	25	56	84	115	145	176	206	237	268	298	329	359
26	26	57	85	116	146	177	207	238	269	299	330	360
27	27	58	86	117	147	178	208	239	270	300	331	361
28	28	59	87	118	148	179	209	240	271	301	332	362
29	29		88	119	149	180	210	241	272	302	333	363
30	30		89	120	150	181	211	242	273	303	334	364
31	31		90		151		212	243		304		365

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

CLIENT: **Dave and Casey Schoch**

ASSISTED BY: Jennifer Zwicke

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM INVENTORY

ANIMAL INVENTORY																
Type of Animal	Number of Animals	Average Weight (lbs.)	Animal Units (1,000 lb.)	Milk Production in Pounds/Cow/Day=70										Manure CF/D/AU	Annual	
				(lbs./day/1000 lb. Animal Unit)						(lbs./day)					Days Confined	Days Grazed
				N	P	K	N	P	K	N	P	K				
				N	P	K	N	P	K	N	P	K				
MILKER (Holstein)	160	1,350	216.0	0.70	0.12	0.32	151.20	25.96	69.51	1.70	365	0				
MILKER (DRIY)	30	1,350	40.5	0.33	0.07	0.17	13.37	2.84	6.89	0.92	182	183				
HEIFERS (12-24 Months)	79	850	67.2	0.27	0.05	0.12	17.86	3.06	8.06	0.90	214	151				
CALVES (1-12 Months)	30	250	7.5	0.42	0.05	0.11	3.15	0.41	0.83	1.34	365	0				
Totals/Averages-	299	950	331.2	0.56	0.10	0.26	185.6	32.3	85.3	1.4						

GRAZING PERIOD

[illegible]

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

WEATHER STATION		HILLSBORO		▼
Month	25Yr-24Hr	Lot Runoff Factors as a Percent of Monthly Precipitation		
	Monthly Average in Inches	Paved	Unpaved	
October	2.68	1.72	55%	15%
November	6.03	0.76	55%	20%
December	6.44	0.43	55%	20%
January	5.76	0.48	55%	20%
February	4.72	0.81	45%	20%
March	3.93	1.57	45%	15%
April	2.46	2.40	35%	15%
May	1.90	3.75	35%	10%
June	1.46	4.34	35%	10%
July	0.61	5.42	30%	0%
August	0.93	4.94	35%	10%
September	1.61	3.37	45%	15%
Annual	38.53	29.99		

AREAS CONTRIBUTING RUNOFF TO LIQUID STORAGE FACILITY

[illegible]

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	160.0	2	1.00	320	42.8
Equipment Wash		2	50.00	100	13.4
Flushwater		2	0.00	0	0.0
Miscellaneous		2	0.00	0	0.0
Total>				420	56.1

CROP DATA

Field Number	Acres	Crop	Condition	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre	Nitrogen	Phosphorous	Potassium
1	2.1	Grass/Legume Hay/Pasture	▼	DM	4.00	50	136	50	16
2	11.6	Hay/Pasture Mix 14% Protein	▼	DM	4.00	49	179	49	13
3	40.5	Hay/Pasture Mix 14% Protein	▼	DM	6.00	74	269	74	205
4	3.4	Oats Hay/Pasture	▼	DM	3.00	70	78	70	54
G	40.0	Hay/Pasture Mix 14% Protein	▼	DM	6.00	74	269	74	205
LA	28.0	Hay/Pasture Mix 14% Protein	▼	DM	6.00	74	269	74	205
			▼						
			▼						
			▼						
Off-Farm			▼						

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

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
MILKER (Holstein)	Free Stall	Sawdust	12.00	10.00	0.83	180	2,160
MILKER (DRY)	Free Stall	Paper Pulp	4.00	10.00	2.50	101	405
HEIFERS (12-24 Months)	Loose Housing	Paper Pulp	4.00	12.00	3.00	201	806
CALVES (1-12 Months)	Loose Housing	Loose Straw	2.50	60.00	24.00	180	450

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
MILKER (Holstein)	Static Inclined Screen with Drag Chain	15%	34	193	361	7	180	36	1,224
MILKER (DRY)	Static Inclined Screen with Drag Chain	15%	16	90	37	1	8	36	570
HEIFERS (12-24 Months)	Static Inclined Screen with Drag Chain	15%	32	179	59	1	22	36	1,138
CALVES (1-12 Months)	Dry Scrape System	100%	190	0	0	10	0	36	6,842
Total Solids			271	462	457	19	211		9,774

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

MONTHLY VOLUMES

Month	Runoff in Cubic Feet				Facility Water Use Cubic Feet	Manure		Bedding		Solids Separated		Solids in Liquids		Total Solids Cubic Feet	Total Liquids Cubic Feet
	Roof Area Square Feet 1,600	Paved Slab Area Square Feet 30,070	Unpaved Lot Area Square Feet 6,000	Silage Pit Surface Area, SF 3,500		Solids Cubic Feet	Liquids Cubic Feet	Cubic Feet	Pounds	Cubic Feet	Pounds	Cubic Feet	Pounds		
October	357	3,694	201	613	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,073	8,416	35,071
November	804	8,311	603	823	1,684	2,110	12,164	19,881	114,624	8,145	293,217	13,846	498,458	8,145	40,230
December	859	8,876	644	871	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,073	8,416	41,456
January	768	7,938	576	832	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,073	8,416	40,320
February	629	5,322	472	723	1,572	1,969	11,353	18,556	106,982	7,602	273,669	12,923	465,228	7,602	35,800
March	524	4,432	295	668	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,073	8,416	36,124
April	328	2,158	185	579	1,684	1,758	9,948	12,009	83,135	6,911	248,808	6,856	246,807	6,911	23,348
May	253	1,666	95	55	1,741	1,808	10,232	12,222	85,157	7,112	256,044	6,918	249,038	7,112	22,232
June	195	1,280	73	43	1,684	1,750	9,902	11,827	82,410	6,883	247,784	6,695	241,005	6,883	21,474
July	81	459	0	0	1,741	1,806	10,216	12,159	84,907	7,103	255,691	6,862	247,040	7,103	20,628
August	124	816	47	27	1,741	1,806	10,216	12,159	84,907	7,103	255,691	6,862	247,040	7,103	21,102
September	215	1,815	121	542	1,684	1,758	9,948	12,009	83,135	6,911	248,808	6,856	246,807	6,911	22,792
Annual	5,137	46,766	3,311	5,775	20,495	23,487	134,257	192,996	1,199,035	91,435	3,291,677	125,048	4,501,716	91,435	360,577

DAILY NUTRIENT PRODUCTION

Type of Animal	Pounds/Day of Nutrients from LIQUIDS			Pounds/Day of Nutrients from SOLIDS			Pounds/Day of Nutrients from GRAZING		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
MILKER (Holstein)	128.52	50.56	71.19	22.68	8.92	12.56	0.00	0.00	0.00
MILKER (DRY)	11.36	5.52	7.05	2.00	0.97	1.24	13.37	6.49	8.30
HEIFERS (12-24 Months)	15.18	5.95	8.25	2.68	1.05	1.46	17.86	7.00	9.71
CALVES (1-12 Months)	0.00	0.00	0.00	3.15	0.93	0.99	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
	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

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

MONTHLY NUTRIENT PRODUCTION

Month	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		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
October	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
November	4,652	1,861	2,595	915	356	488	0	0	0	0	0	0	5,567	2,217	3,083
December	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
January	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
February	4,342	1,737	2,422	854	332	455	0	0	0	0	0	0	5,196	2,069	2,877
March	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
April	3,947	1,552	2,185	791	302	415	830	363	482	0	0	0	5,567	2,217	3,083
May	4,064	1,599	2,251	815	311	428	874	381	507	0	0	0	5,753	2,291	3,186
June	3,933	1,547	2,178	789	301	414	846	369	491	0	0	0	5,567	2,217	3,083
July	4,059	1,597	2,248	814	311	428	879	384	510	0	0	0	5,753	2,291	3,186
August	4,059	1,597	2,248	814	311	428	879	384	510	0	0	0	5,753	2,291	3,186
September	3,947	1,552	2,185	791	302	415	830	363	482	0	0	0	5,567	2,217	3,083
Annual	52,231	20,734	29,038	10,367	3,998	5,487	5,138	2,244	2,982	0	0	0	67,736	26,975	37,507

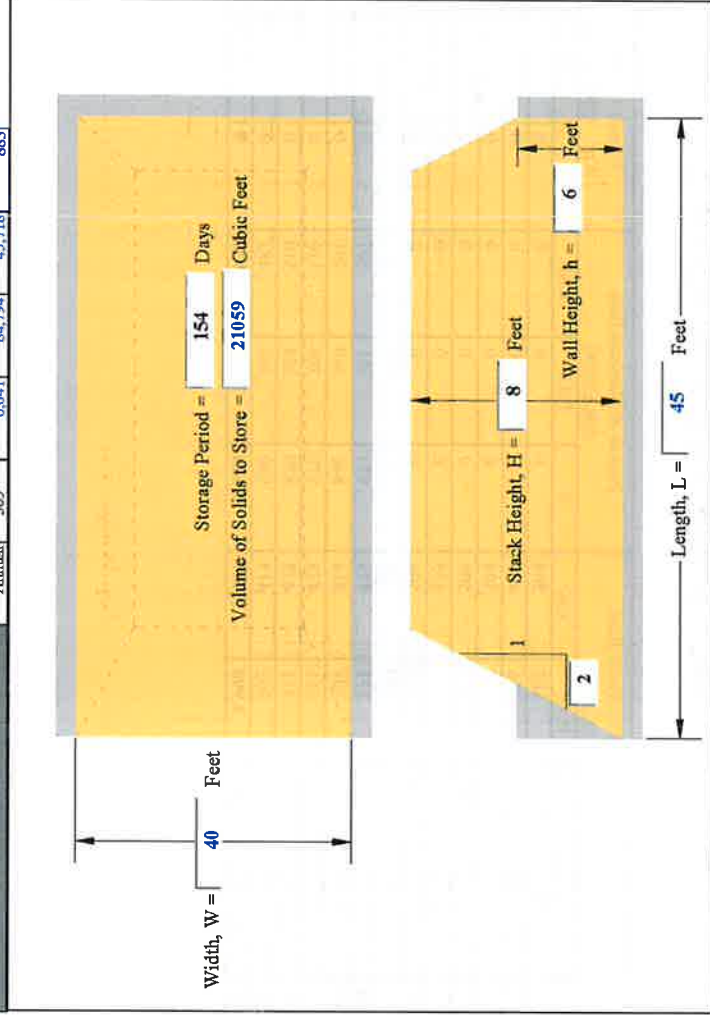
MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

CLIENT: Dave and Casey Schoch
ASSISTED BY: Jennifer Zwicke

CHECKED BY:

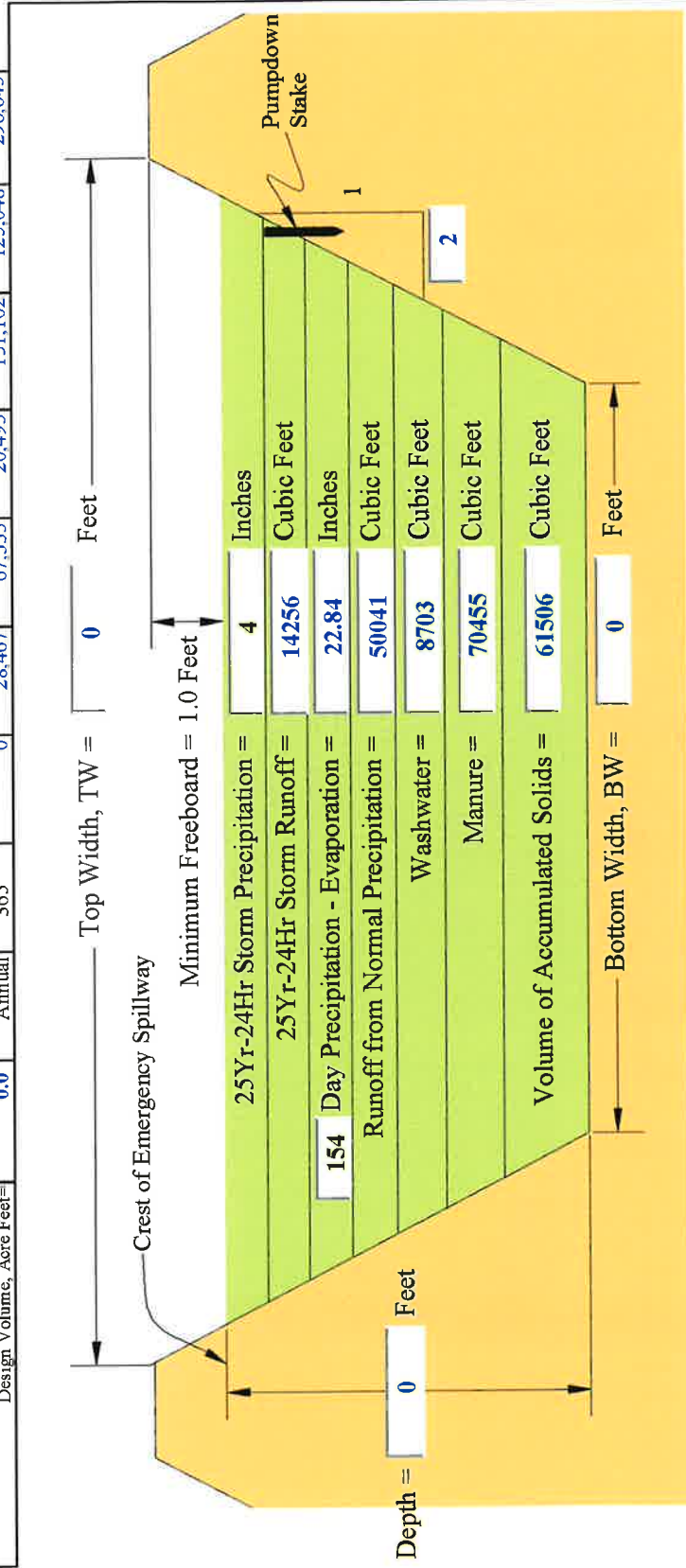
ANIMAL WASTE MANAGEMENT SYSTEM STORAGE

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=	154	October	31	592	7,825	4,208	54
Stacking Width, W in Feet=	40	November	30	573	7,572	4,072	161
Stacking Height, H in Feet=	8.00	December	31	592	7,825	4,208	172
Wall Height, h in Feet=	6.00	January	31	592	7,825	4,208	154
Stack Side Slope (X:1)=	2.00	February	28	535	7,067	3,801	126
Existing Storage, Cubic Feet=	9,898	March	31	592	7,825	4,208	79
Surface Area of Existing Storage, SF=	1,600	April	30	520	6,391	3,456	49
25 Year-24 Hour Storm Runoff, CF=	533	May	31	586	6,576	3,556	23
Volume Needed, Cubic Feet=	21,059	June	30	519	6,364	3,441	19
Design Volume, Cubic Feet=	11,458	July	31	536	6,567	3,551	0
Is Facility Covered? YES		August	31	536	6,567	3,551	12
		September	30	520	6,391	3,456	32
		Annual	365	6,641	84,794	45,718	883



MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

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	Solids CF	Waste to Store CF	
Storage Period, Days=	154	October	31	0	3,200	5,087	1,741	14,158	14,308	30,206	
Side Slope (X:1)=	2.00	November	30	0	17,567	11,637	1,684	13,701	13,846	29,232	
Bottom Width, BW, Feet=	0	December	31	0	20,033	12,428	1,741	14,158	14,308	30,206	
Bottom Length, BL, Feet=	0	January	31	0	17,600	11,116	1,741	14,158	14,308	30,206	
Accumulated Solids Duration, Years=	1	February	28	0	13,033	7,926	1,572	12,788	12,923	27,283	
Existing Storage, Acre Feet=	8.40	March	31	0	7,867	6,475	1,741	14,158	14,308	30,206	
Surface Area of Existing Storage, SF=	40,000	April	30	0	200	3,437	1,684	11,186	6,856	19,726	
Minimum Soil Liner Depth, Feet=	1.00	May	31	0	-6,167	2,594	1,741	11,504	6,918	20,162	
25 Year-24 Hour Storm Runoff, CF=	14,256	June	30	0	-9,600	1,993	1,684	11,133	6,695	19,512	
Top Width, TW, Feet=	0	July	31	0	-16,033	718	1,741	11,486	6,862	20,088	
Top Length, TL, Feet=	0	August	31	0	-13,367	1,270	1,741	11,486	6,862	20,088	
Volume Needed, Acre Feet=	8.3	September	30	0	-5,867	2,653	1,684	11,186	6,856	19,726	
Design Volume, Acre Feet=	0.0	Annual	365	0	28,467	67,335	20,495	151,102	125,048	296,645	



MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

Section 4

Livestock Manure Storage Assessment Worksheet					
Ground & Surface Water Contaminants - Nutrients, Organics & Pathogens					
Rating Item	Low Risk 4 Points	Low-Mod Risk 3 Points	Mod-High Risk 2 Points	High Risk 1 Point	Score
1. No on-farm storage facilities	Wastes hauled off farm for proper storage and disposal			Daily spreading of livestock wastes	NA
2. On-farm storage Manure stack and/or Liquid/Slurry storage	Manure stack covered; on impermeable surface; rainfall and runoff diverted; built to NRCS standards. Concrete, clay lined, or other liquid tight design; designed and built to NRCS standards; properly maintained; no cracks and leaks.	Manure covered; on low permeable soil; rainfall and runoff diverted. Earthen structure built to NRCS standards and properly maintained.	Manure partially covered; on slightly permeable soils; some runoff collected. Not designed to NRCS standards; on slightly permeable soils; poorly maintained, some evidence of cracks and leaks.	Manure not covered; runoff not collected. Not designed to NRCS standards; on permeable soils; not maintained; leaks and cracks.	3 3
3. Storage volume	Not full at end of rainy season; if liquid/slurry adequate capacity to hold 25-year, 24-hour storm; solids removed to avoid loss of storage capacity.	Not full at end of rainy season; if liquid/slurry not adequate capacity to hold 25-year, 24-hour storm.	Storage facility requires occasional emptying during the rainy season; if liquid/slurry not adequate capacity to hold 25-year, 24-hour storm.	Storage facility requires regular emptying during the rainy season; if liquid/slurry not adequate capacity to hold 25-year, 24-hour storm.	3
4. Storage location	Manure stack or earthen pond located more than 500 feet from well, stream, pond, or drainageway. Or Liquid/slurry storage located more than 200 feet from well, stream, pond, or drainageway or has emergency containment dike for accidental spills or leaks.	Manure stack or earthen pond located between 250-500 feet from well, stream, pond, or drainageway. Or Liquid/slurry storage located between 100-200 feet from well, stream, pond, or drainageway	Manure stack or earthen pond located less than 250 feet downslope from well, stream, pond, or drainageway. Or Liquid/slurry storage located more than 100 feet downslope from well, stream, pond, or drainageway	Manure stack or earthen pond located less than 250 feet upslope from well, stream, pond, or drainageway. Or Liquid/slurry storage located 100 feet from upslope well, stream, pond, or drainageway	3
Livestock Waste Storage Rating for Ground & Surface Waters		Accumulative Score (sum of above ratings)			12.00
		Average Score (sum of ratings / number of items rated)			3
Overall Risk Rating-		Low to moderate risk			

Ratings: 3.6-4=Low risk, 2.6-3.5=Low to moderate risk, 1.6-2.5=Moderate to high risk, 1-1.5=High Risk

Source: Modification of Oregon Home*A*Syst, EM 8546, Worksheet #7, Livestock Waste Storage

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

Livestock Yard Management Assessment Worksheet					
Ground & Surface Water Contaminants – Nutrients, Organics & Pathogens					
Rating Item	Low Risk 4 Points	Low-Moderate Risk 3 Points	Mod-High Risk 2 Points	High Risk 1 Point	Score
1. Location	More than 200 feet from well and more than 500 feet from stream, pond, or drainageway	Between 100-200 feet of well and between 250-500 feet from stream, pond, or drainageway	Between 50-100 feet of well and between 100-250 feet from stream, pond, or drainageway	Less than 50 feet of well and less than 100 feet from stream, pond, or drainageway	3
2. Livestock water source	Stock water in troughs, with overflow diverted to wastewater system	Stock water in troughs with overflow diverted from lot area. Stock excluded from streams or ditches.	Live water fenced, with stock water provided in water gap.	Stock water provided by live stream or irrigation ditch.	4
3. Surface water diversion	All upslope and roof water diverted. Diversion and gutters well maintained.	Most upslope surface and roof water diverted. Diversions and gutters occasionally maintained.	No surface water diverted. Some roof water collected and redirected. Gutters and diversions not maintained.	All water (surface and roof water) runs through the yard.	3
4. Lot runoff control system	No yard runoff. Fully covered area or runoff from surfaced lot directed to waste storage facility.	All runoff collected from compacted, earthen lot. Solids mounded and collected or stored.	Most of lot runoff diverted to filter strip and collected. Some solids removed.	Lot runoff uncontrolled. Solids rarely collected.	2
5. Yard cleaning and scraping	No yard (animals confined)	Every month or two lot smoothed, leveled, and regularly shaped.	Quarterly. Lot rough and irregular in shape.	Rarely. Lot poorly sited and developed for cleaning and scraping.	3
6. Dairy cow concentration on yard	No yard. Confined to barn, roofed yard or pasture.	75 sf/a or more on fenced, curbed concrete pad and/or 400 sf/a on graded earthen surface. More than 1800 sf/a in exercise area.	50 sf/a or more on concrete pad and/or 200-300 sf/a on earthen surface. More than 1200 sf/a in exercise area.	Some concrete, less than 50 sf/a and less than 200 sf/a on earthen surface.	3
7. Dairy replacements concentration	No yard. Confined to barn, roofed yard, or pasture.	More than 40 sf/a on fenced, curbed concrete pad and/or more than 150 sf/a on earthen yard.	40-20 sf/a on concrete and/or 75-150 sf/a on earthen surface.	Less than 75 sf/a on earth.	3

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

Livestock Yard Management Assessment Worksheet					
Ground & Surface Water Contaminants – Nutrients, Organics & Pathogens					
Rating Item	Low Risk 4 Points	Low-Moderate Risk 3 Points	Mod-High Risk 2 Points	High Risk 1 Point	Score
8. Beef feeder concentrations	No yard. Confined to barn.	Barn and/or paved lot more than 50 sf/a. Earthen lot with mound more than 300 sf/a, or without mound more than 500 sf/a.	No shelter. Paved lot with 30-50 sf/a. Earthen lot with mound 150-300 sf/a or earthen without mound 250-500 sf/a.	Paved less than 30 sf/a. Earthen less than 250 sf/a.	NA
9. Beef cows/heifers concentrations	Barn, roofed yard, or pasture.	Barn with paved lot more than 60 sf/a. Earthen with mound 400 sf/a or without mound 600 sf/a.	Paved lot more than 30 sf/a. Earthen with mound 200-400 sf/a or without mound 300-600 sf/a.	Paved less than 30 sf/a. Earthen without mound less than 200 sf/a.	NA
10. Sheep/ewes concentrations	No yard. Confined to barn, roofed yard, or pasture.	Barn and paved lot more than 20 sf/a. Earthen more than 40 sf/a.	Barn and paved lot 15-20 sf/a. Earthen 25-40 sf/a.	Barn and paved lot less than 15 sf/a. Earthen less than 25 sf/a.	NA
11. Feeder lambs concentrations	No yard. Confined to barn, roofed yard, or pasture.	Barn and paved lot more than 10 sf/a. Earthen more than 25 sf/a.	Barn and paved lot 5-10 sf/a. Earthen 10-25 sf/a.	Barn and paved lot less than 5 sf/a. Earthen less than 10 sf/a.	NA
12. Hogs/sows Concentrations	No yard. Confined to barn.	Shed and paved lot more than 30 sf/a.	Shed and earthen lot more than 10 sf/a.	Shed and earthen lot less than 10 sf/a.	NA
13. Horses concentrations	No yard. Confined to barn, roofed yard, or pasture.	Earthen exercise lot more than 2,500 sf/a.	Earthen exercise lot 1,000-2,500 sf/a.	Earthen exercise lot less than 1,000 sf/a.	NA
14. Poultry concentrations	No lot. In building.		Earthen lot of more than 4 sf/a.	Earthen lot of less than 4 sf/a.	NA
Livestock Yard Rating		Accumulative Score (sum of above ratings)			21.00
		Average Score (sum of ratings / number of items rated)			3
Overall Rating-		Low to moderate risk			

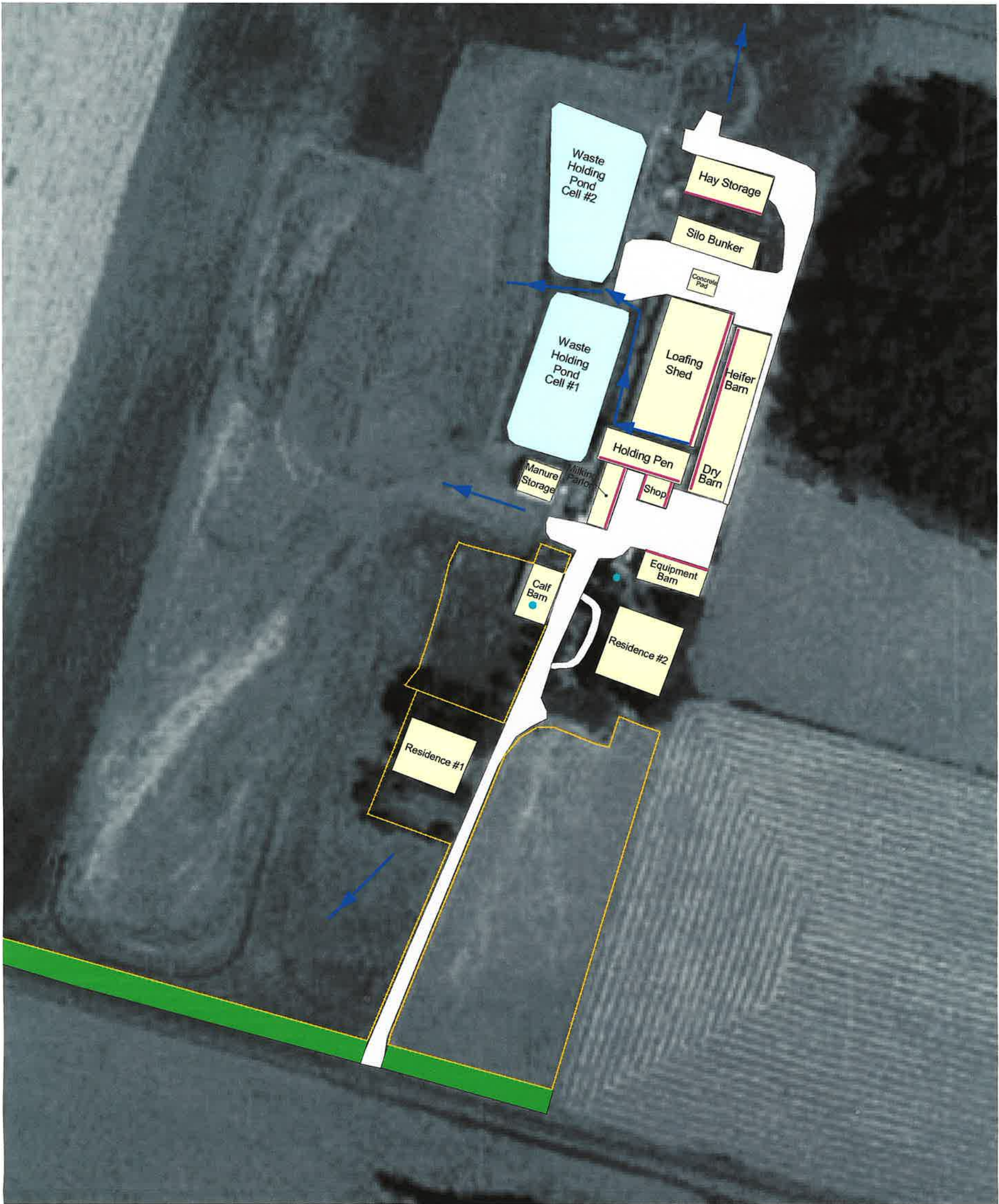
Ratings: 3.6-4=Low risk, 2.6-3.6=Low to moderate risk, 1.6-2.5=Moderate to high risk, 1-1.5=High Risk

Note: sf/a = square feet per animal

Source: Modification of Oregon Home*A*Syst, EM 8546, Worksheet #8, Livestock Yards Management

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

Facility Map



Client: Dave and Casey Schoch
County: Washington
State: Oregon
Date: September 2006
Approximate Acres of Fields: 58
Approximate Acres of HQ: 6
Tracts 3375 and 3376
T2N, R2W, S10

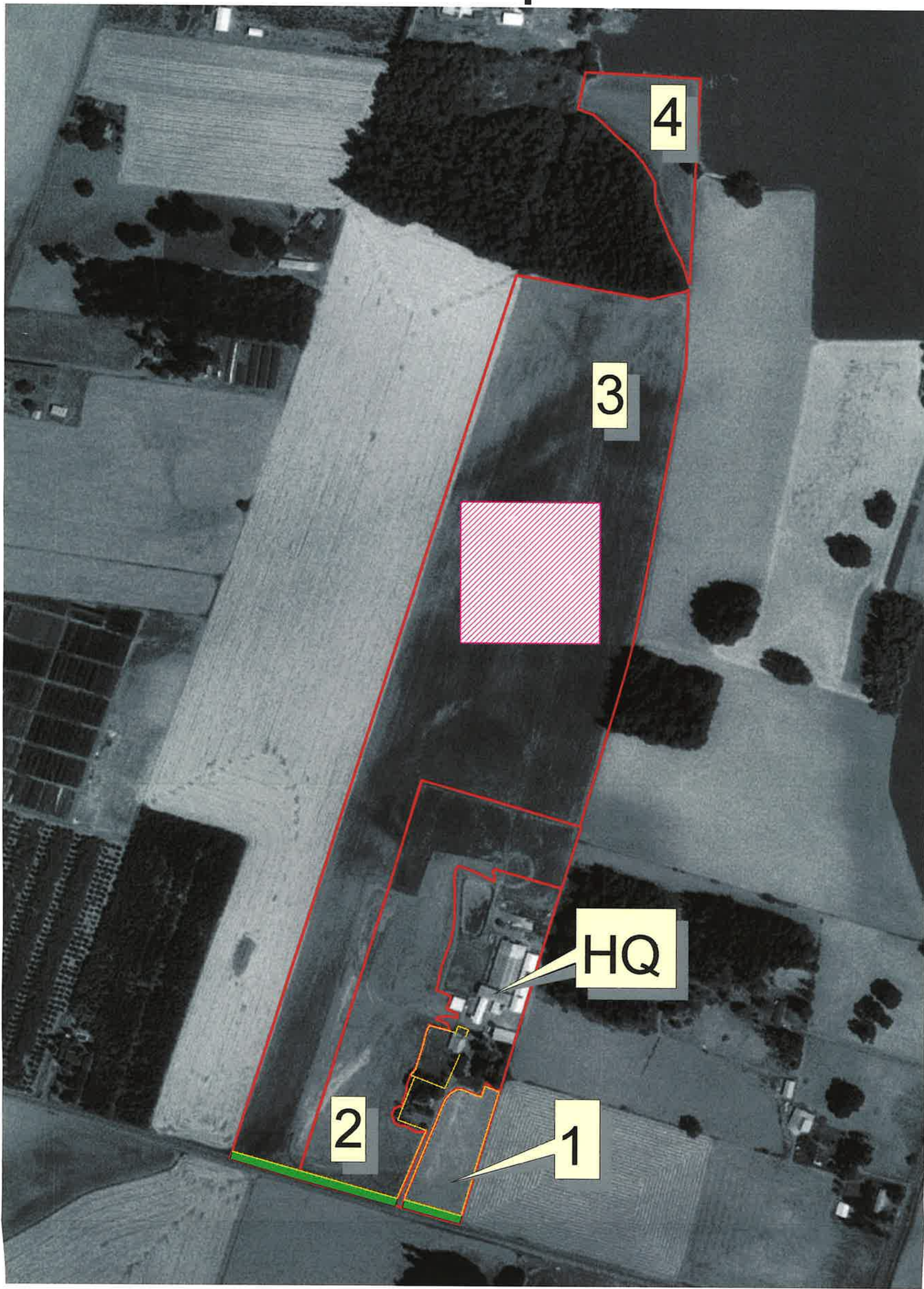
Map Legend

	Gutters*	*All animal structures have adequate gutters
	Drainage	
	Well	
	Fence	
	Structures	
	Waste Holding Pond	
	Gravel Access Roads	
	Field Border Buffer	



Assisted by:
Jennifer Zwicke

Plan Map



Client: Dave and Casey Schoch
County: Washington
State: Oregon
Date: September 2006
Approximate Acres of Fields: 58
Approximate Acres of HQ: 6
Tracts 3375 and 3376
T2N, R2W, S10

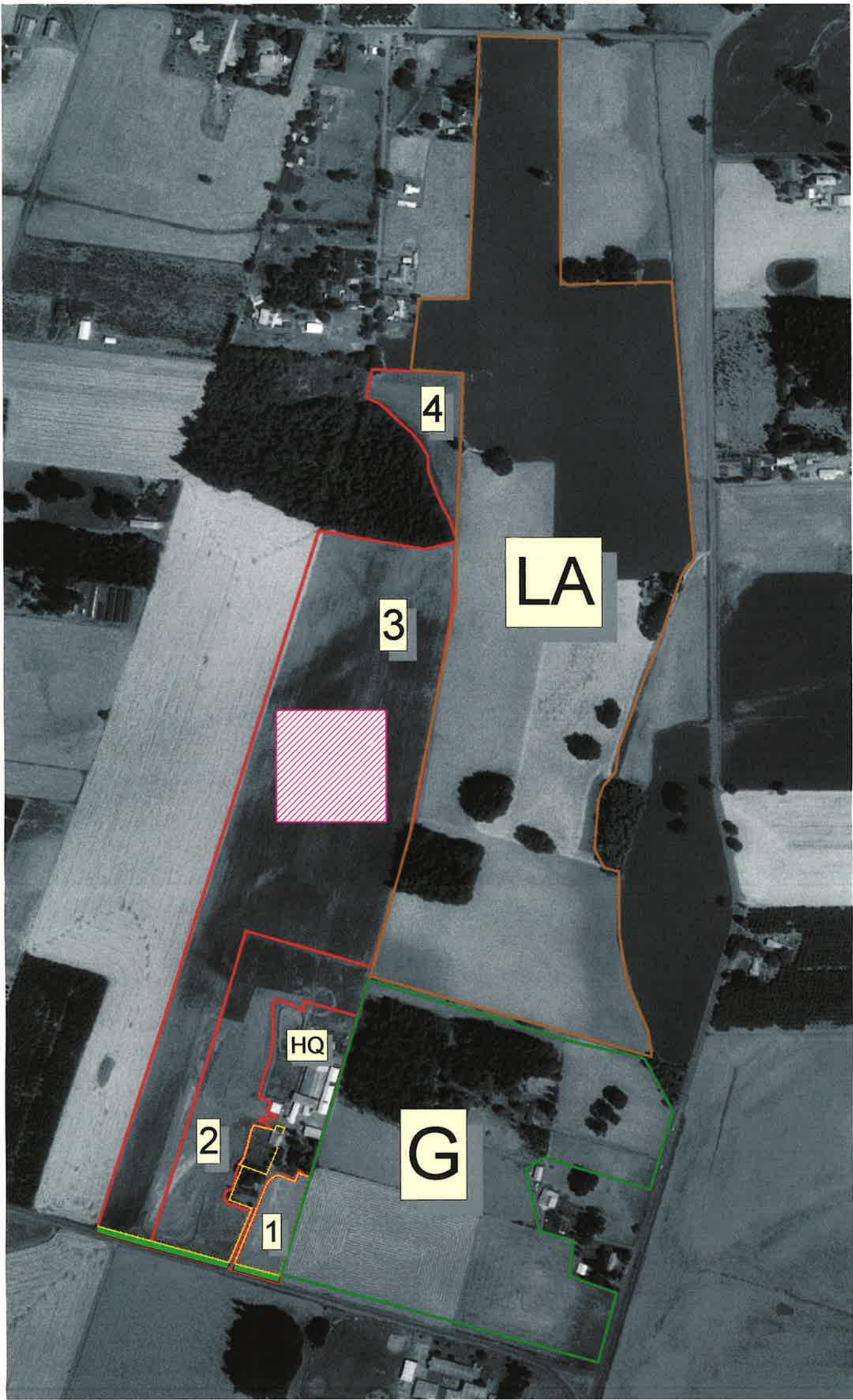
Field	Area (acre)	Landuse
1	2.1	Grass/Legume Hay/Pasture
2	11.6	Hay/Pasture Mix
3	40.5	Hay/Pasture Mix
4	3.4	Oats Hay/Pasture

Map Legend	
	Emergency Application Area
	Fence
	Field Border Buffer
	Field Boundaries



Assisted by:
Jennifer Zwicke

Plan Map with Additional Landuse



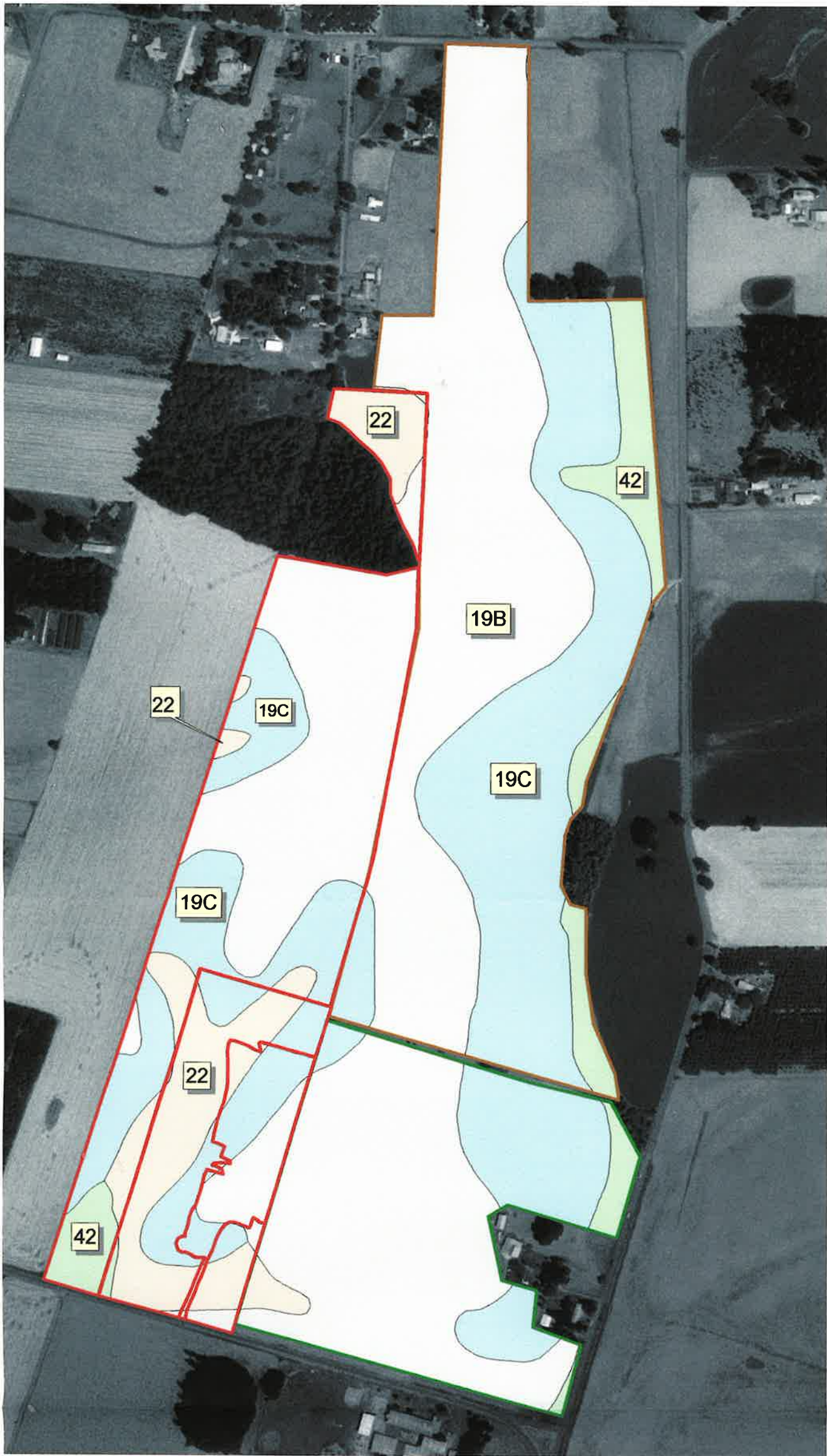
Client: Dave and Casey Schoch
County: Washington
State: Oregon
Date: September 2006
Approx Acres of Fields: 58
Approx Acres of Extra Fields: 125
Approx Acres of HQ: 6
Tracts 3375 and 3376
T2N, R2W, S10

Field	Area (acre)	Landuse
1	2.1	Grass/Legume Hay/Pasture
2	11.6	Hay/Pasture Mix
3	40.5	Hay/Pasture Mix
4	3.4	Oats Hay/Pasture
G	40.0	Hay/Pasture Mix
LA	85.0	Liquid Application

Map Legend	
	Potential Liquid Application
	Extra Grazing and Liquid Application
	Emergency Application Area
	Fence
	Field Border Buffer
	Field Boundaries

Assisted by:
Jennifer Zwicke

Soils Map Including Neighbors



Client: Dave and Casey Schoch
County: Washington
State: Oregon
Date: September 2006
Approx Acres of Fields: 58
Approx Acres of Extra Fields: 125
Approx Acres of HQ: 6
Tracts 3375 and 3376
T2N, R2W, S10

Map Legend

	Field Boundaries
	Extra Grazing and Liquid Application
	Potential Liquid Application
Soils	
	19B, Helvetia Silt Loam
	19C, Helvetia Silt Loam
	22, Huberly Silt Loam
	42, Verboort Silty Clay Loam

Assisted by:
Jennifer Zwicke

Soils Map



Client: Dave and Casey Schoch
County: Washington
State: Oregon
Date: September 2006
Approximate Acres of Fields: 58
Approximate Acres of HQ: 6
Tracts 3375 and 3376
T2N, R2W, S10

Map Legend

	Field Boundaries
Soils	
	19B, Helvetia Silt Loam
	19C, Helvetia Silt Loam
	22, Huberly Silt Loam
	42, Verboort Silty Clay Loam



Assisted by:
Jennifer Zwicke

LAND TREATMENT PRACTICES

Soils Map Legend and Interpretations

Map Unit Legend

Washington County, Oregon

Map symbol	Map unit name
19B	Helvetia silt loam, 2 to 7 percent slopes
19C	Helvetia silt loam, 7 to 12 percent slopes
22	Huberly silt loam
42	Verboort silty clay loam
44B	Willamette silt loam, 3 to 7 percent slopes



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LAND TREATMENT PRACTICES

Map Unit Text

Washington County, Oregon

Map unit: 19B - Helvetia silt loam, 2 to 7 percent slopes

Text kind/Category: Nontechnical description/SOI

The Helvetia soil is over 60 inches deep to bedrock. It is clayey, moderately well drained and occurs on terraces. A water table is present during the winter and spring. Water erosion is a potential hazard.

Map unit: 19C - Helvetia silt loam, 7 to 12 percent slopes

Text kind/Category: Nontechnical description/SOI

The Helvetia soil is over 60 inches deep to bedrock. It is clayey, moderately well drained and occurs on terraces. A water table is present during the winter and spring. Water erosion is a potential hazard.

Map unit: 22 - Huberly silt loam

Text kind/Category: Nontechnical description/SOI

The Huberly soil is over 60 inches deep to bedrock. It is silty, poorly drained and occurs on terraces. Permeability is slow. A water table is present during the winter and spring. This is a hydric soil.

Map unit: 42 - Verboort silty clay loam

Text kind/Category: Nontechnical description/SOI

The Verboort soil is over 60 inches deep to bedrock. It is clayey, poorly drained and occurs on floodplains. Permeability is very slow. This soil is subject to flooding. A water table is present during winter and spring. This is a hydric soil.

Map unit: 44B - Willamette silt loam, 3 to 7 percent slopes

Text kind/Category: Nontechnical description/SOI

The Willamette soil is over 60 inches deep to bedrock. It is silty, well drained and occurs on terraces. Water erosion is a potential hazard.



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LAND TREATMENT PRACTICES

Agricultural Disposal of Manure, Food-Processing Waste, and Sewage Sludge

Washington County, Oregon

[The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Map symbol and soil name	Pct. of map unit	Application of manure and food-processing waste		Application of sewage sludge	
		Rating class and limiting features	Value	Rating class and limiting features	Value
19B: Helvetia	85	Somewhat limited		Somewhat limited	
		Slow water movement	0.3	Slow water movement	0.22
		Too acid	0.03	Too acid	0.14
19C: Helvetia	85	Somewhat limited		Somewhat limited	
		Slow water movement	0.3	Slow water movement	0.22
		Slope	0.16	Slope	0.16
		Too acid	0.03	Too acid	0.14
22: Huberly	90	Very limited		Very limited	
		Slow water movement	1	Depth to saturated zone	1
		Depth to saturated zone	1	Slow water movement	1
		Runoff	0.4	Too acid	0.42
		Too acid	0.11		
42: Verboort	90	Very limited		Very limited	
		Slow water movement	1	Slow water movement	1
		Depth to saturated zone	1	Depth to saturated zone	1
		Flooding	1	Flooding	1
		Runoff	0.4	Too acid	0.42
		Too acid	0.11		
44B: Willamette	93	Somewhat limited		Somewhat limited	
		Too acid	0.03	Too acid	0.14

LAND TREATMENT PRACTICES

Physical Soil Properties

Washington County, Oregon

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear expansibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	-		
	in	Fci	Pci	Fci	g/cc	micro m/sec	in/in	Pct	Pct					
18B: Helveta	0-5	---	---	15-25	1.10-1.30	4.00-14.00	0.10-0.21	0.0-2.9	2.0-4.0	.32	.32	5	6	45
	5-10	---	---	27-35	1.10-1.30	4.00-14.00	0.10-0.21	0.0-2.9	1.0-3.0	.32	.32			
	10-45	---	---	35-50	1.20-1.40	1.40-4.00	0.15-0.18	3.0-5.9	0.5-1.0	.37	.37			
	45-60	---	---	25-35	1.20-1.40	1.40-4.00	0.10-0.21	3.0-5.9	0.0-0.5	.43	.43			
19C: Helveta	0-5	---	---	15-25	1.10-1.30	4.00-14.00	0.10-0.21	0.0-2.9	2.0-4.0	.32	.32	5	6	45
	5-10	---	---	27-35	1.10-1.30	4.00-14.00	0.10-0.21	0.0-2.9	1.0-3.0	.32	.32			
	10-45	---	---	35-50	1.20-1.40	1.40-4.00	0.15-0.18	3.0-5.9	0.5-1.0	.37	.37			
	45-60	---	---	25-35	1.20-1.40	1.40-4.00	0.10-0.21	3.0-5.9	0.0-0.5	.43	.43			
22: Hubery	0-5	---	---	15-20	1.35-1.55	4.00-14.00	0.10-0.21	0.0-2.9	2.0-3.0	.37	.37	4	6	45
	5-25	---	---	20-30	1.40-1.55	1.40-4.00	0.10-0.21	0.0-2.9	0.0-2.0	.43	.43			
	25-60	---	---	10-25	1.60-1.80	0.42-1.40	0.03-0.05	0.0-2.9	0.0-0.5	.20	.20			
42: Verboort	0-10	---	---	27-35	1.20-1.30	1.40-4.00	0.10-0.21	3.0-5.9	5.0-6.0	.28	.25	3	7	35
	10-33	---	---	35-50	1.30-1.50	0.01-0.42	0.03-0.05	5.0-6.9	0.5-5.0	.20	.20			
	33-60	---	---	25-35	1.20-1.30	0.42-1.40	0.10-0.21	3.0-5.9	0.0-0.5	.32	.32			
44B: Willamette	0-23	---	---	20-27	1.20-1.40	4.00-14.00	0.10-0.21	0.0-2.9	3.0-5.0	.32	.32	6	6	45
	23-43	---	---	25-35	1.20-1.40	4.00-14.00	0.10-0.21	0.0-2.9	1.0-3.0	.43	.43			
	43-60	---	---	20-30	1.20-1.40	4.00-14.00	0.10-0.21	0.0-2.9	0.0-0.5	.43	.43			

This report shows only the major soils in each map unit. Others may exist.


USDA Natural Resources Conservation Service

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Soil Features

Washington County, Oregon

Map symbol and soil name	Restrictive layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		in	in		in	in			
18B: Helveta	---	---	---	---	0	---	Low	Moderate	Moderate
19C: Helveta	---	---	---	---	0	---	Low	Moderate	Moderate
22: Hubery	Fragipan	20-33	---	Noncemented	0	---	Low	Moderate	Moderate
42: Verboort	---	---	---	---	0	---	None	Moderate	Moderate
44B: Willamette	---	---	---	---	0	---	Low	Moderate	Moderate

This report shows only the major soils in each map unit. Others may exist.


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LAND TREATMENT PRACTICES

Water Features

Washington County, Oregon

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Flooding			Flooded	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				P:	P:	P:				
19B: Helveta	C	---	January	3.0->6.0	4.0->6.0	---	---	None	---	None
			February	3.0->6.0	4.0->6.0	---	---	None	---	None
			March	3.0->6.0	4.0->6.0	---	---	None	---	None
			December	3.0->6.0	4.0->6.0	---	---	None	---	None
19C: Helveta	C	---	January	3.0->6.0	4.0->6.0	---	---	None	---	None
			February	3.0->6.0	4.0->6.0	---	---	None	---	None
			March	3.0->6.0	4.0->6.0	---	---	None	---	None
			December	3.0->6.0	4.0->6.0	---	---	None	---	None
22: Hubery	D	---	January	0.0-1.5	1.7-2.5	---	---	None	---	None
			February	0.0-1.5	1.7-2.5	---	---	None	---	None
			March	0.0-1.5	1.7-2.5	---	---	None	---	None
			April	0.0-1.5	1.7-2.5	---	---	None	---	None
			December	0.0-1.5	1.7-2.5	---	---	None	---	None
42: Verboort	D	---	January	0.0-2.0	0.8-2.0	---	---	None	Brief	Frequent
			February	0.0-2.0	0.8-2.0	---	---	None	Brief	Frequent
			March	0.0-2.0	0.8-2.0	---	---	None	Brief	Frequent
			April	0.0-2.0	0.8-2.0	---	---	None	Brief	Frequent
			December	0.0-2.0	0.8-2.0	---	---	None	Brief	Frequent
44B: Willamette	B	---	Jan-Dec			---	---	None	---	None

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This report shows only the major soils in each map unit. Others may exist.

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Irrigated and Nonirrigated Yields by Map Unit Component

Washington County, Oregon

Map symbol and soil name	Land capability		Grass hay		Pasture		
	N	I	N	I	N	I	
			Tons	Tons	AUM	AUM	
19B: Helvetia	2e	3e	---	---	12.0	16.0	
19C: Helvetia	2e	4e	---	---	12.0	16.0	
22: Huberly	3w	3w	---	---	8.0	10.0	
42: Verboort	3w	3w	---	---	---	15.0	
44B: Willamette	2e	2e	---	---	---	---	

LAND TREATMENT PRACTICES

Predicted Soil Loss (Erosion) for Planned System

Farm or Tract	Field Number	Acreage	Soil Survey IDMap Unit	Soil Acreage	T Value Tons/Ac/Yr	Predicted Soil Loss Tons/Ac/Yr
T3375	T3375-1	2.11	22	1.19	4	<1
T3375	T3375-1	2.11	19C	0.38	5	<1
T3375	T3375-1	2.11	19B	0.54	5	<1
T3375	T3375-2	11.61	42	0.17	3	<1
T3375	T3375-2	11.61	22	7.58	4	<1
T3375	T3375-2	11.61	19C	3.8	5	<1
T3375	T3375-2	11.61	19B	0.06	5	<1
T3376	T3376-3	40.54	44B	0.01	5	<1
T3376	T3376-3	40.54	42	0.92	3	<1
T3376	T3376-3	40.54	22	1.19	4	<1
T3376	T3376-3	40.54	19C	13.56	5	<1
T3376	T3376-3	40.54	19B	21.76	5	<1
T3376	T3376-4	3.38	22	2.71	4	<1
T3376	T3376-4	3.38	19B	0.67	5	<1

LAND TREATMENT PRACTICES

Section 5

Farm Resource Setting

The landscape is generally stream floodplains, broad terraces and rolling hillsides above the streams in valleys along the Willamette River. The annual precipitation varies from 40-50 inches of which 70% falls within a 5 month period from November through March and less than 7% falls from June through August. Winds are generally moderate in the winter (15-30 mph) from the south to southwest and mild in the summer (5-15 mph) from the north to northwest. Humidity usually varies from 60 to 90 percent throughout the year except when dry east winds occur dropping the humidity to 10 to 15 percent. There is approximately 200-210 frost free days and the average annual temperature is 50 to 55 degrees Fahrenheit. Soils Vary from deep to moderately deep clays, silts and sandy loams that are poor to excessively well drained.

The headquarters facilities contain confined livestock feeding operations and associated structures such as home(s), barns, lots, commodity sheds, shop areas, and feed storage areas. Also included are the components of a waste management system consisting of manure and wastewater production, collection, transfer, treatment and storage facilities.

The sprinkler irrigated and nonirrigated crop land consists mainly of corn silage crops, pasture and hay land grown for livestock feed. The crop land fields are also used to utilize nutrients and organics in manure and wastewater from the livestock feeding operation.

Headquarters Land Use Resource Concerns

Resource Concern	Description
Water Quality, Surface Water, Nutrients & Organics	Nutrients and organics contained in manure produced from AFO are contaminating surface water.
Air Quality; Undesirable Odors from Agricultural Sources	Air quality is affected by odors produced from the headquarter facilities.
Plant Management; Establishment, Growth, & Harvest	Plant establishment, growth and cover are reduced by animals in confined areas.

Headquarters Land Use Plan of Operations

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
HQ	Access Road (Ft) (PS560) Existing roadways allow access to farm facilities and fields to perform needed management operations. A gravel roadway exists from West Union Road to the north end of the facility by the hay storage. Refer to Section 8 for Operation and Maintenance guidelines for Access Roads	1,400 Ft	Existing
HQ	Agitator (No) (PS634) An agitator will be installed in the second cell of the waste storage pond. The agitator will help suspend solids which have settled to the bottom of the waste storage pond. Refer to Section 8 for Operation and Maintenance guidelines for planned Agitator.	1	Planned
HQ	Dike (Ft) (PS356) Weir box controls flow from first cell of waste storage pond to the second cell. Refer to Section 8 for Operation and Maintenance guidelines for existing Dikes.	1	Existing

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
HQ	Feed Management (No-Aus) (PS592) The quantity of available nutrients fed to dairy cows, heifers, and calves will be managed to improve efficiency of nutrients fed and excreted. Phosphorus content of manure can be modified with proper feed management. Refer to Section 7 for guidance on Feed Management.	331 Aus	Planned
HQ	Fence (Ft) (PS382) Existing fences control the movement and access of animals and humans. The current headquarter fences are around the residence, calf barn exercise area, and grazing pasture that is field 1. Refer to Section 8 for Operation and Maintenance guidelines for existing Fences.	3,134 Feet	Existing
HQ	Heavy Use Area Protection (Ac) (PS561) Areas shown on the facilities map are stabilized with suitable materials such as gravel to control soil erosion, improve air and water quality, improve aesthetics and improve animal health. Shop material such as oils and gasoline are stored on concrete floors to prevent seepage into soil and groundwater. Refer to Section 8 for Operation and Maintenance guidelines for Heavy Use Protection areas.	6.41 Acres	Existing
HQ	Manure Transfer (No) (PS634) Manure solids generated in the calf barn are scraped and removed twice a week into a manure spreader. The manure is transferred to the solids stacking facility. Manure solids generated in free stalls are stored on the concrete floor until scraped and transferred into a manure spreader. The manure is transferred to the solids stacking facility. Manure solids and liquids generated in the loafing areas and alleyways are stored on the concrete floor until scraped and transferred to the reception tank via a concrete lined ditch. Some manure solids and liquids are transferred to the concrete lined ditch by gravity. Liquid manure is transferred to the crop and hay land by a pump, aluminum handline and 1000 foot hard hose reel. Manure solids and liquids are pumped through an above ground waste transfer pipeline from the reception tank to the solids separator and back to the waste storage pond. Liquid wastewater will be transferred from waste storage pond cell#1 to cell#2 using a weir. Manure solids and liquids generated in the holding area and milking parlor or directed to the concrete lined ditch. Refer to Section 8 for Operation and Maintenance guidelines for planned Manure Transfer Equipment.	1 – Tractor pulled manure spreader used for hauling 1 – Tractor pulled manure spreader used for hauling 2 – Barn floors 1 – Concrete lined transfer ditch 1 – Pump, 1 – Big gun sprinkler, 1 – Pipeline 1 – Pipeline 1 – Pump 1 – Weir 1 – Concrete lined transfer ditch	Planned Planned Existing Existing Existing Existing Existing Existing

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
	<p>Pipeline (Ft) (PS516)</p> <p>Pipelines are installed to convey water to provide water for livestock and human use. Pipelines are also used to transfer manure solids and liquid from the reception tank to the solids separator. Refer to Section 8 for Operation and Maintenance guidelines for existing Pipeline.</p>	350 Feet	Existing
HQ	<p>Pond Sealing or Lining, Compacted Clay Treatment (No.) (PS521D)</p> <p>A compacted clay treatment seals the waste storage pond cell #1 and cell #2 to protect groundwater from contamination. Refer to Section 8 for Operation and Maintenance guidelines for existing Compacted Clay Liners.</p>	2	Existing
HQ	<p>Pumping Plant (No) (PS533)</p> <p>A sump pump is used to transfer waste from the reception tank to the solids separator. A pump is used to transfer liquid waste from the second cell of the waste storage pond to the irrigation system. A pumped located in the water well is used to transfer fresh water from the well to the animal watering facility. Refer to Section 8 for Operation and Maintenance guidelines for existing Pumping Plants.</p>	1 – sump pump 2 – pumps	Existing Existing
HQ	<p>Roof Runoff Structure (No) (PS558)</p> <p>Gutters are installed to collect, control, and transport rainfall from roofs to tile drainage. Refer to Section 8 for Operation and Maintenance guidelines for existing Roof Runoff Structures.</p>	8	Existing
HQ	<p>Solid/Liquid Separation Facility (No) (PS632)</p> <p>The solids separator facility shown on the facilities map, is used to separate solids from the waste stream. The type of mechanical separator is an Albers drag change/ squeeze press. Refer to Section 8 for Operation and Maintenance guidelines for existing Solid/Liquid Separation Facility.</p>	1	Existing
HQ	<p>Subsurface drainage system (No) (PS606)</p> <p>The subsurface drainage consists of tiles. A perforated tile is used to direct runoff from silage storage to the second cell of the waste storage pond. Tiles are used to direct rainfall from gutters to tiles that drain into Field #2. Rainfall runoff is directed away from the waste storage ponds through tile drainage. Refer to Section 8 for Operation and Maintenance guidelines for existing subsurface drains.</p>	4	Existing
HQ	<p>Underground Outlets (Ft) (PS620)</p> <p>Leachate from the silage storage area is directed through underground perforated tiles and an underground outlet into the second cell of the waste storage pond. The silage storage area is lined with concrete and covered with plastic. The outlets are designed to drain runoff from the surface if any should occur. Refer to Section 8 for Operation and Maintenance guidelines for existing Underground Outlets.</p>	1	Existing
HQ	<p>Use Exclusion (Ac) (PS472)</p> <p>Fences are used to control animal and human access to the facilities. Refer to Section 8 for Operation and Maintenance guidelines for existing Use Exclusion areas.</p>	3 Acre	Existing

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
HQ	<p>Waste Storage Facility (No) (PS313)</p> <p>The waste storage pond consists of 2 cells. The first cell is 3.5 acre-ft and the second cell is 4.9 acre-ft in capacity. The combined capacity of 8.4 acre-ft or 2,737,148 gallons allows for 154 days of storage which meets the recommended storage period computed using Worksheet OR10A-7 found in Section 4. The capacity of the waste storage pond includes a 1 year build up of solids, a 25 year 24 hour storm event, 1 foot of freeboard as well as the manure entering the waste storage pond from the confined animal facility and milking parlor. Manure solids, liquids and bedding material is contained in the waste storage pond.</p>	2	Existing
	<p>A reception tank is used to store waste from animal housing and milking parlor before solids separation. The storage capacity of this 20 foot by 15 foot by 8 foot deep is less than a day (a few hours). Cell #1 of the waste storage pond provides secondary containment if the reception tank overflows.</p>	1	Existing
	<p>A weir box is used to control flow from cell#1 into cell #2. The waste storage pond was cleaned approximately 5 years ago and currently has a significant volume of solids. A backhoe will be used to remove solids and store them on a plastic liner around the edge of the waste storage pond during the summer dry months. This process will be repeated until the majority of solids are removed. The backhoe will be used so as not to disturb the compacted clay liner. Once the solids are dried, they will be moved to the solids stacking facility until ready to be hauled off-site or hauled directly off-site.</p>	1	Existing
	<p>The solids stacking facility is 40 foot by 40 foot with a roof and 6 foot sidewalls which will store 9,898 cubic feet of solids allowing 71 days of storage which does not meet the recommended storage period computed using Worksheet OR10A-7 found in Section 4. The solids stacking facility is located directly under the solids separator and adjacent to the waste storage pond. The roof does not have gutters and rainfall runoff is directed to the waste storage pond.</p>	1	Existing
	<p>In order to meet the 154 days of storage for solids, a 40 by 45 foot roofed section of the hay storage structure will be used to store solids. The sidewall are at least 15 feet tall which will allow for a stacking height of 8 feet. This new storage area will store 11,458 cubic feet of solids so the combined storage will store 21,059 cubic feet or 527 tons of storage which meets the recommended storage period of 154 days computed using Worksheet OR10A-7 found in Section 4</p>	1	Planned
	<p>The annual volume of solids produced is 91,438 cubic feet or 2286 tons. The annual volume of liquids produced is 360,595 cubic feet or 2,697,438 gallons.</p> <p>Refer to Section 8 for Operation and Maintenance guidelines for Liquid and Solid Waste Storage Facilities.</p>		

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
	<p>Pipeline (Ft) (PS516)</p> <p>Pipelines are installed to convey water to provide water for livestock and human use. Pipelines are also used to transfer manure solids and liquid from the reception tank to the solids separator. Refer to Section 8 for Operation and Maintenance guidelines for existing Pipeline.</p>	350 Feet	Existing
HQ	<p>Pond Sealing or Lining, Compacted Clay Treatment (No.) (PS521D)</p> <p>A compacted clay treatment seals the waste storage pond cell #1 and cell #2 to protect groundwater from contamination. Refer to Section 8 for Operation and Maintenance guidelines for existing Compacted Clay Liners.</p>	2	Existing
HQ	<p>Pumping Plant (No) (PS533)</p> <p>A sump pump is used to transfer waste from the reception tank to the solids separator. A pump is used to transfer liquid waste from the second cell of the waste storage pond to the irrigation system. A pump located in the water well is used to transfer fresh water from the well to the animal watering facility. Refer to Section 8 for Operation and Maintenance guidelines for existing Pumping Plants.</p>	<p>1 – sump pump</p> <p>2 – pumps</p>	<p>Existing</p> <p>Existing</p>
HQ	<p>Roof Runoff Structure (No) (PS558)</p> <p>Gutters are installed to collect, control, and transport rainfall from roofs to tile drainage. Refer to Section 8 for Operation and Maintenance guidelines for existing Roof Runoff Structures.</p>	8	Existing
HQ	<p>Solid/Liquid Separation Facility (No) (PS632)</p> <p>The solids separator facility shown on the facilities map, is used to separate solids from the waste stream. The type of mechanical separator is an Albers drag change/ squeeze press. Refer to Section 8 for Operation and Maintenance guidelines for existing Solid/Liquid Separation Facility.</p>	1	Existing
HQ	<p>Subsurface drainage system (No) (PS606)</p> <p>The subsurface drainage consists of tiles. A perforated tile is used to direct runoff from silage storage to the second cell of the waste storage pond. Tiles are used to direct rainfall from gutters to tiles that drain into Field #2. Rainfall runoff is directed away from the waste storage ponds through tile drainage. Refer to Section 8 for Operation and Maintenance guidelines for existing subsurface drains.</p>	4	Existing
HQ	<p>Underground Outlets (Ft) (PS620)</p> <p>Leachate from the silage storage area is directed through underground perforated tiles and an underground outlet into the second cell of the waste storage pond. The silage storage area is lined with concrete and covered with plastic. The outlets are designed to drain runoff from the surface if any should occur. Refer to Section 8 for Operation and Maintenance guidelines for existing Underground Outlets.</p>	1	Existing
HQ	<p>Use Exclusion (Ac) (PS472)</p> <p>Fences are used to control animal and human access to the facilities. Refer to Section 8 for Operation and Maintenance guidelines for existing Use Exclusion areas.</p>	3 Acre	Existing

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
HQ	<p>Waste Storage Facility (No) (PS313)</p> <p>The waste storage pond consists of 2 cells. The first cell is 3.5 acre-ft and the second cell is 4.9 acre-ft in capacity. The combined capacity of 8.4 acre-ft or 2,737,148 gallons allows for 154 days of storage which meets the recommended storage period computed using Worksheet OR10A-7 found in Section 4. The capacity of the waste storage pond includes a 1 year build up of solids, a 25 year 24 hour storm event, 1 foot of freeboard as well as the manure entering the waste storage pond from the confined animal facility and milking parlor. Manure solids, liquids and bedding material is contained in the waste storage pond.</p>	2	Existing
	<p>A reception tank is used to store waste from animal housing and milking parlor before solids separation. The storage capacity of this 12 foot by 12 foot by 10 foot deep is less than a day (a few hours). Cell #1 of the waste storage pond provides secondary containment if the reception tank overflows.</p>	1	Existing
	<p>A weir box is used to control flow from cell#1 into cell #2. The waste storage pond was cleaned approximately 5 years ago and currently has a significant volume of solids. A backhoe will be used to remove solids and store them on a plastic liner around the edge of the waste storage pond during the summer dry months. This process will be repeated until the majority of solids are removed. The backhoe will be used so as not to disturb the compacted clay liner. Once the solids are dried, they will be moved to the solids stacking facility until ready to be hauled off-site or hauled directly off-site.</p>	1	Existing
	<p>The solids stacking facility is 40 foot by 40 foot with a roof and 6 foot sidewalls which will store 9,898 cubic feet of solids allowing 71 days of storage which does not meet the recommended storage period computed using Worksheet OR10A-7 found in Section 4. The solids stacking facility is located directly under the solids separator and adjacent to the waste storage pond. The roof does not have gutters and rainfall runoff is directed to the waste storage pond.</p>	1	Existing
	<p>In order to meet the 154 days of storage for solids, a 40 by 45 foot roofed section of the hay storage structure will be used to store solids. The sidewall are at least 5 feet tall which will allow for a stacking height of 8 feet. This new storage area will store 11,458 cubic feet of solids so the combined storage will store 21,059 cubic feet or 527 tons of storage which meets the recommended storage period of 154 days computed using Worksheet OR10A-7 found in Section 4</p> <p>The annual volume of solids produced is 91,438 cubic feet or 2286 tons. The annual volume of liquids produced is 360,595 cubic feet or 2,697,438 gallons.</p> <p>Refer to Section 8 for Operation and Maintenance guidelines for Liquid and Solid Waste Storage Facilities.</p>	1	Planned

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
HQ	Watering Facility (No) (PS614) A watering trough is installed in the barn to provide animals access to drinking water. Refer to Section 8 for Operation and Maintenance guidelines for existing Water Facilities.	1	Existing
HQ	Water Well (No) (PS642) A water well on the east side of the access road is used to provide water to animals in confinement and is the main water well for animal use. It pumps 35 gpm and occasionally sucks air when the plant nurseries in the area are watering heavily. The well located in the calf barn provides drinking water to the calves and to the residences. Refer to facilities map for well locations. Refer to Section 8 for Operation and Maintenance guidelines for existing Water Wells.	2	Existing

Pasture/ Hay Land Use Resource Concerns

Resource Concern	Description
Water Quality, Surface Water; Nutrients & Organics	High potential for surface runoff of nutrients.
Plant Management; Pests	Noxious weeds and pests reduce forage productivity.
Air Quality; Undesirable Odors from Agricultural Sources	Objectionable odors from manure.

LAND TREATMENT PRACTICES

Pasture/ Hay Land Use Plan of Operations

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
Field 2 and 3	Field Border (Ft) (PS386) A 30 foot by 600 foot buffer is planned to be left along West Union Road. The field border will control the movement of phosphorus from leaving the property. If the field is converted to row crop then the field border will need to be maintained with permanent grass. If the field is converted to pasture then the fence line will need to be moved behind the field border. Refer to Section 8 for Operation and Maintenance guidelines for planned Field Border.	30 Foot by 600 Foot	Planned
Field 1, 2, 3, 4	Forage Harvest Management (Ac) (PS511) The timely cutting and removal of forage from the fields shown on the land use plan map for all fields for hay. Refer to Section 8 for Operation and Maintenance guidelines for existing Forage Harvest Management.	58 Acres	Planned
Field 2 and 3	Irrigation Water Management (Ac) (PS449) Irrigation Water Management will be applied to the irrigated fields as shown on the land use plan map for fields 2 and 3 to manage soil moisture in order to promote the desired crop response, optimize the available water supplies, minimize irrigation induced erosion, decrease non-point source pollution of surface and groundwater sources, manage salts in the crop root zone and manage the crop micro climate. The "big gun" sprinkler has the following specifications: 230 gpm capacity, 1 inch nozzle, 60 psi, 200 ft diameter, and 0.5 in/hr capacity. There will be 3 yearly applications of liquids totaling 504 thousand gallons. Irrigation is scheduled based on a feel soil moisture test and crop wilt. The planned application times are mid-March, mid-June, and mid-September totaling 504 thousand gallons of liquid applied. Refer to Section 11 for specifications for planned Irrigation Water Management Activities.	52 Acres	Planned
Field 2 and 3	Irrigation System-Sprinkler (No-Ac) (PS442) A sprinkler irrigation system is used to apply irrigation water in an efficient manner to the fields as shown on the land use map for fields 2 and 3 to manage soil moisture and apply nutrients and organics to promote plant growth without causing excessive runoff and leaching. Refer to Section 11 for specifications for planned Sprinkler Irrigation Systems.	52 Acres	Planned
Field 2 and 3	Irrigation Pipeline (Ft) (PS430AA) An aluminum handline and 1000 foot hard hose reel is used to convey irrigation water in an efficient manner to prevent conveyance losses and soil erosion. Refer to Section 8 for Operation and Maintenance guidelines for existing Irrigation Pipelines.	1000 feet	Existing

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
Field 1, 2, 3, 4	<p>Nutrient Management (Ac) (PS590)</p> <p>The amount, placement, source, timing of inorganic and organic nutrients and soil amendments is managed on fields shown on the plan map to prevent non-point source pollution of air, surface water and groundwater resources. Because of the medium p-index rating nutrients will be applied to the field at a 2 times phosphorus removal rate.</p> <p>The nutrient balance is based on 2 times P₂O₅ removal. The annual net application (after losses) of nutrients from manure for the whole farm (Schoch's property) is as follows: 4,440 lbs N; 4,387 lbs P₂O₅; and 6,135 lbs K₂O Annual nutrients harvested for the whole farm (Schoch's property) are as follows: 13,528 lbs N; 3,928 lbs P₂O₅; and 10,445 lbs K₂O</p> <p>The nutrient balance for the neighboring property is on Nitrogen removal. The annual net application (after losses) of nutrients from manure for the neighbor's property is as follows: 17,447 lbs N; 16,664 lbs P₂O₅; and 23,187 lbs K₂O Annual nutrients harvested for the neighbor's property are : 18,278 lbs N; 5,048 lbs P₂O₅; and 13,962 lbs K₂O</p> <p>Soil samples need to be taken every 3 to 5 years to monitor nutrient levels. Refer to fall soil nitrate testing for manured field guidelines from OSU's EM 8832-E found in Section 13. Also found in Section 13 are guidance and protocol for soil and manure testing, fall soil nitrate test, and crop harvest nutrient removal testing. If phosphorus levels increase significantly, the amount of manure applied to the field needs to be decreased or the manure needs to be treated to remove phosphorus concentrations before application.</p> <p>Nutrients applied to field 1 consists only of manure from grazing. Field 2 and 3 applications are from waste storage pond effluent and field 4 application is from the solids storage facility. On these fields total annual net application (after losses) of nutrients from manure is: 256 lbs N/acre, 76 lbs P₂O₅/acre, and 106 lbs K₂O/acre. Total annual nutrients harvested are as follows: 234 lbs N/acre, 68 lbs P₂O₅/ acre, and 181 lbs K₂O/acre.</p> <p>Nutrients applied to field G consist of manure from grazing and liquid application. Nutrients applied to field LA consist of only liquid manure with only one third of the field receiving liquid manure every year. On these fields, the total annual net application (after losses) of nutrients from manure is: 77 lbs N/acre, 245 lbs P₂O₅/acre, and 341 lbs K₂O/acre. Total annual nutrients harvested are as follows: 269 lbs N/acre, 74 lbs P₂O₅/ acre, and 205 lbs K₂O/acre.</p> <p>Nitrogen needs of the crop are deficient with this balance and will need to be supplemented with alternate forms of nitrogen only fertilizer. Refer to Section 11 for specifications for planned Nutrient Management activities.</p>	64 Acres	Planned

LAND TREATMENT PRACTICES

Field ID	Conservation or Best Management Practices	Amount	Existing or Planned
Field 1, 2, 3, 4	<p>Pasture and Hayland Planting (Ac) (PS512)</p> <p>Pasture and Hay Land fields shown on the plan map will be replanted as necessary with suitable grass species to maintain production and provide forage for livestock. Refer to Section 8 for Operations and Maintenance guidelines for planned Pasture and Hayland planting.</p>	58 Acres	Planned
Field 1, 2, 3, 4	<p>Waste Utilization (Ac) (PS633)</p> <p>The box spreaders are calibrated to apply manure and bedding solids at the rate needed to meet the requirements of the nutrient management practice for the crops grown. Calibrating manure spreading equipment is an essential function of nutrient application and waste utilization. Refer to Section 11 for guidance and planning of equipment calibration within the Nutrient Management specifications.</p> <p>The emergency winter application area was chosen based on a greater than 1000 foot distance from a water body and drainage (moderately well) of soil 19B compared to other soils on the property. Soil type 19B also is characterized by a smaller slope than other soil type choice on the property.</p> <p>A 30 foot by 800 foot field border as shown on the landuse plan map will be installed along West Union Road. The field border will prevent phosphorus from migrating off-site. If the field is converted to row crop then the field border will need to be maintained with permanent grass. If the field is converted to pasture then the fence line will need to be moved behind the field border.</p> <p>504,000 gallons or 67,375 cubic feet of liquid waste and 803 cubic feet of solid waste will be applied in mid-March, mid-June, and mid-September. Liquid and solid waste will also be exported in mid-March, mid-June, and mid-September at a rate of 900 tons or 36,000 cubic feet of solids and 2850 thousand gallons or 381,000 cubic feet. All exported liquid manure is anticipated to be applied to the neighboring property as identified in the Nutrient Management description above.</p> <p>Refer to Section 11 for specifications for planned Waste Utilization.</p>	58 Acres	Planned

NUTRIENT MANAGEMENT

Utilization Area Summary

Farm or Tract	Field Number	Acreage	Buffered Acreage	Spreadable Acreage	Soil Test P (ppm)	PI Risk Rating	Controlling Nutrient
T3375	T3375-1	2.11	0	2.11	114	MEDIUM	Nitrogen
T3375	T3375-2	11.61	0	11.61	154	MEDIUM	Nitrogen
T3376	T3376-3	40.54	0	40.54	152	MEDIUM	Nitrogen
T3376	T3376-4	3.38	0	3.38	152	MEDIUM	Nitrogen

Crop Type, Yield Goals, and Nutrient Utilization Rates

Farm or Tract	Field Number	Crop Name	Expected Yield/Acre	Nutrient Removal (lb/Acre)		
				N	P2O5	K2O
T3375	T3375-1	Grass Legume, Pasture	4 Tons	158	37	191
T3375	T3375-2	Hay/Pasture Mix (14% Protein)	5 Tons	224	62	171
T3376	T3376-3	Hay/Pasture Mix (14% Protein)	5 Tons	224	62	171
T3376	T3376-4	Oat haylage	3 Tons	38	15	27

Note: Yields for forages and hay are based on plant material as dried in the field, Dry Harvested Material (DHM). Yields for corn silage are based on plant moisture conditions at the time of harvest, As Harvested (AH) moisture conditions.

Land Base Requirements^{1, 2}

Year	Acreage Available	Acreage Required Based on Nitrogen Recommendation		Acreage Required Based on Phosphorus Removal	
		Land Required	Excess or (Still Needed)	Land Required	Excess or (Still Needed)
2007	58	102	(44)	400	(342)

1. Acreage required for Nitrogen utilization is based on estimated losses.
2. Land base requirements are based on the cropping system described in this plan.

Manure Nutrient Analysis

Storage Name	Type of Sample	Sample Date	% Moisture	TKN	NH4-N	Org - N	NO3-N	P2O5	K2O	Units
Waste Holding Pond	Book Value	09/01/2006	95	11.35	0	11.35	0	7.6	10.7	lbs/th gals
Roofed manure storage	Book Value	09/01/2006	65	7.4	3.7	3.7	0	3.4	4.7	lbs/Ton

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Soil Test Results

Farm or Tract	Field Number	Sample ID	Sample Date	OM%	P	K	Mg	Ca	Units	Soil pH	CEC
T3375	T3375-1	1	07/19/2006	7.4	114	592	11	3.4	ppm	6	NA
T3375	T3375-2	2	07/19/2006	7.7	154	732	13.8	4	ppm	6.6	NA
T3376	T3376-3	3	07/19/2006	8.4	152	1141	15.6	4.9	ppm	7.3	NA
T3376	T3376-4	3	07/19/2006	8.4	152	1141	15.6	4.9	ppm	7.3	NA

Estimated Phosphorus Concentrations in Soils after 2, 5 and 10 Years Based on Bray P1 Extraction and Planned Nutrient Management

Farm or Tract	Field Number	P At Start	Units	2 Years	5 Years	10 Years
T3375	T3375-1	114	ppm	118	124	134
T3375	T3375-2	154	ppm	155	157	160
T3376	T3376-3	152	ppm	153	155	158
T3376	T3376-4	152	ppm	152	153	154

Note: This plan will have to be revised when phosphorus concentrations in soils and phosphorus applications cause a change in the Phosphorus Index site vulnerability rating.

NUTRIENT MANAGEMENT

Utilization Area Summary

Farm or Tract	Field Number	Acreage	Buffered Acreage	Spreadable Acreage	Soil Test P (ppm)	PI Risk Rating	Controlling Nutrient
T3375	T3375-1	2.11	0.13	1.98	114	MEDIUM	Nitrogen
T3375	T3375-2	11.61	0.25	11.36	154	MEDIUM	Nitrogen
T3376	T3376-3	40.54	0.17	40.37	152	MEDIUM	Nitrogen
T3376	T3376-4	3.38	0	3.38	152	MEDIUM	Nitrogen

Crop Type, Yield Goals, and Nutrient Utilization Rates

Farm or Tract	Field Number	Crop Name	Expected Yield/Acre	Nutrient Removal (lb/Acre)		
				N	P2O5	K2O
T3375	T3375-1	Grass Legume, Pasture	4 Tons	158	37	191
T3375	T3375-2	Hay/Pasture Mix (14% Protein)	4 Tons	179	49	137
T3376	T3376-3	Hay/Pasture Mix (14% Protein)	6 Tons	269	74	205
T3376	T3376-4	Oat haylage	3 Tons	38	15	27

Note: Yields for forages and hay are based on plant material as dried in the field, Dry Harvested Material (DHM). Yields for corn silage are based on plant moisture conditions at the time of harvest, As Harvested (AH) moisture conditions.

Land Base Requirements^{1, 2}

Year	Acreage Available	Acreage Required Based on Nitrogen Recommendation		Acreage Required Based on Phosphorus Removal	
		Land Required	Excess or (Still Needed)	Land Required	Excess or (Still Needed)
2007	58	102	(44)	400	(342)

1. Acreage required for Nitrogen utilization is based on estimated losses.
2. Land base requirements are based on the cropping system described in this plan.

Manure Nutrient Analysis

Storage Name	Type of Sample	Sample Date	% Moisture	TKN	NH4-N	Org -N	NO3-N	P2O5	K2O	Units
Waste Holding Pond	Book Value	09/01/2006	95	10.22	6.81	3.41	0	6.91	9.69	lbs/th gals
Roofed manure storage	Book Value	09/01/2006	65	6.8	3.4	3.4	0	3.14	4.32	lbs/Ton

NUTRIENT MANAGEMENT

Soil Test Results

Farm or Tract	Field Number	Sample ID	Sample Date	OM%	P	K	Mg	Ca	Units	Soil pH	CEC
T3375	T3375-1	1	07/19/2006	7.4	114	592	11	3.4	ppm	6	NA
T3375	T3375-2	2	07/19/2006	7.7	154	732	13.8	4	ppm	6.6	NA
T3376	T3376-3	3	07/19/2006	8.4	152	1141	15.6	4.9	ppm	7.3	NA
T3376	T3376-4	3	07/19/2006	8.4	152	1141	15.6	4.9	ppm	7.3	NA

Estimated Phosphorus Concentrations in Soils after 2, 5 and 10 Years Based on Bray P1 Extraction and Planned Nutrient Management

Farm or Tract	Field Number	P At Start	Units	2 Years	5 Years	10 Years
T3375	T3375-1	114	ppm	118	124	134
T3375	T3375-2	154	ppm	155	156	158
T3376	T3376-3	152	ppm	154	156	160
T3376	T3376-4	152	ppm	154	156	160

Note: This plan will have to be revised when phosphorus concentrations in soils and phosphorus applications cause a change in the Phosphorus Index site vulnerability rating.

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Phosphorus Index

The Phosphorus Index for Oregon was developed by a nutrient management advisory group comprised of members from the Natural Resources Conservation Service in Oregon and Washington, Oregon State University, Washington State University, and agricultural industry.

The Phosphorus Index is a field-level assessment tool designed to evaluate the relative potential for off-site movement of phosphorus from the landscape. The purpose of the Phosphorus Index is to provide field personnel, watershed planners, and land managers with a tool to assess various soils, landforms, and management practices for potential risk of phosphorus movement into surface waters. Conservation planners can use the Phosphorus Index to develop alternatives that include management and conservation practices that will reduce the potential for phosphorus transport to surface waters.

Phosphorus Concerns in the Environment

Eutrophication is the process of enrichment of water with nutrients, mainly phosphorus and nitrogen, which results in excessive growth of algae and nuisance aquatic plants. The movement of phosphorus in runoff and eroded sediment from agricultural land to surface water can accelerate eutrophication. Phosphorus is the limiting nutrient in most fresh water systems. The eutrophic condition and excessive aquatic plant growth cause depletion of oxygen in water due to heavy oxygen demand by microorganisms as they decompose organic material. The pH of water also increases as algae and other aquatic plants consume carbon dioxide.

Eutrophication impairs water use for fisheries, wildlife, recreation, agriculture, industry, and drinking due to excessive growth of algae and other aquatic plants. Some blue-green algae can form compounds that are toxic to livestock, humans, and other animals. Accelerated eutrophication is often associated with increases in water pH, causing an increase in ammonia concentrations, which can be harmful to fish and other aquatic animals.

Phosphorus Movement in the Landscape

Phosphorus movement in runoff occurs in sediment-bound and dissolved forms. Sediment P is attached to mineral and organic particles and is transported during erosion events. In general, sediment P contributes about 60 to 90 percent of the P transported in runoff from most cultivated land. Dissolved P makes up the largest portion of the total P in runoff from non-cultivated lands such as pastures, hayland, forests, and cropland using no-till practices. Most sediment P is not readily available for algae and plant uptake because it is chemically bound with mineral (particularly iron, aluminum, and calcium) and organic compounds. Sediment P can however represent a long-term source of P for algae and aquatic plant uptake from the water body. Most dissolved P is immediately available for aquatic plant uptake.

Phosphorus Movement Factors

The main factors influencing P movement can be separated into two main categories: **transport and source factors**. The following factors are considered in the Phosphorus Index for Oregon.

Transport factors:

- Soil erosion (sheet and rill, wind)
- Irrigation-induced erosion
- Runoff class
- Flooding frequency
- Distance to surface waters / buffer width
- Subsurface drainage

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Source Factors:

- Soil test P concentration
- Commercial P fertilizer application rate
- Commercial P fertilizer application method
- Organic P source application rate
- Organic P source application method

Each factor is assigned a **Phosphorus Loss Rating** of *None, Low, Medium, High, or Very High* based on the relative risk of phosphorus transport to surface waters. In addition, each factor is assigned a **Factor Weight** ranging from 0.25 to 1.50, based on the relative contribution of that factor to P transport.

Separate Phosphorus Indices were developed for Western and Eastern Oregon. Differences in cropping systems, tillage practices, irrigation systems, climatic factors, and soil phosphorus testing methods across the state made it necessary to have separate indices.

Descriptions of Phosphorus Index Factors

Transport Factors-

Soil Erosion

Soil Erosion – tons/ac/yr (RUSLE)	tons/ac/yr (Score)	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)
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This factor includes both sheet and rill and wind erosion. Irrigation-induced erosion is addressed in other factors. Sheet and rill erosion is the detachment of soil particles by raindrop impact, surface runoff from rainfall, and snowmelt runoff on frozen or thawing soil. Wind erosion is the detachment and transport of soil particles by wind forces. Sheet and rill erosion rates are estimated with the Revised Universal Soil Loss Equation (RUSLE). Wind erosion rates are estimated using the Wind Erosion Equation (WEQ). These soil loss models predict long-term average erosion rates, over the entire crop rotation, in tons of soil loss per acre per year. They do not predict sediment transport and delivery to a water body. The prediction models are used in the Phosphorus Index to quantify the movement of soil, thus potential for sediment and attached phosphorus transport on a slope or unsheltered distance toward a water body.

Soil Erosion from Sprinkler Irrigation

Soil Erosion from Sprinkler Irrigation	Criteria (Score)	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)
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This factor is evaluated by comparing the application rate of the sprinkler irrigation system (inches of water per hour) with the infiltration rate of the soil. A visual assessment of runoff and soil erosion caused by irrigation water is also conducted to assign a **Phosphorus Loss Rating** to this factor.

Runoff Class

Runoff Class	Criteria (Score)	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	(8.0)
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The *runoff class* is determined from the *hydrologic group* assigned to the soil map units in a field, and the average slope gradient. *Hydrologic groups* are group of soils having similar runoff potential under similar

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storm and cover conditions. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. (National Soil Survey Handbook, Part 618.35).

Flooding Frequency Class

Flooding Frequency Class	Criteria (Score)	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)
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Flooding is the temporary covering of the soil surface by flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources. Floodwaters can carry both sediment-bound and dissolved P into surface waters. Estimates of flooding frequency are based on the interpretation of soil properties and other evidence gathered during soil survey fieldwork. Flooding frequency is defined as the number of times flooding occurs over a period of time and is expressed as a class.

Distance to Perennial Surface waters / Buffer Widths

Distance to Perennial Surface Waters / Buffer Widths	Criteria (Score)	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)
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This factor considers the flow distance from the edge of the field to the closest perennial surface water, which may include streams, lakes, and those irrigation and drainage ditches that contain water year around. It also considers the presence and width of a vegetated buffer adjacent to that surface water. The closer the edge of the field is to surface water, the higher the potential risk of P transport to that water.

Vegetated buffers are effective in trapping sediment-bound P in runoff water. They are less effective in reducing dissolved P transport. Dissolved P can flow through a buffer and enter surface water. The wider the vegetated buffer, the more effective it will be in reducing total P transport to surface water. Vegetated buffers that are commonly used adjacent to perennial water include filter strips (NRCS Standard 393) and riparian forest buffers (NRCS Standard 391).

Subsurface Drainage

Subsurface Drainage	Criteria (Score)	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)
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Recent research has shown that P can leach through the soil profile, and the risk of leaching is directly related to the soil test P concentration in the soil. The higher the P concentration, the greater the potential for leaching. When subsurface drainage is present, such as perforated pipe tile drains, dissolved and sediment-bound P can enter the drains and be directly transported to surface water at the drain outlet. This factor therefore considers whether tile drains are present in the field, and the soil test P concentration.

NUTRIENT MANAGEMENT

Source Factors-

Soil Test P

Soil Test P – ppm (Bray P1)	(Score)	Soil Test P – $40 \times 0.10 =$ () Assign 0 points if Soil Test P < 40 ppm
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A soil sample from the site is necessary to assess the level of "available P" in the surface layer of the soil. Available P is the level customarily reported in a soil test analysis by commercial soil test laboratories. The soil test level for "available P" does not ascertain the total P in the soil. It does however, give an indication of the amount of total P that may be present because of the general relationship between the forms of P (organic, adsorbed, and labile) and the dissolved P available for crop uptake. The higher the soil test P level, the greater the risk of P transport to surface waters.

The depth at which soil samples are collected for available P analysis should be determined from the fertilizer or nutrient management guides for the crops being grown on the site. These guides are available from Oregon State University or Washington State University Cooperative Extension Services. Sampling depth is normally 0 to 6 inches or 0 to 12 inches for cultivated crops, and generally corresponds to typical depth of primary tillage. For established pastures that have not been cultivated for many years, a sample depth of 0 to 3 inches may be appropriate because P tends to be concentrated near the surface when the soil is not cultivated.

In eastern Oregon, soil test P levels should be determined using the Olsen (sodium bicarbonate) extraction method. In western Oregon, the Bray P1 extraction method should be used.

P Fertilizer Application Rate

Commercial P Fertilizer Application Rate	(Score)	lbs/ac $P_2O_5 \times 0.02 =$ ()
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The P fertilizer application rate is the amount of commercial phosphate fertilizer (P_2O_5), in pounds per acre per year, which is applied to the soil. This factor does not include phosphorus from organic sources. The higher the application rate, the greater the risk of P transport to surface waters.

Commercial P Fertilizer Application Method

Commercial P Fertilizer Application Method	Criteria	None Applied	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)
	(Score)	(0)				

The manner in which P fertilizer is applied to the soil, and the length of time that fertilizer remains on the soil surface will affect potential P movement. Banding or incorporating P fertilizer into the soil reduces the risk of P transport. P fertilizer that is surface applied, and not incorporated into the soil, has a higher risk of transport to surface water.

The time of year that P fertilizer is applied also affects the risk of P movement. P fertilizer that is applied during the winter and early spring in Western Oregon, when heavy or prolonged precipitation events are likely to occur, creates a higher risk of P transport than applications made from mid-spring to early fall. In Eastern Oregon, there is a greater risk of P transport when fertilizer is surface applied and not incorporated prior to irrigation or winter precipitation.

NUTRIENT MANAGEMENT

Organic P Source Application Rate

Organic P Source Application Rate	(Score)	lbs/ac P_2O_5 x 0.02 = ()
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The organic P source application rate is the amount of phosphate (P_2O_5) contained in organic material that is applied to the soil, in pounds per acre per year. An analysis of the organic material is desirable to determine the phosphorus content. When an analysis of the organic material is not available, values from the Animal Waste Management Field Handbook can be used. The higher the application rate, the greater the risk of P transport to surface waters.

Organic P Source Application Method

Organic P Source Application Method	Criteria	None Applied	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September	Incorporated within 5 days of application from October through February OR Surface applied March through August	Incorporated more than 5 days after application OR Surface applied September through October	Surface applied November through February
	(Score)	(0)	(1.0)	(2.0)	(4.0)	(8.0)

The manner in which organic P material is applied to the soil, and the length of time it remains on the soil surface will affect potential P movement. Injecting or incorporating organic P sources into the soil reduces the risk of P transport. Organic P material that is surface applied, and not incorporated into the soil, has a higher risk of transport to surface water.

The time of year that organic P is applied also affects the risk of P movement. Organic P that is applied during the winter and early spring in western Oregon, when heavy or prolonged precipitation events are likely to occur, creates a higher risk of P transport than applications made from mid-spring to early fall. In Eastern Oregon, there is a greater risk of P transport when organic material is surface applied and not incorporated prior to irrigation or winter precipitation.

Oregon Phosphorus Index Rating and Interpretation

P Index rating	Interpretation	Recommended Nutrient Limitation
PI Score <13	Low potential for P movement from this site given current management practices and site characteristics. There is a low probability of an adverse impact to surface waters from P losses on this site. Soil test P and P losses are likely to increase in future due to N-based nutrient management from animal manure.	Nitrogen
PI Score 13-25	Medium potential for P movement from this site given current management practices and site characteristics. Practices should be introduced to reduce P losses by surface runoff, subsurface flow, and erosion. Soil test P and P losses are likely to increase in future due to N-based nutrient management from animal manure.	Nitrogen
PI Score 25.1-50	High potential for P movement from this site given current management practices and site characteristics. All practicable management practices to reduce P losses through surface runoff, subsurface flow, or erosion should be implemented.	Phosphorus
PI Score >50	Very high potential for P movement from this site given current management practices and site characteristics. Active remediation techniques should be implemented in an effort to reduce the P loss potential from this site.	No manure

NUTRIENT MANAGEMENT

horus Index – Western Oregon

ed Manure Exports

received 6/12/00

NUTRIENT MANAGEMENT

1st Application Plan

1st Assumptions:

ets to tile drained fields must be controlled if liquid manure is applied.

* Losses associated with Application.

Allocation Date	Field Name	Spreadable Acres	Nutrient Source	Application Equipment	Amount Applied per Field	Pounds N * Lb/Acre	Pounds P2O5 Lb/Acre	Pounds K2O Lb/Acre
03/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	34.08 th gals or 0.11 inches	22	21	29
06/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	34.08 th gals or 0.11 inches	22	21	29
09/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	22.72 th gals or 0.07 inches	15	14	19
rients Applied to Field T3375-2-						59	56	77
03/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	161.48 th gals or 0.15 inches	30	28	39
06/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	161.48 th gals or 0.15 inches	30	28	39
09/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	201.85 th gals or 0.18 inches	37	35	48
rients Applied to Field T3376-3-						97	91	126
03/15/2007	T3376-4	3.38	Roofed manure storage	Box spreader: tractor pulled	16.9 tons or 1 loads	24	16	22
05/15/2007	T3376-4	3.38	Roofed manure storage	Box spreader: tractor pulled	16.9 tons or 1 loads	24	16	22
rients Applied to Field T3376-4-						48	32	44

Phosphorus Index – Western Oregon

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Planned Manure Exports

Export Date	Exported To	Quantity	Units	TKN	NH4-N	Org-N	NO3-N	P205	K20
03/15/2007	Nursery	300	Ton	7.4	3.7	3.7	0	3.4	4.7
06/15/2007	Nursery	300	Ton	7.4	3.7	3.7	0	3.4	4.7
09/15/2007	Nursery	300	Ton	7.4	3.7	3.7	0	3.4	4.7
03/15/2007	Neighbor	950	th gals	11.35	0	11.35	0	7.6	10.7
06/15/2007	Neighbor	950	th gals	11.35	0	11.35	0	7.6	10.7
09/15/2007	Neighbor	950	th gals	11.35	0	11.35	0	7.6	10.7

NUTRIENT MANAGEMENT

Nutrient Application Plan

Notes and Assumptions:

- Outlets to tile drained fields must be controlled if liquid manure is applied.

* Losses associated with application

Tract Number	Allocation Date	Field Name	Spreadable Acres	Nutrient Source	Application Equipment	Amount Applied per Field	Pounds N Lb/Acre	Pounds P2O5 Lb/Acre	Pounds K2O Lb/Acre
T3375	03/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	34.83 th gals or 0.11 inches	23 *	23	32
T3375	06/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	40.635 th gals or 0.13 inches	27 *	27	37
T3375	09/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	36.688 th gals or 0.12 inches	24 *	24	34
Total Nutrients Applied to Field T3375-2-							74	74	103
T3376	03/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	121.62 th gals or 0.11 inches	23	23	32
T3376	06/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	141.89 th gals or 0.13 inches	27	27	37
T3376	09/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	128.106 th gals or 0.12 inches	24	24	34
Total Nutrients Applied to Field T3376-3-							74	74	103
T3376	03/15/2007	T3376-4	3.38	Roofed manure storage	Box spreader: tractor pulled	10.14 tons or 1 loads	16	10	14
T3376	06/01/2007	T3376-4	3.38	Roofed manure storage	Box spreader: tractor pulled	9.937 tons or 1 loads	16	10	14
Total Nutrients Applied to Field T3376-4-							32	20	28

NUTRIENT MANAGEMENT

Nutrient Utilization Worksheet

CLIENT: Dave and Casey Schoch
ASSISTED BY: Jennifer Zwicke

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 ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids		Storage Pond (<50%) Dilution	52,231	20,734	29,038	53%	90%	90%	27,587	18,661	26,134
Solids		Solids Storage Facility (Roofed)	10,367	3,998	5,487	75%	90%	90%	7,775	3,598	4,938
Grazing		NONE	5,138	2,244	2,982	100%	100%	100%	5,138	2,244	2,982

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 ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids		Sprinkling	27,587	18,661	26,134	75%	100%	100%	20,690	18,661	26,134
Solids		Broadcast (Incorporated 7 or more days after application)	7,775	3,598	4,938	70%	100%	100%	5,443	3,598	4,938
Grazing		Grazing	5,138	2,244	2,982	85%	100%	100%	4,367	2,244	2,982

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location		Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification		
			N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids		Between Coastal and Cascade Mountains	20,690	18,661	26,134	87%	100%	100%	18,001	18,661	26,134
Solids		Soil Drainage Class	5,443	3,598	4,938	87%	100%	100%	4,735	3,598	4,938
Grazing		Moderately Well Drained	4,367	2,244	2,982	83%	100%	100%	3,625	2,244	2,982

NUTRIENT MANAGEMENT

PERCENT OF MANURE TO BE APPLIED TO FIELD AND UTILIZATION ACRES NEEDED BASED ON PHOSPHOROUS, P2O5

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	2.1	Grass/Legume Hay/Pasture	0%	0	0	0%	0	0	6%	135	3
2	11.6	Hay/Pasture Mix 14% Protein	4%	746	15	0%	0	0	0%	0	0
3	40.5	Hay/Pasture Mix 14% Protein	18%	3,359	45	0%	0	0	0%	0	0
4	3.4	Oats Hay/Pasture	0%	0	0	6%	198	3	0%	0	0
G	40.0	Hay/Pasture Mix 14% Protein	41%	7,651	103	0%	0	0	94%	2,109	28
LA	28.0	Hay/Pasture Mix 14% Protein	37%	6,904	93	0%	0	0	0%	0	0
Off-Farm			0%	0		95%	3,400		0%	0	
TOTALS	125.65		100%	18,661	256	100%	3,598	3	100%	2,244	31

NUTRIENT BALANCE BASED ON AVAILABLE ACRES

Field Number	Acres	Crop	NUTRIENTS APPLIED			NUTRIENTS REMOVED			NUTRIENT BALANCE		
			Nitrogen, N Lbs/Acre	Phosphorous, P2O5 Lbs/Acre	Potassium, K2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P2O5 Lbs/Acre	Potassium, K2O Lbs/Acre	Nitrogen, N Lbs/Acre	Phosphorous, P2O5 Lbs/Acre	Potassium, K2O Lbs/Acre
1	2.1	Grass/Legume Hay/Pasture	103	64	85	136	50	166	-33	13	-81
2	11.6	Hay/Pasture Mix 14% Protein	62	64	90	179	49	137	-117	15	-47
3	40.5	Hay/Pasture Mix 14% Protein	80	83	116	269	74	205	-189	9	-89
4	3.4	Oats Hay/Pasture	77	58	80	78	70	54	-1	-12	27
G	40.0	Hay/Pasture Mix 14% Protein	270	244	338	269	74	205	1	170	133
LA	28.0	Hay/Pasture Mix 14% Protein	238	247	345	269	74	205	-31	172	140
Off-Farm											

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NATURAL RESOURCES
DIVISION

NUTRIENT MANAGEMENT

Field Nutrient Balance

Tract No Field No Acres	Crop Name	Crop Yield	Crop Year	Crop Removal (lb/ac)			Credits (lb/ac)			Manure (lb/ac)			Fertilizer (lb/ac)			Nutrient Balance (lb/ac)		
				N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
T3375 T3375-1 2.11	Grass Legume, Pasture	4 Tons	2007	158	37	191	137	76	106	0	0	0	0	0	0	-21	39	-85
			Totals	158	37	191	137	76	106	0	0	0	0	0	0	-21	39	-85
T3375 T3375-2 11.61	Hay/Pasture Mix (14% Protein)	5 Tons	2007	224	62	171	0	0	0	74	74	103	0	0	0	-150	12	-68
			Totals	224	62	171	0	0	0	74	74	103	0	0	0	-150	12	-68
T3376 T3376-3 40.54	Hay/Pasture Mix (14% Protein)	5 Tons	2007	224	62	171	0	0	0	74	74	103	0	0	0	-150	12	-68
			Totals	224	62	171	0	0	0	74	74	103	0	0	0	-150	12	-68
T3376 T3376-4 3.38	Oat haylage	3 Tons	2007	38	15	27	0	0	0	32	20	28	0	0	0	-6	5	1
			Totals	38	15	27	0	0	0	32	20	28	0	0	0	-6	5	1

Credits are nutrients generated from pasturing animals or other preapplication credits.

NUTRIENT MANAGEMENT

NUTRIENT MANAGEMENT

Field Nutrient Balance

Tract No Field No Acres	Crop Name	Crop Yield	Crop Year	Crop Removal (lb/ac)			Credits (lb/ac)			Manure (lb/ac)			Fertilizer (lb/ac)			Nutrient Balance (lb/ac)		
				N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
T3375 T3375-1 1.98	Grass Legume, Pasture	4 Tons	2007	158	37	191	137	76	106	0	0	0	0	0	0	-21	39	-85
			Totals	158	37	191	137	76	106	0	0	0	0	0	0	-21	39	-85
T3375 T3375-2 11.36	Hay/Pasture Mix (14% Protein)	4 Tons	2007	179	49	137	0	0	0	59	56	77	0	0	0	-120	7	-60
			Totals	179	49	137	0	0	0	59	56	77	0	0	0	-120	7	-60
T3376 T3376-3 40.37	Hay/Pasture Mix (14% Protein)	6 Tons	2007	269	74	205	0	0	0	97	91	126	0	0	0	-172	17	-79
			Totals	269	74	205	0	0	0	97	91	126	0	0	0	-172	17	-79
T3376 T3376-4 3.38	Oat haylage	3 Tons	2007	38	15	27	0	0	0	48	32	44	0	0	0	10	17	17
			Totals	38	15	27	0	0	0	48	32	44	0	0	0	10	17	17

Credits are nutrients generated from pasturing animals or other preapplication credits.

NUTRIENT MANAGEMENT

FEED MANAGEMENT CONSIDERATIONS



Natural
Resources
Conservation
Service

**Ecological
Sciences
Division**

October 2003

Nutrient Management Technical Note No. 1

Effects of Diet and Feeding Management on Nutrient Content of Manure

Introduction

Accumulation of excess nutrients on the farm results in a whole-farm nutrient imbalance that can contribute to water and air pollution. A major portion of nutrients brought onto livestock and poultry farms comes from purchased feeds. Reducing nutrients or selecting more efficient feed nutrient sources and/or feeding techniques can significantly reduce the nutrient content of excreted manure (helping to achieve a whole farm nutrient balance), and help to reduce odors and other gaseous emissions from manure.

The U.S. Department of Agriculture (USDA) and the Environmental Protection Agency (EPA) released *Unified National Strategy for Animal Feeding Operations* in March 1999. Importantly, the Strategy articulated a national performance expectation that all animal feeding operations should develop and implement technically sound, economically feasible, and site-specific comprehensive nutrient management plans (CNMPs) to minimize potential adverse impacts on water quality and public health. Feed management is one component of a CNMP.

Proper management of animal diets is a valuable tool to help balance nutrient flows, to achieve a whole-farm nutrient balance, and to reduce the potential negative impacts some nutrients have on the environment.

This is the first in a series of nutrient management technical notes on feeding management.

Series was prepared by **Dr. Alan Sutton**, professor of Animal Science at Purdue University, West Lafayette, Indiana, and **Charles H. Lander**, national agronomist, NRCS, Washington, DC. This series was developed from material published by the Federation of Animal Science Societies (FASS), Savoy, Illinois.

This technical note describes a series of basic nutrition and feeding management principles and potential adjustments that can be made on livestock and poultry operations to reduce nutrient excretions. This technical note was prepared from material published by the Federation of Animal Science Societies (FASS), Savoy, Illinois (fass@assochn.org). Additional technical notes provide specific feeding management and nutrient excretion information for beef, dairy, poultry, and swine. These technical notes are not intended to be all-inclusive. Farmers or operators should consult with Extension personnel or qualified animal nutritionists for detailed information and thorough evaluations of the animal diets and feeding management programs for livestock or poultry operations.

FEED MANAGEMENT CONSIDERATIONS

Effects of Diet and Feeding Management on Nutrient Content of Manure

Digestive processes

The digestive process begins with the intake of feed ingredients provided to meet animal maintenance, production, and reproduction requirements. The requirements for production are affected by stage of growth and the type of product (e.g., meat, milk, eggs) involved. How well the animal can retain nutrients for productive purposes depends upon the bioavailability of the nutrients in the diet, absorption, and metabolism. The quantity of nutrients excreted by animals is affected by three main factors:

- the amount of dietary nutrients consumed,
- the efficiency with which they are utilized by the animal for growth and other functions, and
- the amount of normal metabolic losses (endogenous). In other words, the amount of excreted nutrients can be expressed as:

$$\text{Nutrients excreted} = \text{Nutrient intake} - \text{Nutrients utilized} + \text{Nutrients from endogenous sources}$$

The primary way to reduce the amount of nutrients excreted by animals is to decrease the amount that is consumed and increase the efficiency of utilization of the dietary nutrients for formation of the product.

The goal of efficient and productive feeding of animals, within economic and environmental constraints, is to provide essential available nutrients for maintenance and production with minimal excess amounts.

Nutrients in feeds can vary considerably, and not all nutrients in feeds are available to the animal. Therefore, any means of increasing the digestibility or availability of nutrients will increase the potential for animal use and retention and reduce the amount of nutrients excreted. There is increasing interest today in using enzymes, genetically modified feed ingredients, and feed-processing technologies to enhance the availability of nutrients so as to meet the specific animal needs and reduce excretion of nutrients. In addition, a routine feed analysis program is imperative so that diets can be formulated and periodically adjusted to meet, but not exceed, the nutrient requirements of the animal.

Ruminants and nonruminants have different digestive systems. The ruminant (cattle and sheep) is capable of digesting and utilizing nutrients and energy from forages as well as from the easily digestible grains (concentrates). The nonruminant (poultry and swine) cannot effectively use a large amount of forages (fiber). Also, poultry and swine cannot digest some of the nutrients, particularly phytate phosphorus (P)

contained in grains. Usually, 50 percent of the P in the grains and oilseeds is in the form of phytate, which is not available to swine and poultry. Therefore, to meet their P requirements, their diets must include additional P, generally supplied by mineral supplements. The combination of the P in feed grains and the additional mineral P added to the diet increases the total P consumed by the animal. A considerable portion of the nonavailable P and/or extra P not needed by the animal is excreted. If the diet contains an enzyme called phytase, which will release the phytate form of phosphorus from the grains, then supplemental phosphorus in the diets can be reduced.

Following are some factors that should be considered for making adjustments in the diet or feeding program to reduce anticipated excretion of nutrients and manure volume. In all cases, nutrients should be managed to meet the animal needs and, of equal importance, to minimize nutrient excesses.

Feed management factors

Recommended feed management practices for a particular operation may include implementation of grouping strategies, including grouping by gender and increasing the number of production groups; appropriately adjusting diets based on climatic factors; minimizing feed wastage; and employing processing options to improve feed use efficiency. Further information is provided in the species-specific technical notes.

Grouping—(1) Place animals of similar ages, weights, and/or production levels together. (2) Place animals of the same gender together. Split-sex feeding divides the animals by gender so that diets can be formulated to meet the special nutrient needs of each sex.

Climate—Adjust diet to meet specific climate conditions (e.g. temperature, wind, precipitation), or adjust the building climate to optimize nutrient utilization.

Phase feeding—Use multi-phase feeding versus minimal-phase feeding. Phase feeding provides a series of diets that are formulated to more closely meet the nutrient needs of the animal at a particular stage of growth or production. Dividing the growth period into several periods with a smaller spread in body weight allows producers to provide diets that more closely meet the animal's nutrient requirements.

Wastage—Minimize feed and water spillage.

FEED MANAGEMENT CONSIDERATIONS

Effects of Diet and Feeding Management on Nutrient Content of Manure

Processing—Pelleting, extrusion, steaming, micronization, ensiling, and reducing particle size increase the digestibility of diets for swine and poultry. Processing feeds (e.g., grinding, pelleting, and fermenting) releases nutrients in the diet so the animal can absorb and retain more nutrients and excrete less nutrients and manure volume. Processing is not as critical for ruminants; however, coarse grinding, ensiling, and steaming have been effective for ruminants.

Diet manipulation factors

Diet considerations that are described in more detail in the technical notes on individual species include formulation based on feed available nutrients, the use of growth promotants to improve feed use efficiency, consideration of genetic factors that influence nutrient needs, use of specialty feeds, and consideration of nutrient intake from water supplies.

Available nutrients—Know the availability of nutrients in feed ingredients and formulate diets based upon available nutrients in the feed ingredients. Nutritionists should use the respective National Research Council (NRC) nutrient requirements for each farm animal as a guide to formulating diets unless data are available on the farm showing nutrient requirements of a specific genetic line of animals.

Nutrient levels—Some nutrient levels in commercial animal diets may be excessive. Chemical analyses of ingredients and reformulation are critical to minimizing excesses.

Genetics—Know the genetic capability of the animal, including feed intakes and responses to environmental conditions (e.g., climate, disease pressure, housing system).

Growth promoters—Antibiotics and other growth promoters increase feed efficiency. Growth promoters reduce nutrient excretion by increasing nutrient utilization.

Specialty feeds—Providing specific feed ingredients (e.g., high-oil corn, nutrient-dense corn, low-phytate corn, and soybeans) helps achieve a proper balance or increased availability of nutrients. Some of these are not commercially available today, but may be so in the near future.

Water supplies—Water supply sources can contribute significantly to mineral intakes.

Supplemental phosphorus—Reduce supplemental P and add phytase to swine and poultry diets to reduce P excretion. Remove all supplemental P in beef cattle diets and most of the supplemental P in dairy cattle diets to reduce P excretion.

Crude protein—Reduce dietary protein content and add synthetic amino acids to swine and poultry diets; reduce protein and select nitrogen (N) sources that cattle can absorb more effectively.

Benefits of reducing nutrients

Reducing the nutrient content of farm animal manure has the following benefits:

- A smaller land base per animal unit is required for manure application. This may provide a means to balance nutrients on a whole-farm basis.
- Greater volumes of manure can be applied per acre of land to meet agronomic rates for crop production. This may result in less labor and fuel costs for land application and reduce the potential need to supplement crop nutrient budgets with commercial fertilizer. Applying greater amounts of organic matter from manure per acre could result in more carbon sequestration and reduced emissions of gases responsible for global warming.
- Reduced N and sulfur excretion have the potential to reduce odors.

Reduced volumes of manure production will reduce the requirement for manure storage capacity and increase the flexibility for timing of manure application to cropland.

Dietary adjustments

The table on page 4 provides potential reductions in the excretion of nutrients with the dietary and/or feeding management adjustments mentioned above for livestock and poultry on operations that have not yet adopted diet and/or feeding management strategies to reduce manure nutrient content. It should be noted, however, that these potential effects are not additive. For more specific information, see the FASS fact sheets and the NRCS technical notes in this series for the specific animal species.

FEED MANAGEMENT CONSIDERATIONS

Effects of Diet and Feeding Management on Nutrient Content of Manure

Potential reductions in the excretion of nutrients

Strategy	Nitrogen reduction (%)	Phosphorus reduction (%)
Formulate diet closer to requirement	10–15 (nonruminants) 10–25 (ruminants)	10–15 (nonruminants) 10–30 (ruminants)
Reduced protein/AA supplementation (nonruminants)	10–25 (poultry) 20–40 (swine)	n/a ¹
Protein manipulation (ruminants)	15–25	n/a ¹
Use of highly digestible feeds	5	5
Use of phytase/low P (nonruminants)	2–5	20–30
Selected enzymes	5	5
Growth promotants	5	5
Phase feeding	5–10	5–10
Split-sex feeding	5–8	n/a ¹

¹ Not applicable.

Table data adapted from Federation of Animal Science Societies (FASS) publication, *Dietary Adjustments to Minimize Nutrient Excretion from Livestock and Poultry*, January 2001.

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Glossary terms used in the series of nutrient management technical notes

Available nutrient basis. Formulating a diet based on the bioavailability of the nutrients from the feed ingredients in the diet for the intended production purposes.

Bacterial protein (BCP). The crude protein in rumen bacteria made up of amino acids and nucleic acids.

Barrow. Male castrate of swine.

Bioavailability of nutrients. The amount of nutrient in the diet that is released in the digestion process and that can be absorbed in a form that can be used in the body for normal metabolic functions of the nutrient.

Bovine growth hormone. A natural nonsteroidal protein hormone produced in the pituitary glands of cattle that helps cows produce milk. The growth hormone produced in cattle will only be effective in cattle. This protein has been produced synthetically in bacteria.

Broiler. Chicken produced for meat.

By-products. Feed ingredients from sources that are normally waste products from other industries.

Concentrates. Plant materials (feeds) that contain relatively high starch content.

Crude protein. A measure of dietary protein that is based on the assumption that the average amino acid in a protein contains 16 percent nitrogen. Thus, total chemically determined nitrogen $\times 6.25$ ($100 \div 16$) = crude protein.

Crystalline amino acid. Amino acid produced in its pure chemical form.

Cystine. A sulfur-containing amino acid that can replace up to one-half of the methionine requirement.

Degradable intake protein (DIP). Crude protein that is degraded in the rumen by micro-organisms.

Denitrification. The process by which nitrogen is converted to nitrogen gas (N_2) and nitrous oxide (N_2O) and returned to the atmosphere.

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Effects of Diet and Feeding Management on Nutrient Content of Manure

Diet formulation. The process of combining an assortment of feed ingredients into a diet that will meet the nutrient and energy requirements of the animal for the intended purpose for which the animal is produced.

Digestibility. The relative amount of nutrients released from the digestion process.

Digestion. The process of breaking down nutrients through chewing and the action of enzymes to release nutrients that can be absorbed in animals.

Dry-matter intake. The amount of completely dry feed consumed by animals.

Dry precipitation. Chemicals combining in the atmosphere and falling to Earth.

Endogenous. Nutrients within the animal that may be produced or synthesized. Excretion of endogenous nutrients may occur from the recycling of nutrients and normal cellular metabolic processes.

Endogenous phytase. The enzyme naturally derived within the animal or from microbial sources within the animal that degrades phytate and releases phosphorus.

Feed use efficiency. The amount of live weight gain, milk production, or egg production per unit of feed consumed.

Fermentation by-products. By-products that have been processed by anaerobic fermentation.

Fermented feeds. Feeds that have been processed and preserved by anaerobic fermentation. A typical example is the acid fermentation of whole corn plant silage.

Forage. Plant material that contains relatively high fiber content.

Gilt. A term used to describe young female swine before sexual maturity.

Grass tetany. A nutritional disease caused by inadequate magnesium in the blood. It most commonly occurs among lactating animals grazing on rapidly growing, lush spring pastures containing less than 0.2 percent magnesium and more than 3 percent potassium and 4 percent nitrogen.

Ideal protein basis. Formulating a diet based on the concept that the protein content of the diet has a balance of amino acids that exactly meets the animal's amino acid requirements.

Layer. A chicken raised to produce eggs.

Leaching. The process by which plant nutrients move down through the soil profile, potentially reaching ground water.

Lysine. A basic amino acid required for growth.

Metabolizable protein (MP). Protein (amino acids) absorbed from the small intestine of ruminants. Contains bacterial protein and undegraded intake protein.

Methionine. A sulfur-containing amino acid required for growth.

Microbial protein synthesis. The process by which protein is synthesized in the rumen as micro-organisms grow and multiply.

Near infrared spectroscopy. Feed analysis performed using near infrared light wave reflectance.

Nonruminant (monogastric). An animal that has a simple stomach (one compartment) and must utilize concentrate diets.

Phase feeding—Changing the nutrient concentrations in a series of diets formulated to meet an animal's nutrient requirements more precisely at a particular stage of growth or production.

Phytase. An enzyme that degrades phytate, making phosphorus available to nonruminants.

Phytate phosphorus. A complex, organic form of phosphorus that is bound to the phytate molecule and is not readily digested by nonruminant animals.

Precision nutrition. Providing the animal with the correct ratio and quantity of nutrients in a diet at the ideal ratio to most efficiently produce the end product for which the animal is raised.

Ruminant. An animal capable of digesting forages (roughages) because it has a large stomach with four compartments that have micro-organisms present.

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Effects of Diet and Feeding Management on Nutrient Content of Manure

Somatotropin. The hormone that regulates growth, affects the metabolism of all classes of nutrients, stimulates milk production, and improves productive efficiency.

Sparing effect. The process whereby one chemical or metabolite reduces the need or requirements for another nutrient.

Split sex feeding. A feeding and housing program that divides animals by gender and formulates diets to meet the specific nutrient requirements of each sex more precisely.

Total digestible nutrients (TDN). Total of all the nutrients in the diet that are available to the animal.

Undegraded intake protein (UIP). Feed protein that is not degraded in the rumen by micro-organisms.

Volatilization. The process by which chemicals evaporate at ordinary temperatures.

Wet-chemistry procedures. Analysis of nutrients using standard, approved laboratory procedures.

Wet-dry feeding systems. Feeding systems designed to introduce water with dry feeds, either at prescribed times or at any time on demand by the animal. By introducing water at the time of feeding, the potential for water spillage and dust from feed sources is reduced.

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FEED MANAGEMENT CONSIDERATIONS



**Ecological
Sciences
Division**

October 2003

Nutrient Management Technical Note No. 5

Feed and Animal Management for Dairy Cattle

Introduction

Dairy operations typically include the milking cow herd with some of the cow population in the nonlactation stage (dry cows). Operations may or may not include growing heifers being raised as replacements for the milking herd. Distinctly different diets are required for each of the three production cycle stages, resulting in great differences in the volume and nutrient compositions of manure. This technical note briefly highlights some factors that affect nutrients in manure from dairy cattle and modifications in the diet that can be used to reduce them.

This is the fifth in a series of nutrient management technical notes on feeding management.

Series was prepared by **Dr. Alan Sutton**, professor of Animal Science at Purdue University, West Lafayette, Indiana, and **Charles H. Lander**, national agronomist, NRCS, Washington, DC. This series was developed from material published by the Federation of Animal Science Societies (FASS), Savoy, Illinois.

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A critical part of feed management is to accurately formulate diets and manage the feeding so that the nutrients fed consistently match the nutrients needed by each group in the herd. For example, table 1 shows how the concentration of nutrients needed in the diet change with stage of the life cycle and level of milk production. This table is an example to illustrate how the diet formula needs to be specific for each group in the herd. The concentration of nutrients needed in the diet for a particular level of production changes with dry matter intake.

Diet formulation

Diets should be formulated and updated regularly to avoid overfeeding of nutrients or fluctuations in milk production. The most common guideline for diet formulation is the National Research Council's (NRC) publication, *Nutrient Requirements of Dairy Cattle*, 2001. This publication provides equations to compute nutrient requirements for any size cow and milk production level and any stage of the life cycle. Therefore, actual dry matter intakes and a computer program that includes NRC and/or other research-based equations should be used to formulate diets. Because of the complexity of formulating diets to optimize production while minimizing excretion, producers not trained in nutrition should obtain help from qualified nutritionists when formulating diets. Proper diet formulation requires routine (monthly or quarterly) forage and by-product analysis because these ingredients are highly variable. Tabular values and previous sample analyses are not reliable for determining the nutrient content of these feed ingredients. Conducting a routine moisture analysis is important to adjust and mix feeds to ensure delivery of the formulated diet to the cattle. Cows should be evaluated for their body condition routinely so that the proper energy level of the diet can be determined.

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Feed and Animal Management for Dairy Cattle

A 50 percent variation in manure production might result from differences in feed wastage, ration formulation, type of feeding program (e.g., dry lot versus pasture feeding), and/or animal grouping systems.

Since dairy cattle are ruminants, they can utilize forages (generally lower in digestibility) as well as concentrates (generally higher in digestibility) in their diets. Depending upon the stage of production, the roughage-to-concentrate ratio can vary tremendously. As a result, volumes of manure produced are much greater when poorly digestible forages (fiber) are fed as compared to concentrates. In addition, the availability of nutrients in forages can vary considerably with different forage species and stage of maturity. Also, the composition of the manure is significantly different with these different scenarios.

Studies have shown that selecting the right type of protein sources in the diet to meet animal requirements can reduce nitrogen (N) excretion by 15 to 25 percent. Most of the N consumed by cattle is a part of the protein the animal consumes. When cows consume excess protein, an increased amount of N is excreted

in the urine as urea. Small amounts of urea can also be diffused into the milk. The concentration of urea in milk is proportional to the amount of N excreted in urine for cows with a given body weight. Cows consuming excess protein typically have higher milk urea nitrogen (MUN) concentration than cows consuming protein at or below their requirements. MUN can be measured for use as an indicator of excess protein in the diet. A general rule is that an average herd MUN should fall between 9 and 14 mg/deciliter of milk. The current recommendation from the NRC (2001) for phosphorus (P) feeding is a range of about 0.32 to 0.42 percent of dietary dry matter content, depending upon level of milk production and stage of lactation. Yet many producers are feeding closer to 0.5 percent for all lactating cows. Farmers often overfeed P with the thought that (1) they will improve reproductive efficiency, and (2) the feed ingredient tables typically underestimate the amount of P in most ingredients.

Mineral P supplements, such as dicalcium phosphate or monocalcium phosphate, are added to dairy cow diets at levels exceeding recommendations to provide a safety margin, especially if reproductive problems

Table 1 Selected nutrient requirements of dairy cattle (as determined by sample diets) ¹

Holstein, 1,500 lb cow, avg. body condition, 65 months of age Milk yield, lb/d =	----- Stage of production -----						Dry, preg. 270 days in gestation BW=1,656 lb	660 lb heifer @ 1.91 lb gain/day
	--- early lactation ---		----- 90 days in milk -----					
	55	77	55	77	99	120		
Dry matter intake, lb/d	29.7	34.3	44.7	51.9	59.2	66	30.1	15.6
Net energy, Mcal/lb	0.94	1.01	0.62	0.67	0.70	0.73	0.48	1.03
Diet, % RDP	10.5	10.5	9.5	9.7	9.8	9.8	8.7	9.4
Diet, % RUP	7	9	4.6	5.5	6.2	6.9	2.1	2.9
Crude protein, % ²	17.5	19.5	14.1	15.2	16.0	16.7	10.8	12.3
NDF, min %	25-33	25-33	25-33	25-33	25-33	25-33	33	30-33
NFC, max %	36-44	36-44	36-44	36-44	36-44	36-44	42	34-38
Calcium, %	0.74	0.79	0.62	0.61	0.67	0.60	0.45	0.41
Phosphorus, %	0.38	0.42	0.32	0.35	0.36	0.38	0.23	0.23
Potassium, % ³	1.19	1.24	1.00	1.04	1.06	1.07	0.52	0.48
Sodium, %	0.34	0.34	0.22	0.23	0.22	0.22	0.10	0.08
Copper, mg/kg ⁴	16	16	11	11	11	11	13	10
Zinc, mg/kg	65	73	43	48	55	65	22	27

¹ Adapted from tables 14-7, 14-8, 14-9, and 14-16, Nutrition Requirements of Dairy Cattle, 7th revised edition, 2001, National Research Council (NRC), National Academy of Sciences, National Academy Press, 2101 Constitution Ave., Washington, DC 20418 (J.H. Clark, chair, Subcommittee on Dairy Nutrition).

² Equivalent to the sum of rumen degradable protein (RDP) and rumen undegradable protein (RUP) only when they are perfectly balanced.

³ Heat stress may increase the need for potassium.

⁴ High dietary molybdenum, sulfur, and iron can interfere with copper absorption, increasing the requirement.

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Feed and Animal Management for Dairy Cattle

are suspected. As a result, diets typically contain 25 to 35 percent more P than is recommended by the NRC. By reducing or removing all supplemental P in the dairy diet, P excretion in manure can be reduced by as much as 30 percent.

Overfeeding P for reproductive performance has no scientific basis. Research shows that using accurate requirements for P along with actual feed analysis to formulate diets optimizes animal performance and minimizes P concentration in manure. Forages in particular are highly variable in P content and should be determined for each farm, using wet-chemistry procedures.

By-products (e.g., products of the brewing and distilling industries) are often utilized in cattle diets. Balancing the proper nutrient levels in cattle diets can be challenging when by-products are used. A consideration in the use of by-products is that the concentration and availability of nutrients, especially N and P, from each feed ingredient source can vary greatly, causing significant variation in nutrient contents that can create excesses in the diet.

The dietary salt intake level should be reduced in cattle feeds in semiarid and arid climates where salinity problems can exist and sodium accumulation can adversely affect crop production. In addition, beware of potassium accumulation in forages receiving high levels of manure application. This can potentially cause grass tetany problems in cattle consuming such forages.

Production management

Several new technologies have the potential to reduce manure nutrients per 100 pounds of milk produced. Average responses from some research studies are used in this technical note. Actual responses vary from farm to farm and from group to group within a farm.

One such technology is the manipulation of photoperiod by providing artificial lighting. It has been shown that increasing day length can increase milk production in dairy cattle by up to 8 percent. Nutrient intake required by such light-stimulated herds increased by only 4.1 percent, and N and P excretion increased by only 2.8 percent as compared with similar herds under natural day length.

Penning and grouping dairy cattle of similar milk production levels or stage of lactation and formulating diets to meet more nearly the nutritional needs of

cattle reduce feed nutrient wastage. Uniform groups (by weight and stage of production) allow the producer to use diets that more closely match the actual needs of all animals in the group since there is less variation among animals, and overfeeding of nutrients can be minimized.

Dividing the milk production cycle into several periods with less variation in milk production within the group allows producers to provide diets that more closely meet the cattle's nutrient requirements. Use of phase feeding has been estimated to reduce N and P excretion by at least 5 to 10 percent.

Another new technology that may impact nutrient utilization and excretion is the administration of bovine growth hormone (BGH), or somatotropin. This peptide hormone can increase milk production by as much as 30 percent in certain cows within the herd, although the entire herd's production would increase by only 14 percent. The nutrient requirements of a herd treated with BGH may increase by about 7 to 8 percent, and manure P may increase by 5 percent. However, the nutrient losses from the farm per unit of milk produced would, therefore, decrease by 8 to 10 percent per unit of milk produced.

Milking three times instead of twice per day can increase production per cow by an average of 11 percent and reduce stress on a herd. This increase in production results in the consumption of 5 percent more protein, with 3.5 percent more nutrients excreted in manure. The extra milking per day reduces the amount of nutrient excreted in manure by 7 percent per unit of milk.

Feed management

Feed bunk management. Good bunk management is imperative to reduce feed wastage. This involves checking feed intake levels for each group in the herd and adjusting intake to that required for the production level of each group. Consideration should also be given to how much feed is being wasted. In some operations leftovers are scraped up from lactating cows and re-fed to nonlactating cattle. In other cases refused feed is scraped from the feeding area and discarded. In this situation waste removed from the lot includes wasted feed and manure nutrients that need to be applied to the land.

Feed storage. Proper feed storage is necessary to preserve the nutrient value of the feed and to reduce direct loss of nutrients to the environment. Nutrients

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in water can come from leachate from fermented feeds (such as silage) and from runoff from feeds exposed to rain. Containment of silage leachate and good management of all feed storage areas are advised so that feed-based nutrients are not lost directly to the environment.

Nutritional value of water. The mineral content of the water supply should be considered with regard to the total intake of dietary minerals. Depending on the quality of water supply available, water intake may make a substantial contribution to daily mineral intake, particularly with regard to sulfur and, in some areas of the country, salt. Routine water sampling can help the nutritionist formulate properly for the amount of minerals to add to the diet to meet the animal's actual requirements.

Summary

The NRC publication *Nutrient Requirements for Dairy Cattle*, 2001, is a key reference to evaluate dairy cattle diets on a commercial operation. Also consult qualified nutritionists to accurately evaluate current or planned diet compositions during the development of a conservation plan, particularly during the development of a Comprehensive Nutrient Management Plan (CNMP). Various feed management activities can impact the nutrient content of excreted dairy cattle manure. Table 2 lists the potential of various feed management strategies to decrease the N and/or P content of manure excreted by dairy animals.

The actual impact of a feed management strategy or strategies on a dairy operation can only be determined by analysis of the manure after the strategy has been implemented. During the development of CNMPs, the potential impact of such strategies can be estimated using values in table 2. In using data from this table, planners are encouraged to be conservative in their selection of factors. Also, it is important to remember that the impact of using multiple strategies in a single diet is not likely to be additive for each single strategy used. Rather, it is more likely to be something greater than the value for the strategy with the smallest impact, but less than the sum of the values for all the individual strategies used.

During the development of CNMPs, it is better to underestimate the potential impact of feed management than to overestimate it. Later, the plan can be modified based on data accumulated from the actual production operation.

Glossary

By-products. Feed ingredients from sources that are normally waste products of other industries.

Bovine growth hormone. A natural nonsteroidal protein hormone produced in the pituitary glands of cattle that helps cows produce milk. The growth hormone produced in cattle will only be effective in cattle. This protein has been produced synthetically in bacteria.

Concentrate. Plant materials (feeds) that contain relatively high starch content.

Diet formulation. The process of combining an assortment of feed ingredients into a diet that will meet the nutrient and energy requirements of the animal for the intended purpose for which the animal is produced.

Forage. Plant material that contains a relatively high fiber content.

Phase feeding. Changing the nutrient concentrations in a series of diets formulated to meet an animal's nutrient requirements more precisely at a particular stage of growth or production.

Somatotropin. The hormone that regulates growth, affects metabolism of all classes of nutrients, stimulates milk production, and improves efficiency.

Table 2 Potential for feed management to impact the nutrient content of dairy cattle manure ¹

Strategy	Nitrogen reduction %	Phosphorus reduction %
Minimize dietary nutrient excesses	10–15	10–30
Protein manipulation	15–25	n/a ²
Increase number of production groups	5–10	5–10

¹ Adapted from the Federation of Animal Science Societies (FASS) publication, *Dietary Adjustments to Minimize Nutrient Excretion from Livestock and Poultry*, January 2001.

² Not applicable.

OPERATION AND MAINTENANCE

Proper management is an essential component of every Comprehensive Nutrient Management Plan (CNMP). The following guidelines accompanied with necessary corrective action will help ensure the CNMP is implemented successfully.

SAFETY

Waste collection and management facilities should be kept in a state of good repair and safe operating condition at all times. Warning signs, ladders, ropes, bars, rails, and other safety devices should be provided, as appropriate, to help insure the safety of humans and livestock. Each device should be structurally adequate to support anticipated loads. (A rope may be adequate sight warning, but inappropriate to support a person who accidentally slips on wet concrete.)

At least four noxious gasses are generated when organic waste is subject to anaerobic processes. They are: Methane (CH_4), Hydrogen Sulfide (H_2S), Ammonia (NH_3) and Carbon Dioxide (CO_2). In high enough concentrations, all can be lethal through lack of oxygen or poisoning. (Three gases are heavier than air and will exclude oxygen from depressed areas.) All but carbon dioxide can be explosive. Ventilation and warning signs must be provided for enclosed waste holding structures to help prevent explosions, poisoning or asphyxiation. Pipelines from an enclosed tank(s) in a building should be provided with a water - sealed trap and vent to prevent gas entry into the building. Entry into pits, ponds or tanks should not be allowed but if entry cannot be avoided the following procedures should be adhered to:

- 1) Ventilate the facility before and during occupancy and use a self-contained breathing apparatus. Do not assume any storage tank, including open top storage tanks, are well ventilated.**
- 2) Attach a tether or lead capable of supporting the weight of the person entering the facility and have a person outside the facility at all times tend the tether or lead.**

When inspecting or working on machinery, the following procedures should be adhered to:

- 1) Disconnect all power connections and provide lockouts whenever possible.**
- 2) Use blocks in front and behind rolling equipment to prevent movement.**

OPERATION AND MAINTENANCE

ACCESS ROADS, LOTS AND WALKWAYS (560, 561, 575)

Maintain road, parking lot and pathway surfaces in good condition, which includes periodic grading and addition of surface material when necessary. Prevent surface ponding by localized grading or addition of surface materials to remove depressions. Road base-course rock may be required to stabilize the road and parking lot foundations. If so, remove unstable materials and rebuild travelway. Limit traffic and animal access with fencing or barriers, where needed.

Remove debris, litter or blockages from roads, parking lots and walkways. Also remove debris and maintain capacity of associated drainage ditches, drop inlets, culverts, bridges, waterways and storm water outlets.

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

Immediately repair any vandalism, vehicular, or livestock damage to earthfills, side slopes, drainage facilities, water ways and storm water outlets or other appurtenances.

Maintain good vegetative cover, mulches, and other covering installed for erosion protection.

BUILDING ROOFS (313)

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

COMPOSTING FACILITY (317)

Refer to the compost mix design recipe in Section 11 to prepare the raw compost mixture. Take a representative sample of the raw compost mixture and have a laboratory determine the carbon and nitrogen content. The carbon to nitrogen ratio should range between 25 and 40 to 1. Make adjustments as needed to the ingredients of the recipe as necessary to achieve a carbon to nitrogen ratio within the acceptable range.

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

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

Check pile temperature using thermometer probe on a daily basis. The pile temperature should be checked at a point one-third the distance from the outside of the pile to the center of the mass. Initially it will take approximately 2 to 3 days for the compost to get above 105 degrees F. Compost temperatures should peak between 130 and 140 degrees F in 5 to 7 days. When the temperature of the compost material falls below 110 degrees F the compost needs to be aerated by turning or other means. Failure to achieve the desired temperatures may result in the incomplete destruction of pathogens and weed seeds and can cause fly and odor problems.

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

For a well managed windrow or static pile composting operation, the composting time during the summer months should range from 14 days to a month. To ensure a finished compost, observe that the

OPERATION AND MAINTENANCE

composted material has little or no trace of the original raw material and has little odor. The material should be black to brown in color. Particle size should be consistent and soil-like in texture.

DIKES AND BERMS (356)

Periodically inspect flap gates, control gates, valves and other appurtenances for proper functioning, and their ability to maintain the water level to design elevations. Immediately remove any blockage or debris that could cause malfunction. At approximately 3 month intervals exercise gates and valves to help assure proper function.

Periodically check elevations of earthfills and restore to grade and shape, if necessary. All settlement or cracks in the soil should be investigated to determine the cause and immediately repaired.

Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization, and application of herbicides when necessary. Fertilize the established stand with at least 200 pounds of 21-0-0 per acre or equivalent annually or as needed to maintain a uniform vigorous stand. Avoid excess travel and uncontrolled grazing on any portion of the dike system that will harm or destroy vegetative cover. Periodic mowing or controlled grazing may also be needed to control height.

Maintain installed fences to prevent unauthorized human access or uncontrolled grazing of dike surfaces. Livestock can be used to control vegetation height, providing grazing is controlled to short periods of time when damage to the dike surface and vegetation will not result.

Check all rock riprap and erosion control matting sections for accelerated weathering and displacement of materials. Replace to original shape and grade if necessary.

Immediately repair any vandalism, vehicular, or livestock damage to any earthfills, spillways, outlets or other appurtenance.

Removal of debris that may accumulate on the dike and immediately upstream or downstream from inlet and outlet facilities.

Make sure all structure drains are functional and soil is not being transported through the drainage system. Keep screens and/or rodent guards maintained and in place.

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

DIVERSION DAM (348)

Periodically inspect the spillways and control gates for proper functioning for their ability to maintain the water level to design elevations. Immediately remove any blockage or obstructions in spillways.

Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization, and application of herbicides when necessary. Fertilize the established stand with at least 200 lbs of 21-0-0 per acre or equivalent annually or as needed to maintain a uniform vigorous stand. Periodic mowing may also be needed to control height.

Immediately repair any vandalism, vehicular, or livestock damage to any earthfills, spillways, outlets or other appurtenance.

Remove debris that may accumulate at the Sediment Basin and immediately upstream or downstream from the basin.

Make sure all structure drains are functional and soil is not being transported through the drainage system. The screens and/or rodent guards shall also be kept in place.

OPERATION AND MAINTENANCE

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

DROP INLETS (CATCH BASINS) (587)

Remove debris and sediment from grates as needed. Annually inspect grates and receiving structures and repair or replace as necessary.

FENCES AND USE EXCLUSION (382, 472)

Do not allow livestock access to open water courses and drainageways. Provide off stream watering facilities where possible and limit access to designated watering areas.

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

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

FIELD BORDER (VEGETATED BUFFER) (PS386)

Do not apply wastewater or solids to Field Border areas shown on the plan map. Grazing of Field Border areas should be limited to ensure a good stand of vegetation (3 to 4 inches) is present in October before the fall and winter season begins.

Inspect and repair field borders after storms to fill in gullies, remove sediment accumulations, reseed disturbed areas, and perform other maintenance activities as needed to ensure the effectiveness of the border.

Do not mow or burn for weed control during the nesting season (normally May through July) to protect ground-nesting wildlife. In place of mowing, consider other vegetative management techniques, such as using "wickbar" herbicide applicators or prescribed burning in areas with adequate moisture.

Lightly disk the field border on a 2 or 3 year cycle to promote the growth of native vegetation.

FILTER STRIPS (393)

Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing or grazing may also be needed to control height.

Remove all foreign debris that hinders system operation.

Limit the traffic and do not use as a roadway. Also limit livestock usage to vegetative growth periods when they will not damage vegetative root system or compact the soil. Immediately repair any vandalism, vehicular, or livestock damage.

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

Check all structural sections (i.e. rock riprap) for accelerated weathering and displacement. Replace to original grades if necessary.

FORAGE HARVEST MANAGEMENT (511)

Before forage harvest, clear fields of debris that could damage machinery, or if ingested by livestock, lead to sickness (for example, hardware disease) or death.

OPERATION AND MAINTENANCE

Monitor weather conditions and take action accordingly before and after cutting to optimize forage wilting or curing time to preserve feed quality and prevent forage swaths or windrows from smothering underlying plants.

Inspect and repair harvesting equipment following manufacturer's preventative maintenance procedures.

All shields shall be in place during machine operation to prevent injury or death. Shut off machinery before working on or unplugging moving parts.

Select equipment sizes and capacities that will in a timely and economically feasible manner handle the acreage normally harvested.

Operate all forage harvesting equipment at the optimum settings and speeds to minimize loss of leaves.

Set shear-plate on forage chopper to the proper theoretical cut for the crop being harvested. Keep knives well sharpened. Do not use recutters or screens unless forage moisture levels fall below recommended levels for optimum chopping action.

Regardless of silage/haylage storage method, ensure good compaction and an air-tight seal to exclude oxygen and mold formation.

GRADE STABILIZATION STRUCTURE (410)

Avoid operating farm equipment too close to the structure. Equipment can transfer vibration and weight to the structure that may be in excess of design and cause damage or failure.

Protect vegetated soil covering and control livestock access to structure. Removal of vegetation will accelerate soil erosion which can result in damage to earthfills or spillways and livestock may be injured, damage protective vegetation and earthfills or accelerate soil erosion.

Removal of debris accumulation at the structure, and immediately upstream or downstream. Debris accumulation can reduce hydraulic capacity and cause structural damage or failure during a runoff event. Make sure all structure drains are functional and soil is not being transported through the drainage system. The screens and/or rodent guards shall also be kept in place.

Repair or replace rock riprap either by machine or by hand to the lines and grades of the original design.

Eradicate or otherwise remove all rodents or burrowing animals. Their burrows may weaken earthen sections and develop flow paths for water and accelerate soil erosion that may cause the structure to fail.

IRRIGATION AND WASTEWATER TRANSFER PIPELINES (430, 634)

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

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

Check to make sure all valves and air vents are set at the proper operating condition so they can provide protection to the pipeline.

Inspect pipelines for signs of failure. Inspect risers and valves periodically for leaks or worn gaskets. Repair or replace pipeline, risers and valves as needed.

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

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

OPERATION AND MAINTENANCE

PASTURE AND HAY PLANTING (512)

The operator will inspect and calibrate equipment prior to use to insure proper rate, distribution and depth of planting material.

Growth of seedlings or sprigs shall be monitored for water stress. Depending on the severity of drought, water stress may require reducing weeds, early harvest of any companion crops, irrigating when possible, or replanting failed stands.

Invasion by undesirable plants shall be controlled by cutting, using a selective herbicide, or by grazing management by manipulating livestock type, stocking rates, density, and duration of stay.

Insects and diseases shall be controlled when an infestation threatens stand survival.

Evaluate forage stands each season or as needed to determine management inputs needed to achieve the desired purpose(s).

PUMPS AND AGITATORS (533, 634)

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

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

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

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

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

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

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

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

RAIN GUTTERS AND DOWNSPOUTS (558)

Annually inspect rain gutters, downspouts, pipelines, trash guards, pumps, structures and appurtenances for proper operation. Keep them free of all foreign material, weeds and sediment. Repair or replace any damaged component as needed.

Keep downspouts and outlets free flowing. Repair or replace broken rodent guards as needed. If the hydraulic capacity is insufficient, replace gutters (and downspouts if needed) or make provisions for the waste management system to handle the extra water.

OPERATION AND MAINTENANCE

Protect downspouts from damage by livestock and equipment and repair any damaged components as needed.

SEDIMENT BASIN (350)

Periodically inspect the spillways and control gates for proper functioning for their ability to maintain the water level to design elevations. Immediately remove any blockage or obstructions in spillways.

Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization, and application of herbicides when necessary. Fertilize the established stand with at least 200 lbs of 21-0-0 per acre or equivalent annually or as needed to maintain a uniform vigorous stand. Periodic mowing may also be needed to control height.

Immediately repair any vandalism, vehicular, or livestock damage to any earthfills, spillways, outlets or other appurtenance.

Remove debris that may accumulate at the Sediment Basin and immediately upstream or downstream from the basin.

Make sure all structure drains are functional and soil is not being transported through the drainage system. The screens and/or rodent guards shall also be kept in place.

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

SLABS AND CURBS (561, 634)

Periodically inspect concrete and asphalt slabs and curbs and repair or replace broken sections as needed. Prevent manure from building up next to the curbs or over topping them.

SOLID/LIQUID SEPARATION FACILITY (632)

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

Settling basins are estimated to have a separation efficiency of 50%. Inspect the capacity of settling basins daily to ensure adequate capacity is available for separated solids.

During daily inspections if it is determined that the maximum capacity of the settling basin has been reached, divert flows to another basin and let excess liquids drain from the basin before removing solids. Once the excess liquids have drained from the basin, remove all accumulated solids from the basin and store them in a designated solids storage area or haul them to the application area for utilization. When removing solids from earthen basins take care not to disturb the earthen liner.

Prevent any spillage or leakage onto roadways when removing solids from the settling basins and hauling solids to utilization areas.

SPRING DEVELOPMENT (574)

Check all above ground connections, cover and seals, valves, insect and rodent guards, inlets and outlets to make sure they are functioning properly. Where necessary, maintain coverings and insulation to prevent damage by freezing.

Maintain all fences in good condition to exclude livestock from collection area. Immediately repair any vandalism, vehicular or livestock damage to any of the facilities.

OPERATION AND MAINTENANCE

Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing may also be needed to control growth. Precaution and care is needed to prevent herbicides, insecticides and other pollutants from contamination of the water source.

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

SPRINKLER IRRIGATION SYSTEM (442)

Maintain traveling gun type sprinklers (and hose reel, if used) by oiling and greasing moving parts and the engine in accordance with the manufacturer's recommendations to help ensure trouble free operation. Prevent livestock access to equipment during operation.

Clean plugged nozzles and replace if worn or defective.

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

SUBSURFACE DRAINAGE SYSTEMS (606)

Annually inspect subsurface drainage systems for proper operation. Check fields for signs of positive pressure (blow holes) or negative pressure (sink holes) in drainage lines. Repair or replace damaged or broken drain lines as needed maintaining designed depth of cover.

Keep outlets free of vegetation and sediment. Correct and prevent erosion at outlets by installing riprap or other measures. Repair or replace damaged or broken rodent guards as needed.

Monitor subsurface drainage outlets from fields on which animal waste is being applied daily. Stop all animal waste applications if tile outflow contains any indication of animal waste. If waste application must continue, intercept and return drainage water to the waste storage pond.

Avoid travel over drainlines with heavy equipment when the soil is saturated except at crossings designed for this purpose.

Avoid any subsoiling operation that may disturb the subsurface drain or its filter and/or envelope materials.

Eradicate or otherwise remove all rodents and/or burrowing animals that have or can potentially damage any part of the system. Immediately repair any damage caused by their activity.

Immediately repair any damage due to vandalism, vehicular or livestock.

UNDERGROUND OUTLETS (620)

Annually inspect underground outlets for proper operation. Check fields for signs of positive pressure (blow holes) or negative pressure (sink holes) in underground pipelines. Repair or replace damaged or broken pipelines as needed maintaining designed depth of cover.

Keep outlets free of vegetation and sediment. Correct and prevent erosion at outlets by installing riprap or other measures. Repair or replace damaged or broken rodent guards as needed.

Avoid travel over underground pipelines with heavy equipment when the soil is saturated except at crossings designed for this purpose.

Avoid any subsoiling operation that may disturb the underground outlet.

Eradicate or otherwise remove all rodents and/or burrowing animals that have or can potentially damage any part of the system. Immediately repair any damage caused by their activity.

OPERATION AND MAINTENANCE

Immediately repair any damage due to vandalism, vehicular or livestock.

VEGETATIVE SCREENING (380, 612)

Ensure plants are irrigated during the first three years of establishment. If plants cannot be irrigated using a conventional system, use the following rule of thumb:

- During the first year of establishment apply 1 gallon of water per week to each plant between June and September.
- During the second year of establishment apply 2 gallons of water per week to each plant between June and September.
- During the third year of establishment apply 4 gallons of water per week to each plant between June and September.

Provide weed control until plants are well established.

Exclude livestock and other animals from planting area. Control rodents as necessary. Replant damaged or dying plants in accordance with the planting plan.

Control harmful diseases and insects by removing habitat or through the use of approved chemicals.

As the vegetative screen matures some plants may need to be removed to maintain the desired density and variety of plants.

WASTE STORAGE FACILITIES (313)

WASTEWATER STORAGE PONDS-

The waste storage pond shown on the facility map has a design capacity of 8.4 acre feet to store liquid manure and polluted runoff for a period of October through February.

The waste storage pond will serve as the primary storage facility for wastewater produced from the operation. Emptying of the waste storage pond should begin in late February before the pond is completely filled. Emptying should continue through the spring and summer months as weather conditions permit applying liquids in accordance with the guidance given the nutrient and waste utilization parts of this section. To function properly and have the greatest management flexibility, the waste storage pond must be as empty as possible in October before the fall and winter rainy season begins. Any annual sludge buildup must be removed to maintain design capacity and applied to utilization areas in accordance with guidance given in the nutrient and waste utilization parts of this section.

Do not permit livestock access to the pond or on pond embankments. Control undesirable vegetation growth by spraying or mowing. Control rodents as necessary. Check elevations of earthfills periodically and restored to grade and shape as necessary. Fill and reseed eroded embankment areas or repair with well graded rock riprap. Repair embankment leaks immediately should they occur. Safety features such as signs and fences should be kept in good repair.

Maintain at least 2 feet of freeboard in the pond to prevent embankment overtopping and subsequent embankment erosion.

WASTEWATER STORAGE TANKS-

The wastewater storage tanks shown on the facility map have a design capacity of 2,400 cubic feet or 17,953 gallons for short term storage of process water, manure, bedding and other liquefied organic waste for a period of a few hours to a few days. To function properly and have the greatest management flexibility, the wastewater storage tanks must be as empty as possible in October before the fall and winter rainy season begins.

Do not allow equipment that exceeds the design limit of the tanks on or within twenty feet of the structure. Keep pumps, agitators, piping, valves and all other electrical and mechanical equipment in good condition

OPERATION AND MAINTENANCE

by following the manufacturer's recommendations. Maintain grounding rods and wiring for all electrical equipment in good condition.

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

Immediately remove all foreign debris within the structure that may cause damage to pumps or agitators. Pump the wastewater storage tanks completely empty during the summer months and cleanout any debris and other solid materials that may have accumulated in the tanks.

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

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

SOLIDS STORAGE FACILITY-

The solids storage facility shown on the facility map has a design capacity of 21,059 cubic feet or 527 tons to store manure, bedding and other organic waste for a period of October through February.

The solids storage facility will serve as the primary storage facility for manure, bedding and other organic waste produced from the operation. Emptying of the solids storage facility should begin as early as possible in the spring. Emptying should continue through the spring and summer months as weather conditions permit applying solids in accordance with the guidance given the nutrient and waste utilization parts of this section. To function properly and have the greatest management flexibility, the solids storage facility must be as empty as possible in October before the fall and winter rainy season begins. The solids storage facility is designed with 6 foot high walls which will allow the solids to be stacked to a height of 8 feet. At no time should the solids be stacked higher than 8 feet or allowed to over top the walls of the structure.

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

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

WATERING FACILITIES (614)

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

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

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

OPERATION AND MAINTENANCE

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

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

Immediately repair any vandalism, vehicular or livestock damage.

WELLS (642)

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

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

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

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

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

Keep all surface water from entering or accumulating at the immediate vicinity of the well site. Immediately repair any vandalism, vehicular, or livestock damage.

OPERATION AND MAINTENANCE

PERMITS

010 7147

Confined Animal Feeding Operation Facility Inspection Report



Oregon
Department
of Agriculture
635 Capitol Street N.E.
Salem, OR 97301-2532

INSPECTION TYPE:

- ☒ Routine ☐ EPA
☒ Follow-up ☐ Planning Assistance
☐ Complaint ☒ Announced ☐ Unannounced
☐ Educational Review ☐ Other:

Date: 8/9/06 Arrival Time: 1:00pm License Number: 63616 Permitted Number of Animals: 850
 Assumed Business Name: Schoch Dairy LLC
 Operator's Name: Hans and Dave Schoch E-mail Address:
 Address: 24327 NW West Union Rd #24336 = Dave & Casey
 City: Hillsboro Zip: 97124 County: Washington
 Phone Number: (503) 647-2638 GPS: N45 34 41.8 W122 55 35.7

A Confined Animal Feeding Operation inspection was made at your facility on this date. Items found in non-compliance with Oregon Revised Statutes and/or Oregon Administrative Rules are identified below.

LEGEND: C=Compliance N=Non-compliance NA=Not Applicable NE=Not Evaluated M=Modification *-See Remark

ITEM	REMARKS
* 1. Livestock Inventory: milking and dry 190 calves = 40; heifers 140 Total: 270	1) over permitted # but still within the additional 25 animals
C 2. Parlor, Milk House, Holding Pen a. Milk parlor/bulk tank waste water not properly drained b.	
C 3. Animal Confinement Facilities a. Liquid manure accumulation on unprepared bare-earth surfaces b. Excessive uncontained manure accumulation on animal access lanes c. Openings through which manure or run-off can escape d.	
* 4. Manure and Silage Containment Facilities a. Uncontained manure stockpiled prior to or during rainy weather b. Uncontained manure stockpiled in or near drainageways c. Uncontained contaminated run-off from silage bunker or feedstuffs d. Liquid manure facilities overflowing e. Manure storage facilities not emptied/prepared for start of rainy season f. Capacity of liquid manure facilities reduced by accumulation of solids g. Earthen embankments not properly maintained or leaking h. Facilities have openings through which manure or run-off can escape i. Roof run-off system failure can or does produce uncontained contaminated run-off or reduces manure storage capacity j. Pumps or agitators inoperable k.	4) all solid manure exported.
* 5. Manure Application Areas Acres: 58 + 15 rented a. Manure applied to soils that are saturated, flooded, or standing water b. Manure applied to soils likely to be flooded in the next couple of months c. Liquid manure ponding on soils d. Contaminated surface and subsurface effluent from drainage tiles e. Manure or contaminated run-off flowing toward or into waters of the state f. Deposits of manure that cover vegetation or are several inches thick g. Liquid manure applied during heavy rainfall h. Manure applied during autumn or winter to soils with no growing crop i. Manure applied to frozen or snow-covered soils j. Liquid manure transfer lines separated or leaking k.	5) renting additional 15 acres to apply manure to.
* 6. Animal Waste Management Plan (AWMP) and Record Keeping a. Soil-sampling results b. Manure-sampling results c. AWMP due October 1, 2006.	6) AWMP due 10/1/06

CONCLUSIONS:

- ☒ a. Facility in compliance. Thank you for your cooperation in protecting the quality of Oregon's surface and waters and groundwaters.
☐ b. On Schedule.
☐ c. Planning Assistance.
☐ d. Educational Review.
☐ e. Concern(s) identified. See attached Water Quality Advisory.
☐ f. Violation(s) identified. See attached Notice of Noncompliance and/or Plan of Correction. dated 8/22/06 KH.

Inspector Signature

White (Office copy) Yellow (Operator copy) Pink (Inspector copy)

Operator Signature

Form No. 7014 (Rev. 08/04)

PERMITS

05 6973

Confined Animal Feeding Operation Facility Inspection Report



Oregon
Department
of Agriculture
635 Capitol Street N.E.
Salem, OR 97301-2532

INSPECTION TYPE:

- ☒ Routine
☐ Follow-up
☐ Complaint
☐ Educational Review

- ☐ EPA
☐ Planning Assistance
☒ Announced ☐ Unannounced
☐ Other:

Entered 9/20/05
STH

Date: 9/20/05 Arrival Time: 11am License Number: 1031016 Permitted Number of Animals: 250
Assumed Business Name: Schoch Dairy
Operator's Name: Dave Schoch E-mail Address:
Address: 24327 NW Union Rd
City: Hillsboro Zip: 97124 County: Washington
Phone Number: 503-647-2638 GPS: on file

A Confined Animal Feeding Operation inspection was made at your facility on this date. Items found in non-compliance with Oregon Revised Statutes and/or Oregon Administrative Rules are identified below.

LEGEND: C=Compliance N=Non-compliance NA=Not Applicable NE=Not Evaluated M=Modification *=See Remark

ITEM	REMARKS
C 1. Livestock Inventory:	
C Total: 270	
2. Parlor, Milk House, Holding Pen	
a. Milk parlor/bulk tank waste water not properly drained	
b.	
C 3. Animal Confinement Facilities	
a. Liquid manure accumulation on unprepared bare-earth surfaces	
b. Excessive uncontained manure accumulation on animal access lanes	
c. Openings through which manure or run-off can escape	
d.	
C 4. Manure and Silage Containment Facilities	
a. Uncontained manure stockpiled prior to or during rainy weather	
b. Uncontained manure stockpiled in or near drainageways	
c. Uncontained contaminated run-off from silage bunker or feedstuffs	
d. Liquid manure facilities overflowing	
e. Manure storage facilities not emptied/prepared for start of rainy season	
f. Capacity of liquid manure facilities reduced by accumulation of solids	
g. Earthen embankments not properly maintained or leaking	
h. Facilities have openings through which manure or run-off can escape	
i. Roof run-off system failure can or does produce uncontained contaminated run-off or reduces manure storage capacity	
j. Pumps or agitators inoperable	
k.	
C 5. Manure Application Areas Acres: 52 owned	
a. Manure applied to soils that are saturated, flooded, or standing water	
b. Manure applied to soils likely to be flooded in the next couple of months	
c. Liquid manure ponding on soils	
d. Contaminated surface and subsurface effluent from drainage tiles	
e. Manure or contaminated run-off flowing toward or into waters of the state	
f. Deposits of manure that cover vegetation or are several inches thick	
g. Liquid manure applied during heavy rainfall	
h. Manure applied during autumn or winter to soils with no growing crop	
i. Manure applied to frozen or snow-covered soils	
j. Liquid manure transfer lines separated or leaking	
k.	
C 6. Animal Waste Management Plan (AWMP) and Record Keeping	
a. Soil-sampling results	
b. Manure-sampling results	
c.	

All solids in barn are being exported.

1st cell of pond is almost empty, ready for fall.

Replacing floats on flush tank

Working w/ NRCS to have a CNMP written.

AWMP due July 1, 2006

CONCLUSIONS:

- ☒ a. Facility in compliance. Thank you for your cooperation in protecting the quality of Oregon's surface and waters and groundwaters.
☐ b. On Schedule.
☐ c. Planning Assistance.
☐ d. Educational Review.
☐ e. Concern(s) identified. See attached Water Quality Advisory.
☐ f. Violation(s) identified. See attached Notice of Noncompliance and/or Plan of Correction.

Inspector Signature

White (Office copy) Yellow (Operator copy) Pink (Inspector copy)

Operator Signature

Form No. 7014 (Rev. 08/04)

PERMITS

Notice of Registration and Oregon Confined Animal Feeding Operation (CAFO) General Permit Summary

Overview of CAFO General Permit Summary

The Oregon CAFO General Permit became effective on August 15, 2003, and was issued by the Oregon Department of Agriculture (ODA) and Department of Environmental Quality on October 1, 2003. The permit expires on July 31, 2008. A copy of the general permit is enclosed. This summary describes the permit requirements.

Your Dairy CAFO was registered to the permit on **October 2, 2003** based on information provided by you as follows:

	Operator	Legal owner, if different
Name	Hans Schoch	Schoch Dairy LLC – Hans Schoch & David Schoch
Business Name	Schoch Dairy	
Mailing Address	24327 NW West Union Road Hillsboro, Oregon 97124	Same
Facility Address	Same	
Phone 1	503-647-2638	
Phone 2		
Phone 3		
Email address	hchocs@aol.com	
Maximum Number of Animals	The maximum number of animals that may be held at this CAFO is 250 based on the following population: 150 milking and dry cows and 100 heifers. You may not exceed this number by more than 10% or 25 animals, whichever is greater, without first providing ODA a revised waste management plan and receiving written ODA approval.	
Facility Classification	Based on the type and size of your operation ODA has determined that you operate a State CAFO. <i>Note: Large federal CAFOs have additional requirements. Please see general permit.</i>	

Annual Permit Fee

You will be assessed an annual compliance determination fee of \$25.00 to maintain your registration under this general permit.

For Additional Questions

If you have questions, call your regional livestock water quality specialist. You will find their name and phone number, plus additional CAFO program information on the internet at <http://oda.state.or.us/nrd/cafo/index.html>.

General Permit Conditions

You must be in compliance with all terms and conditions of the permit (not simply this summary of the permit) at all times. You must:

- Contain, treat, store and dispose of wastes and wastewater so that no discharge to surface water or groundwater occurs, except as described below.
- Ensure that animals in the production area do not have direct access to surface water sources.
- Properly operate and maintain all waste handling facilities.

Prohibited Discharges

The following types of discharges are prohibited:

- Contaminated runoff from confinement or waste accumulation areas;
- Overflow or discharges from waste storage facilities;
- Discharges due to improper land application activities from surface drainages, field tile outlets, or seepage below the root zone;
- Discharges due to equipment failure; and
- Leakage or seepage from facilities in the production area in excess of approved designs.

When Discharge is Allowed

Production Area: Discharges of process waste water to surface waters of the state are generally prohibited, except:

- When rainfall events cause an overflow of process waste water from a facility designed, constructed, operated, and maintained to contain all process-generated waste waters plus

PERMITS

the runoff and direct precipitation from a 25-year, 24-hour rainfall event (100-year, 24-hour rainfall event for swine, poultry, and veal CAFOs) provided these discharges do not cause or contribute to a violation of state water quality standards; or

- In the event of an upset or bypass condition. These conditions are further defined in the permit.

All authorized discharges from the production area must be properly land applied or otherwise handled in a way that minimizes impacts on surface water and groundwater sources.

Land Application Area: Storm water runoff from the land application area is not considered a prohibited discharge and is allowed if the land is being managed in compliance with a waste management plan approved by ODA.

Animal Waste Management Plan (AWMP) Requirement

The permit requires that each permitted operation have a current AWMP. An AWMP describes how a CAFO is managed with respect to containment, treatment, storage, and utilization of manure, litter, and process wastewater in order to remain in compliance with permit conditions and water quality laws. It must accurately represent current land base, manure storage, herd/flock size, and current management practices used at the livestock operation.

Due Date for Animal Waste Management Plan Submittal

Large federal CAFO.....October 1, 2004
Medium federal CAFO.....October 1, 2005
State CAFO.....July 1, 2006

Storage Requirement

You must provide adequate storage capacity for solid and liquid wastes at all times so that land application occurs only during periods when soil and weather conditions are suitable.

Testing & Record Keeping

Testing and record keeping of wastes, soils, crop yields, etc. must occur as described in an animal waste management plan approved by ODA. Testing and record keeping of waste handling activities is not required on pastures or rangeland if such lands have not received wastes other than from grazing animals. *Note: Large federal CAFOs have additional requirements, please see general permit.*

Land Application Rates & Timing

You must apply manure, litter and process wastes to lands at agronomic rates in accordance with proper agricultural practices and as specified in a waste management plan that has been approved by ODA. Waste applications must not exceed the capacity of the soil and crops to assimilate nutrients and minimize water pollution, must be quantifiable, and based on the NRCS Phosphorous Index, Agronomy Technical Note #26, revised October, 2001, and must account for all other nitrogen, phosphorus, and potassium sources.

Prohibitions: If discharge to surface water or groundwater will result, application to flooded, saturated, frozen or snow covered land is prohibited. Land application of wastes or waste water during rainfall events that are expected to result in saturated soils or surface runoff is prohibited.

Land Application Setback Requirements for Large CAFOs

If you operate a large federal CAFO, in the land application area you must maintain a setback (buffer) area from any down-gradient surface waters, open tile line intake structures, sinkholes, agricultural well heads, or other conduits to surface waters where manure, litter, and other process waste waters are prohibited. Three options for compliance with the setback requirement are 1) a 100' buffer of no manure, litter or process wastewater application. 2) a 35' vegetated buffer of no application of manure, litter or process wastewater or 3) an alternative, field specific conservation practice buffer that is as protective of surface and ground water as alternative #'s 1 and 2.

PERMITS

Duty to Report Noncompliance

If at any time you are unable to comply with any permit conditions, you have a duty to contact ODA immediately so the situation can be assessed and remedial actions taken if necessary. *Note: If you have a discharge to surface water or groundwater that is not allowed by the permit, you must notify ODA within 24 hours of the discharge.*

Annual Report

You must submit an annual report by March 15th of each year to ODA. *Please see general permit for more detail.*

Proper Decommissioning of Waste Facilities

You must decommission waste handling facilities in accordance with NRCS conservation practice standard, code 360, entitled *Closure of Waste Impoundments*, dated February 2000 and properly dispose of any residual wastes. Permit coverage will not be terminated until decommissioning issues are resolved.

Construction of Waste Storage and Waste Water Control Facilities

All construction of waste storage and waste water control facilities must be sited, designed, constructed, operated and maintained consistent with the waste management plan and must comply with the terms and conditions outlined in rule. New construction, expansion, or modification of waste handling facilities (particularly earth-surfaced lots, ditches, impoundments and other storage facilities with a capacity greater than five days) is allowed if ODA is provided with design and post-construction certification from a licensed engineer that such work was done in accordance with applicable rules. Experimental or unproven technologies must receive prior approval from ODA. For all other modifications or new construction, no approval will be required. Certification forms are available from ODA.

Compliance Assurance (Effect of a Permit)

Except for any toxic effluent standards and prohibitions imposed under section 307 of the federal Clean Water Act (CWA) and groundwater protection requirements established under OAR 340-040, if you are in compliance with this permit during its term, you are considered to be in compliance, for purposes of enforcement, with state water quality laws and relevant sections of the CWA, as provided in 40 CFR §122.5. The specific effect of permit compliance on enforcement authority is set out in OAR 340-045-0080.



Debbie Gorham, Administrator
Natural Resources Division

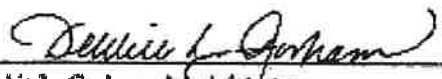
Permit Number: CAFO General Permit #1
Effective Date: August 15, 2003
Expiration Date: July 31, 2008
Issuance Date: October 1, 2003

**OREGON CONFINED ANIMAL FEEDING OPERATION
GENERAL PERMIT NUMBER 1**

State of Oregon
Department of Agriculture
Natural Resources Division
and
Department of Environmental Quality
Water Quality Division

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

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


Debbie L. Gorman, Administrator
Natural Resources Division
Oregon Department of Agriculture

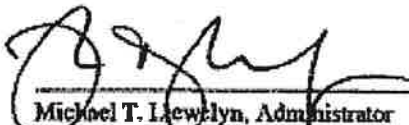

Michael T. Laewelyn, Administrator
Water Quality Division
Oregon Department of Environmental Quality

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S1. PERMIT COVERAGE

S1.A. When is a Permit Required?

1. Any person who owns or operates a confined animal feeding operation (CAFO) that confines for more than four months and has waste water control facilities is required to obtain coverage under this permit. Any person who owns or operates a *concentrated* animal feeding operation is required to obtain coverage under this permit. Failure to obtain coverage under this permit is a violation of ORS 468B.050 and 468B.215 except as provided in S1.E Individual Permit Coverage, p. 4.
2. Any person who owns or operates an animal feeding operation (AFO) designated by the director pursuant to OAR 603-074-0012 as a *concentrated* AFO (see definition S1.F.5(c), p. 6) is required to obtain coverage under this permit. Failure to obtain coverage under this permit is a violation of ORS 468B.050 and 468B.215 except as provided in S1.E Individual Permit Coverage, p. 4.
3. Any person who owns or operates an AFO may be covered under this permit. Any person voluntarily registering for coverage under the permit is liable for compliance with all terms and conditions of the permit.
4. Any person not wishing to be covered by this permit may apply for an individual permit in accordance with OAR 340-045-0030.

S1.B. Schedule for General Permit Coverage

Owners and operators of CAFOs subject to coverage under this permit must submit an ODA Application to Register (ATR) according to the following schedule:

1. All newly constructed CAFOs Newly constructed CAFOs, including "new sources" must submit an ATR at least 180 days prior to the time that the CAFO commences operation.
2. Existing CAFOs that met the previous definition of concentrated AFOs: CAFOs that were defined as *concentrated* under federal regulations in effect prior to April 14, 2003, must submit an ATR immediately.
3. Existing CAFOs newly defined as concentrated AFOs as of April 14, 2003: CAFOs that met the federal definition of *concentrated* as of April 14, 2003, that were not defined as *concentrated* in federal regulation prior to that date must submit an ATR by a date specified by the director, but no later than February 13, 2006.
4. Existing CAFOs that become defined as concentrated AFOs after April 14, 2003: CAFOs that become defined as *concentrated* after April 14, 2003, must submit an ATR within 90 days after becoming defined as a CAFO unless the change in operation that causes the AFO to be defined as a *concentrated* AFO would not have caused it to be defined as a *concentrated* AFO prior to April 14, 2003.
5. All other existing CAFOs that are not concentrated AFOs: Other existing CAFOs that are not *concentrated* AFOs covered by this permit must submit an ATR within 90 days of notification by the director that permit coverage is required.
6. AFOs designated by the director: AFOs designated by the director as a *concentrated* AFO must submit an ATR by a date specified by the director but no later than 90 days after receiving notice of the designation.

S1.C. General Permit Coverage

1. This permit authorizes the discharge of only those pollutants resulting from the CAFO processes, wastes, and operations that have been clearly identified in the permit application process.

2. This general permit does not cover activities or discharges presently covered by an individual NPDES or Water Pollution Control Facilities (WPCF) permit until the individual permit has expired or been cancelled. If appropriate, any person issued an individual permit may apply for coverage under this general permit and request cancellation of the individual permit.
3. This general permit does not cover disposal of human wastes or waste water control systems that mix human and animal wastes. Any person owning or operating such a system must apply to DEQ for coverage under an individual or general permit issued pursuant to ORS 468B.050. This general permit may be used in addition to an individual or general permit issued by DEQ pursuant to ORS 468B.050.
4. The applicant will be notified in writing when general permit coverage has been granted. Written notification will include a notice of registration entitled *Notice of Registration and Oregon CAFO General Permit Summary* and will include:
 - (a) The owner or operator's name;
 - (b) Facility name;
 - (c) Contact information (i.e., business and mailing addresses, phone numbers and e-mail address);
 - (d) Effective date of general permit coverage;
 - (e) Maximum number of animals allowed at the facility; and
 - (f) Regulatory status of CAFO (e.g. Large or Medium *concentrated* AFO, state CAFO, etc.)
5. Coverage under this general permit will be canceled as to the particular permittee upon the issuance of an individual permit to that permittee.
6. Except for any toxic effluent standards and prohibitions imposed under section 307 of the federal Clean Water Act (CWA) and groundwater protection requirements established under OAR 340-040, a permittee in compliance with this permit during its term is considered to be in compliance, for purposes of enforcement, with state water quality laws and relevant sections of the CWA, as provided in 40 CFR §122.5. The specific effect of permit compliance on enforcement authority is set out in OAR 340-045-0080.

S1.D. Request for Cancellation

1. Any permittee may request in writing to ODA that coverage under this permit be cancelled if:
 - (a) Conditions or standards have changed so that the source or activity no longer qualifies for this permit;
 - (b) The facility no longer has animals on site and all waste storage and control facilities have been decommissioned in accordance with NRCS conservation practice standard, code 360, entitled *Closure of Waste Impoundments*, dated February 2000; and
 - (c) The permittee certifies that it will not commence operations at the same location without making a new application for registration under this general permit and is granted coverage or applies for and is issued an individual permit.
2. ODA will respond to the request for cancellation by conducting a site inspection and a review of the permit file. The director will notify the permittee in writing of termination of coverage under the general permit or deny the request with an explanation of why the request was denied.

S1.E. Individual Permit Coverage

1. When appropriate, the director may require any person to obtain an individual permit pursuant to OAR 340-045-0033(9). In such cases, the person will be notified in writing by the director. This written notice will include the reason why an individual permit is being required, an application form, the amount of the permit fee due at application, and application due date.
2. If coverage under this permit has been obtained prior to the requirement for an individual permit, this permit will remain effective until the individual permit is issued provided the application for individual permit was properly made.

S1.F. Definitions

1. "25-year, 24-hour rainfall event" or "100-year, 24-hour rainfall event" means an event with a probable recurrence interval of once in twenty-five years or one hundred years, respectively, as defined by the National Weather Service in Technical Paper Number 40, "Rainfall Frequency Atlas of the United States," May 1961, or equivalent regional or state rainfall probability information developed from this source.
2. "40 CFR §122" or "40 CFR §123" or "40 CFR §412" means the Code of Federal Regulations as amended by 68 FR 7176 (2/12/03).
3. "Animal feeding operation" or "AFO" as defined in 40 CFR §122.23(b)(1) means a lot or facility (other than an aquatic animal production facility) where the following conditions are met:
 - (a) Animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and
 - (b) Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.
4. "CAFO" or "Confined animal feeding operation" as defined in OAR 603-074-0010(3) means:
 - (a) The concentrated confined feeding or holding of animals or poultry, including but not limited to horse, cattle, sheep, or swine feeding areas, dairy confinement areas, slaughterhouse or shipping terminal holding pens, poultry and egg production facilities and fur farms;
 - (i) In buildings or in pens or lots where the surface has been prepared with concrete, rock or fibrous material to support animals in wet weather; or
 - (ii) That have wastewater treatment works; or
 - (iii) That discharge any wastes into waters of the state; or
 - (b) An animal feeding operation that is subject to regulation as a concentrated animal feeding operation pursuant to 40 CFR §122.23 (see definition S1.F.5, p. 5 below).
5. "Concentrated animal feeding operation" or "concentrated AFO" as defined by 40 CFR §122.23(b)(2) means an AFO that is defined as a Large or Medium concentrated AFO, or that is designated as a Small concentrated AFO (see definition S1.F.5(c), p. 6 below). Two or more AFOs under common ownership are considered to be a single AFO for the purposes of determining the number of animals at an operation, if they adjoin each other or if they use a common area or system for the disposal of wastes.
 - (a) An AFO is defined as a Large concentrated AFO if it stables or confines as many as or more than the numbers of animals specified in any of the following categories:
 - (i) 700 mature dairy cows, whether milked or dry;
 - (ii) 1,000 veal calves;
 - (iii) 1,000 cattle other than mature dairy cows or veal calves. Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs;
 - (iv) 2,500 swine each weighing 55 pounds or more;
 - (v) 10,000 swine each weighing less than 55 pounds;
 - (vi) 500 horses;
 - (vii) 10,000 sheep or lambs;
 - (viii) 55,000 turkeys;
 - (ix) 30,000 laying hens or broilers, if the AFO uses a liquid manure handling system;
 - (x) 125,000 chickens (other than laying hens) if the AFO uses other than a liquid manure handling system;
 - (xi) 82,000 laying hens, if the AFO uses other than a liquid manure handling system;
 - (xii) 30,000 ducks (if the AFO uses other than a liquid manure handling system); or
 - (xiii) 5,000 ducks (if the AFO uses a liquid manure handling system)
 - (b) An AFO is defined as a Medium concentrated AFO if:
 - (i) The type and number of animals that it stables or confines falls within any of the following ranges:
 1. 200 to 699 mature dairy cattle, whether milked or dry;
 2. 300 to 999 veal calves;

3. 300 to 999 cattle other than mature dairy cows or veal calves. Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs;
 4. 750 to 2,499 swine each weighing 55 pounds or more;
 5. 3,000 to 9,999 swine each weighing less than 55 pounds;
 6. 150 to 499 horses;
 7. 3,000 to 9,999 sheep or lambs;
 8. 16,500 to 54,999 turkeys;
 9. 9,000 to 29,999 laying hens or broilers, if the AFO uses a liquid manure handling system;
 10. 37,500 to 124,999 chickens (other than laying hens), if the AFO uses other than a liquid manure handling system;
 11. 25,000 to 81,999 laying hens, if the AFO uses other than a liquid manure handling system);
 12. 10,000 to 29,999 ducks (if the AFO uses other than a liquid manure handling system); or
 13. 1,500 to 4,999 ducks (if the AFO uses a liquid manure handling system); and
 - (ii) Either one of the following conditions are met:
 1. Pollutants are discharged into waters of the United States through a man-made ditch, flushing system, or other similar man-made device; or
 2. Pollutants are discharged directly into waters of the United States that originate outside of and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation.
 - (c) An AFO is a Small concentrated AFO if it is designated by the director as a concentrated AFO in accordance with the process outlined in 40 CFR §122.23(c) and is not a Medium or Large concentrated AFO.
6. "Director" means the director of the State of Oregon Department of Environmental Quality and the Department of Agriculture or their authorized designee(s).
7. "Discharge" means:
- (a) The discharge of a pollutant;
 - (b) Any addition of any pollutant or combination of pollutants to waters of the state from any point source;
 - (c) A discharge of pollutants into waters of the state through a manmade ditch, flushing system or similar manmade conveyance; or
 - (d) The application of process wastes to land not consistent with the times and/or rates specified in the waste management plan, in a manner that is likely to result in contamination of waters of the state.
8. "Groundwater" and "Underground water" means water in a saturated zone or stratum beneath the surface of land or below a surface water body.
9. "Manure" means manure, bedding, compost and raw materials or other materials commingled with manure or set aside for disposal.
10. "New source" as defined 40 CFR §122.2 means any building, structure, facility, or installation from which there is or may be a "discharge of pollutants," the construction of which commenced after April 14, 2003.
11. "Overflow" means the discharge of manure or process waste water resulting from the filling of waste water or manure storage structures beyond the point at which no more manure, process waste water, or storm water can be contained by the structure.
12. "Person" as defined in OAR 603-074-0010(11) means the United States and agencies thereof, any state, any individual, public or private corporation, political subdivision, governmental agency, municipality, copartnership, association, firm, trust, estate or any other legal entity whatever.
13. "Pollutant" as defined in 40 CFR §122.2 means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 *et*

seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. It does not mean:

- (a) Sewage from vessels; or
 - (b) Water, gas, or other material that is injected into a well to facilitate production of oil or gas, or water derived in association with oil and gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located, and if the state determines that the injection or disposal will not result in the degradation of ground or surface water resources.
14. "Pollution" or "water pollution" as defined in ORS 468.005(3) means such alteration of the physical, chemical or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state, that will or tends to, either by itself or in connection with any other substance, create a public nuisance or that will or tends to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof.
15. "Process waste water" or "process wastes" means water directly or indirectly used in the operation of the CAFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning or flushing pens, barns, manure pits, or other CAFO facilities; direct contact swimming, washing, or spray cooling of animals; or dust control. Process waste water or process wastes also includes any water that comes into contact with any raw materials, products, or byproducts including manure, litter, feed, milk, eggs, or bedding.
16. "Production area" means that part of a CAFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cowyards, barnyards, medication pens, walkers, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, runoff ponds, storage sheds, stockpiles, under house or pit storages, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment areas include but are not limited to settling basins, and areas within berms and diversions that separate uncontaminated storm water. Also included in the definition of production area is any egg washing or egg processing facility, and any area used in the storage, handling, treatment, or disposal of animal mortalities.
17. "Waste Management Plan" or "animal waste management plan" or "AWMP" means a written plan containing the minimum elements necessary to manage manure, litter and process waste water from CAFOs in accordance with the terms and conditions of this permit. See S3.C, p. 10 for specific plan elements.
18. "Wastes" as defined in ORS 468B.005(7) means sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive or other substances that will or may cause pollution or tend to cause pollution of any waters of the state.
19. "Waste storage facilities" means the physical system used for the isolation and retention of process wastes on the confined animal feeding operation until their ultimate utilization.
20. "Waste water control facility" means a "disposal system" or "treatment works" as defined in ORS 468B.005 that may cause pollution of surface water or groundwater and is used for collecting, conveying, treating, stabilizing or storing manure, litter, process waste water, or contaminated production area drainage (i.e., silage leachate, contaminated storm water runoff, etc.) at confined animal feeding operations.
21. "Water" or "waters of the state" as defined in ORS 468B.005(8) include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface or underground waters), that are wholly or partially within or bordering the state or within its jurisdiction.

S2. DISCHARGE LIMITATIONS AND OPERATING REQUIREMENTS

S2.A. Discharge Limitations

The permittee is prohibited from discharging process wastes to surface water or groundwater of the state, except as allowed in S2.B and S2.C and provided these discharges do not cause or contribute to a violation of state water quality standards. Discharges to surface water due to upset or bypass are authorized only in accordance with applicable requirements in G3, p. 15, and G4, p. 16.

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

S2.B. Production Area Limitations

1. For all CAFOs, except new source swine, poultry, and veal Large concentrated AFOs: Discharges of process waste water to surface waters of the state are prohibited, except when rainfall events cause an overflow of process waste water from a facility designed, constructed, operated, and maintained to contain all process-generated waste waters plus the runoff and direct precipitation from a 25-year, 24-hour rainfall event.
2. For new source swine, poultry, and veal Large concentrated AFOs: Discharges of process waste water to surface waters of the state are prohibited, except when rainfall events cause an overflow of process waste water from a facility designed, constructed, operated, and maintained to contain all process-generated waste waters plus the runoff and direct precipitation from a 100-year, 24-hour rainfall event.
3. All authorized discharges from the production area must be properly land applied or otherwise handled in a way that minimizes impacts on surface water or groundwater of the state.
4. Seepage to groundwater from waste storage or animal confinement facilities must not exceed design rates as approved by ODA or violate state groundwater quality protection standards.

S2.C. Land Application Limitations

1. When applying manure, litter, and process wastes to lands, the permittee must apply at agronomic rates in accordance with proper agricultural practices. If a waste management plan has been approved by ODA, applications must also be performed as specified in that plan. Land application areas include land under the control of the permittee, whether it is owned, rented, or leased, to which manure, litter, or process waste water from the production area is or may be applied.
2. Waste applications must not exceed the capacity of the soil and crops to assimilate nutrients and minimize water pollution, must be quantifiable, and based on the NRCS Phosphorous Index, Agronomy Technical Note #26, revised October 2001, and must account for all other nitrogen, phosphorus, and potassium sources.
3. Discharges to groundwater due to seepage below the root zone of the crop or by other means must not violate state groundwater quality protection standards.
4. If discharge to surface water or groundwater will result, application to flooded, saturated, frozen or snow covered land is prohibited. Land application of wastes or waste water during rainfall events that are expected to result in saturated soils or surface runoff is prohibited.

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

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

S2.E. Waste Storage Facilities

1. The permittee must provide adequate storage capacity for solid and liquid wastes at all times so that land application occurs only during periods when soil and weather conditions allow for agronomic application and are in compliance with the Land Application Limitations in Condition S2.C, p. 8 of this permit.
2. The permittee must site, design, construct, operate, and maintain all waste storage facilities consistent with the waste management plan. New and modified construction of waste facilities must be approved in advance and prior to construction by ODA in conformance with ORS 468B.055, OAR 340-051 and 603-074.
3. The permittee with a Large *concentrated* AFO must also have depth markers in all surface liquid impoundments (e.g., lagoons, ponds, tanks) designed to clearly indicate the:
 - (a) Maximum design volume,
 - (b) Minimum capacity necessary to contain the 25-year, 24-hour rainfall event, or in the case of new source swine, poultry, and veal Large *concentrated* AFOs, the 100-year, 24-hour rainfall event, including additional freeboard requirements, and
 - (c) Depth of manure and process waste water.

S2.F. Prevention of System Overloading

1. The permittee may not increase the number of animals over 10% or 25 animals, whichever is greater, of the maximum number assigned by ODA in the *Notice of Registration and General Permit Summary* until an updated plan is approved in writing by ODA (see S3.B Plan Submittal, p. 10, and S3.D Plan Updates, p. 11).
2. Animal numbers must not exceed the capacity of the waste storage facilities.

S2.G. Handling of Animal Mortalities

The permittee must not dispose of animal mortalities in liquid manure or waste water control facilities. Animal mortalities must be handled in such a way as to prevent discharge of pollutants to surface water or groundwater.

S2.H. Proper Operation and Maintenance

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

S2.I. Maintaining Compliance if System Fails

The permittee, in order to maintain compliance with the permit, must control all applications and discharges upon reduction, loss or failure of the waste storage or utilization facilities until the facilities are restored or an alternative method of storage or utilization is provided. This requirement applies where the primary source of power is reduced, lost, or fails.

S2.J. Setback Requirement for Large *Concentrated* AFOs

In addition to the above conditions, the permittee with a Large *concentrated* AFO must, in the land application area(s), maintain a setback area within 100 feet of any down-gradient surface waters, open tile line intake structures, sinkholes, agricultural well heads, or other conduits to surface waters where manure, litter, and other process waste waters are prohibited. As a compliance alternative, and if demonstrated to the satisfaction of ODA, the permittee may:

1. Establish a 35-foot vegetated buffer where manure, litter, and other process waste waters are prohibited; or
2. Demonstrate that a setback or vegetated buffer is not necessary or may be reduced.

S3. WASTE MANAGEMENT PLANS

S3.A. Plan Implementation and Compliance

1. Upon receipt of notification by ODA or by December 31, 2006, whichever occurs first, the permittee must implement a current waste management plan developed for its CAFO.
2. The permittee must comply with all terms and conditions of its approved waste management plan. Failure to comply with the approved plan constitutes a violation of the terms and conditions of this permit.
3. Absence of a plan or absence of ODA approval of a plan does not allow the permittee to violate the provisions of S2 Discharge Limitations and Operating Requirements, p. 8 or other permit requirements.

S3.B. Plan Submittal

1. Plans must be submitted to ODA for review and approval according to the following schedule:
 - (a) Newly constructed and new source CAFOs must submit a waste management plan with the ATR.
 - (b) Existing CAFOs must submit a current waste management plan for the facility upon notification by ODA or by July 1, 2006, whichever occurs first.
2. Updates to plans (see S3.D Plan Updates, p. 11) must be submitted to ODA for approval at least 45 days before the facility expansion, production increase or process modification is to be implemented unless a different schedule is allowed by ODA in writing.

S3.C. Plan Elements

1. The waste management plan must be adequate for the existing population of animals and be prepared in accordance with the terms and conditions of this permit, OAR 340-051, and NRCS conservation practice standard guidance 590 for Oregon dated May 2001 entitled *Nutrient Management*.
2. The waste management plan may include a schedule for improvement projects.
3. The waste management plan must to the extent applicable:
 - (a) Ensure adequate collection, handling, and storage of manure, litter and process waste water;
 - (b) Include procedures to ensure proper operation and maintenance of the storage facilities;
 - (c) Ensure proper management of animal mortalities to ensure that they are not disposed of in a liquid manure, storm water, or process waste water storage or treatment system that is not specifically designed to treat animal mortalities;
 - (d) Ensure that clean water is diverted, as appropriate, from the production area;
 - (e) Prevent direct contact of confined animals with surface waters;
 - (f) Ensure that chemicals and other contaminants handled on-site, are not disposed of in any manure, litter, process waste water, or storm water storage or treatment system unless specifically designed to treat such chemicals and other contaminants;
 - (g) Identify appropriate site-specific conservation practices to be implemented, including as appropriate buffers or equivalent practices, to control runoff of pollutants to surface water and groundwater;
 - (h) Establish protocols to land apply manure, litter or process waste water in accordance with site specific nutrient management practices that ensure appropriate agricultural utilization of the nutrients in the manure, litter or process waste water. For Large *concentrated* AFOs, these protocols must be based on actual test data. For other CAFOs, data or "book values" from established reference sources (e.g., Oregon Animal Waste Management program) may be used instead of actual testing;
 - (i) For Large *concentrated* AFOs, also identify protocols for appropriate testing of manure, litter, process waste water, and soil. For other CAFOs, identify the references used instead of actual testing data or test protocols if testing; and
 - (j) Identify specific records that will be maintained to document the implementation and management of the minimum elements described above.

S3.D. Plan Updates

1. The permittee must update the waste management plan when facility expansions, production increases, or process modifications will:
 - (a) Result in new or increased generation of waste, litter, or process waste water beyond the scope of the current waste management plan, or
 - (b) Violate the terms and conditions of this permit.
2. The updated waste management plan must be submitted to ODA for approval (see S3.B.2, p. 10, above).
3. The permittee may not increase the number of animals over 10% or 25 animals, whichever is greater, of the maximum number assigned by ODA in the *Notice of Registration and General Permit Summary* until an updated plan is approved in writing by ODA.

S4. MONITORING, INSPECTION, RECORDKEEPING, AND REPORTING REQUIREMENTS

S4.A. Monitoring Requirements

1. Discharge Monitoring If a discharge to surface or groundwaters occurs that is not allowed by Condition S2.B or S2.C, p. 8, the permittee must record the following information:
 - (a) A description and cause of the discharge;
 - (b) The period of discharge including exact dates, times and duration of discharge;
 - (c) An estimate of discharge volume;
 - (d) Name or location of receiving water; and
 - (e) Corrective steps taken, if appropriate, to reduce, eliminate or prevent reoccurrence of the discharge.
2. Analytical Monitoring for Large concentrated AFOs
The permittee with a Large *concentrated* AFO, must conduct the following:
 - (a) Collect and analyze manure, litter, and other process waste waters annually for nutrient content, including nitrogen and phosphorus.
 - (b) At least once during the term of this permit, collect and analyze representative soil samples for phosphorus and nitrogen content from all fields where manure, litter, and other process waste waters are applied.
3. Analytical Monitoring for all other CAFOs At least once during the term of this permit, the permittee must collect and analyze representative soil samples for phosphorus and nitrogen content from all fields where manure, litter, and other process waste waters are applied.

S4.B. Inspection Requirements

The permittee must:

1. Periodically inspect of all storm water diversion devices, runoff diversion structures, animal waste storage structures, and devices channeling contaminated storm water to the waste water and manure storage and containment structure. The permittee with a Large *concentrated* AFO must conduct and record these inspections weekly.
2. Periodically inspect water lines, including drinking water or cooling water lines. The permittee with a Large *concentrated* AFO must conduct and record these inspections daily.
3. Periodically conduct leak inspections of equipment used for land application of manure, litter, or process waste water. The permittee with a Large *concentrated* AFO must record the results of these periodic inspections.
4. The permittee with a Large *concentrated* AFO must inspect liquid impoundments for manure and process waste water on a weekly basis and record the depth of manure and process waste water in those impoundments as indicated by the depth marker required by S2.E.3, p. 9.
5. Any deficiencies found as a result of these inspections must be corrected as soon as possible. The permittee with a Large *concentrated* AFO must record any actions taken to correct these deficiencies and, if deficiencies are not corrected within 30 days, provide an explanation of the factors preventing immediate correction.

S4.C. Record Keeping and Availability Requirements

1. The permittee must maintain all information required by this permit at the facility for at least five years and make this information available to ODA upon request.
2. Upon obtaining general permit coverage, Large *concentrated* AFOs must begin recording the following

information. Other CAFOs must begin recording the following information upon ODA approval of the waste management plan or by December 31, 2006, whichever occurs first. The permittee must maintain this information at the facility for at least five years and make this information available to ODA upon request.

(Note: If any of the following information is provided in the permittee's waste management plan, a separate record keeping effort is not required.)

- (a) Expected crop yields.
- (b) Date, amount, and nutrient loading of manure, litter, or process waste water applied to each field.
- (c) For Large *concentrated* AFOs, weather conditions at the time of application and 24 hours before and after application.
- (d) Explanation of the basis for determining annual manure application rates, as provided in the technical standards established by ODA.
- (e) Calculations showing the total nitrogen and phosphorus to be applied annually to each field, including sources other than manure, litter, or process waste water.
- (f) Total amount of nitrogen and phosphorus actually applied annually to each field, including documentation of calculations of the total amount applied.
- (g) Method(s) used to apply the manure, litter, or process waste water.
- (h) Total amount of manure or waste water transferred to other persons. Large *concentrated* AFOs must also include the date and amount of each transfer and the name and address of each recipient.
- (i) For Large *concentrated* AFOs, animal mortalities management and practices used to meet the requirements of S2.G, p. 9.

S4.D. Reporting Requirements

1. 24-hour Reporting

- (a) If a discharge to surface water or groundwater occurs that is not allowed by Condition S2.B and S2.C, p. 8, the permittee must notify ODA within 24 hours of the discharge.

The permittee must submit a written report within five (5) days to ODA. The information to be submitted is listed in the monitoring requirements (Condition S4.A, p. 12 above) of this permit.

- (b) The permittee must report to ODA within 24 hours of becoming aware of any significant physical failure at any time of a waste water control facility required under this permit.

2. Annual Report The permittee must submit an annual report by March 15 of each year to ODA. The annual report must include the following for the previous calendar year:

- (a) Maximum number and type of animals, whether in open confinement or housed under roof (i.e., beef cattle, broilers, layers, swine weighing 55 pounds or more, swine weighing less than 55 pounds, mature dairy cows, dairy heifers, veal calves, sheep and lambs, horses, ducks, turkeys, other);
- (b) Estimated amount of total manure, litter and process waste water generated by the CAFO (tons/gallons);
- (c) Estimated amount of total manure, litter and process waste water transferred to other persons by the CAFO (tons/gallons);
- (d) Total number of acres for land application covered by the waste management plan developed in accordance with the terms of this permit;
- (e) Total number of acres under control of the CAFO that were used for land application of manure, litter and process waste water in the previous 12 months;
- (f) Summary of all manure, litter and process waste water discharges from the production area that have occurred, including date, time and approximate volume; and
- (g) If the CAFO has a current waste management plan, a statement indicating whether the plan was developed or approved by a certified waste management planner.

3. Manure, Litter, or Process Waste Water Transfers Prior to transferring manure, litter, or process waste water to other persons, Large *concentrated* AFOs must provide the recipient of manure, litter, or process wastewater with the most current nutrient analysis available.

S4.E. Additional Monitoring

ODA may establish specific monitoring requirements in addition to those contained in this permit by administrative order. An administrative order is an agency action expressed in writing directed to a named person or named persons (ORS 183.310).

GENERAL CONDITIONS

G1. Discharge Violations

All land application of wastes and other activities authorized by this permit must be consistent with the terms and conditions of this permit. The application or discharge of any process waste more frequently than, or at a concentration in excess of, that authorized by this permit will constitute a violation of the terms and conditions of this permit.

G2. Noncompliance Notification

- A. If for any reason, the permittee does not comply with, or will be unable to comply with any of the requirements or conditions specified in the permit, the permittee must, at a minimum, provide ODA with the following information:
 1. A description of the nature and cause of noncompliance, including the quantity and quality of any unauthorized waste discharges;
 2. The period of noncompliance, including exact dates and times, and the anticipated time when the permittee will return to compliance; and
 3. The steps taken, or to be taken to reduce, eliminate, and prevent recurrence of the noncompliance.
- B. In addition, the permittee must take immediate action to stop, contain, and clean up any unauthorized discharges and take all reasonable steps to minimize any adverse impacts to waters of the state and correct the problem. The permittee must notify ODA by telephone so that an investigation may be made to evaluate any resulting impacts and the corrective actions taken to determine if additional action should be taken.
- C. In the case of any discharge subject to any applicable toxic pollutant effluent standard under Section 307(a) of the Clean Water Act, or that could constitute a threat to human health, welfare, or the environment, 40 CFR §122 requires that the information specified in conditions G2.A.1, G2.A.2, and G2.A.3 above, be provided not later than 24 hours from the time the permittee becomes aware of the circumstances. If this information is provided orally, a written submission covering these points must be provided within five days of the time the permittee becomes aware of the circumstances, unless ODA waives or extends this requirement on a case-by-case basis.
- D. Compliance with these requirements does not relieve the permittee from responsibility to maintain continuous compliance with the conditions of this permit or resulting liability for failure to comply.

G3. Bypass

- A. Definitions.
 1. "Bypass" means intentional diversion of waste streams from any portion of the treatment facility. The term "bypass" does not include nonuse of singular or multiple units or processes of a treatment works when the nonuse is insignificant to the quality and/or quantity of the effluent produced by the treatment works. The term "bypass" does not apply if the diversion does not cause effluent limitations to be exceeded, provided the diversion is to allow essential maintenance to assure efficient operation.
 2. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities or treatment processes that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
- B. Prohibition of bypass.
 1. Bypass is prohibited unless:
 - (a) Bypass was necessary to prevent loss of life, personal injury, or severe property damage;
 - (b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventative maintenance; and

- (c) The permittee submitted notices and requests as required under G3.C below.
- 2. The director may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, when the director determines that it will meet the three conditions listed above in G3.B.1.

C. Notice and request for bypass.

- 1. Anticipated bypass. If the permittee knows in advance of the need for a bypass, the permittee must submit prior written notice, if possible at least ten days before the date of the bypass.
- 2. Unanticipated bypass. The permittee must submit notice of an unanticipated bypass as required in S4.D.1.

G4. Upset

A. Definition.

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operation error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

B. Effect of an upset.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of G4.C are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

C. Conditions necessary for a demonstration of upset.

A permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

- 1. An upset occurred and that the permittee can identify the causes(s) of the upset;
- 2. The permitted facility was at the time being properly operated;
- 3. The permittee submitted notice of the upset as required in S4.D.1; and
- 4. The permittee complied with any remedial measures required under G2.B.

D. Burden of proof.

In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

G5. Right of Inspection

The permittee must allow the director or an authorized representative of the director, upon the presentation of credentials and such other documents as may be required by law:

- A. To enter upon the property where a potential or actual discharge is located;
- B. To have access to and copy at reasonable times any records that must be kept under the terms of the permit;
- C. To inspect at reasonable times any monitoring equipment or method of monitoring required in the permit;
- D. To inspect at reasonable times any collection, treatment, pollution management, or application facilities; and
- E. To sample any waters of the state or discharge of pollutants.

G6. Permit Registration Modified or Revoked

- A. After notice, registration under this permit may be modified or revoked as it applies to any person for cause as follows:

- 1. Violation of any terms or conditions of the permit;
- 2. Failure of the permittee to disclose fully all relevant facts, or misrepresentations of any relevant facts by the permittee during the permit issuance process and during the life of the permit;
- 3. Failure to pay permit fees when due;
- 4. Information indicating that the permitted operation poses a threat to human health or welfare;

5. A change in ownership or control of the operation, or
6. Other causes listed in 40 CFR §122.62 and 122.63.

- B. Modification or revocation of coverage under this permit as it applies to any person may be initiated by ODA.
- C. Issuance of coverage under an individual permit may be initiated by ODA in accordance with Condition S1.E.

G7. Revocation for Non-Payment of Fees

The director may revoke registration under this permit if the permit fees established under Oregon Administrative Rules are not paid when due.

G8. Compliance With Other Laws and Statutes

Nothing in the permit will be construed as excusing the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G9. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and have the permit renewed. The application must be submitted at least 180 days before the expiration date of this permit. The director may grant permission in writing to submit an application less than 180 days in advance but no later than the permit expiration date.

G10. Change of Ownership or Control

The permittee must notify ODA in writing thirty (30) days prior to a change in facility ownership or control.

G11. Other Requirements of 40 CFR

All other requirements of 40 CFR §122.41 *Conditions applicable to all permits* and §122.42 *Additional conditions applicable to specified categories of NPDES permits* are incorporated in this permit by reference.

RECORD KEEPING

Records are to be kept for a minimum of 5 years or the length of the cropping rotation, whichever is longer. The AFOPro software used to generate this plan has a utility for keeping records associated with this plan or copies of the worksheets provided in this section can be used to keep records. Records shall include the following information:

1. Annual Manure Testing (Refer to the Nutrient Management and Waste Utilization specification located in Section 11 for guidance in sampling and testing manure).
2. Soil test results (Refer to Pacific Northwest Extension Publication PNW 570-E "Monitoring Soil Nutrients Using a Management Unit Approach" located in Section 13 for guidance in soil testing).
3. Application Records for each manure, wastewater or commercial fertilizer application event, including:
 - ☐ Containment source or type and form of commercial fertilizer,
 - ☐ Field(s) where manure or organic by-products are applied,
 - ☐ Amount of manure solids and wastewater applied per acre,
 - ☐ Calculations of nutrients applied per acre (see worksheets in the Nutrient Management and Waste Utilization specification located in Section 11),
 - ☐ Time and date of application,
 - ☐ Weather conditions during nutrient applications,
 - ☐ General soil moisture conditions and time of application (i.e., saturated, wet, moist, dry), and
 - ☐ Application method and equipment used.
4. Crops planted and planting and/or harvesting dates, by field.
5. Records that address manure and wastewater storage containment structures:
 - ☐ Dates of emptying, level before emptying and level after emptying,
 - ☐ Discharges or overflow events, including level before and after event.
6. Transfer of manure and organic by-products off-farm or to third parties:
 - ☐ Manure solids and wastewater nutrient content,
 - ☐ Amount of manure solids and wastewater transferred,
 - ☐ Date of transfer, and
 - ☐ Recipient of manure solids, wastewater or organic by-products.
7. Activities associated with emergency spill response plan.
8. Records associated with any reviews by NRCS, third-party consultants, or representatives of regulatory agencies:
 - ☐ Dates of review,
 - ☐ Name of reviewer and purpose of the review,
 - ☐ Recommendations or follow-up requirements resulting from the review, and
 - ☐ Actions taken as a result of the review.
9. Records of maintenance performed associated with operation and maintenance plans (Refer to guidance in the Operation and Maintenance section for existing and planned practices).
10. Nutrient application equipment calibrations (Refer to guidance in the Nutrient Management and Waste Utilization specification in Section 11).
11. Changes made to this plan.

Date	Name of Person Who Took Sample	Source (Pond, Drystack etc)	Nutrient Concentration (G-lbs/1000 Gallons or T-lbs/Ton)			
			N	P ₂ O ₅	K ₂ O	Units

NOTES:

Multiply pounds of P by 2.3 to get pounds of P_2O_5 . Multiply pounds of K by 1.2 to get pounds of K_2O .

RECORD KEEPING

Soil Sampling Worksheet for Schoch Dairy

Name of Person Who Sampled Soils: _____ Date: _____

Soil Test Information						
Tract number:		Field Number(s):		Total Acres:		
Current Crop:		Yield Goal:				
Soil Test Information						
Soil Test ID	N	P	K	pH	% Organic Matter	Other

NOTES:

Refer to the Nutrient Management and Waste Utilization specification located in Section 11 for guidance in sampling and testing soils.

Field Application Worksheet for Schoch Dairy

Name: _____ Date: _____

[illegible]

* Units and Formulations must be consistent. For commercial fertilizer, units should be lbs and formulation should be %. For solid manure, units should be tons and formulation should be lbs/ton. For liquid manure, units should be ac-in and formulation should be lbs/1000 gal. Multiply pounds of P by 2.3 to get pounds of P_2O_5 . Multiply pounds of K by 1.2 to get pounds of K_2O .

[illegible]

NOTES:

Multiply pounds of P by 2.3 to get pounds of P_2O_5 . Multiply pounds of K by 1.2 to get pounds of K_2O .

RECORD KEEPING**Spill Log for Schoch Dairy**

Date	Source of Spill	Report filed with ODA (Yes/No)	Cleanup Completed by:	Date

NOTES:

See following dated spill report for details of spills.

[illegible]

NOTES:

SchochCNMP.doc

RECORD KEEPING

Record of Operation and Maintenance Inspections for Schoch Dairy

[illegible]

See Operation and Maintenance guidelines in Section * for action items. Record corrective actions needed and taken under notes.

[illegible]

NOTES:

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RECORD KEEPING

ANIMAL MORTALITY MANAGEMENT SPECIFICATION for Schoch Dairy

Prepared for:

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Prepared by:

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

Currently animal mortalities for this operation are being disposed of by a rendering facility.

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

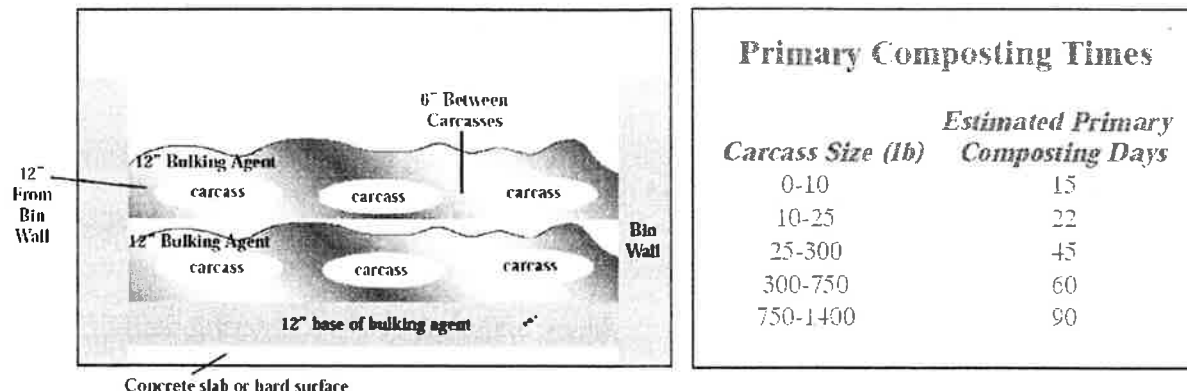
Composting- Rapid composting of dead animals occurs when the carbon to nitrogen (C:N) ratio of the compost mix ranges between 10 and 20 to 1. To achieve the recommended C:N ratio, build the initial compost pile by placing 18 inches of sawdust or other bulking agent on the floor of the composting area.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

Once the bulking agent has been placed on the floor of the composting area, place the animal carcass on top. To decrease composting time and prevent bloating the body cavity should be cut open. Cover the carcass with 1 to 3 feet of separated manure solids or other material that has a moisture content between 30 to 60 percent and a C:N ratio of not more than 30 to 1. Use 1 foot of material for small carcasses and 3 feet for large carcasses such as cattle. Be careful not to add material that is too wet as it will hinder the composting process and cause odors. Small animals can be layered in a compost pile by placing 12 inches of the bulking agent between layers as shown in the figure below. Be sure the total height of the compost pile does not exceed 7 feet in height as it may spontaneously combust causing a fire.

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

ANIMAL MORTALITY MANAGEMENT SPECIFICATION for Schoch Dairy

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



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

After the composting process is finished, it may be used as a bulking agent for a new compost pile. A rule of thumb is to use 50 percent of the composted material for a bulking agent but you may want to use more or less depending on how degraded the bulking agent is in the finished compost. Using finished compost in a new compost pile reduces the amount of bulking agent needed for the new pile and provides microbial inoculants to get the composting process started.

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

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

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

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

ANIMAL MORTALITY MANAGEMENT SPECIFICATION **for Schoch Dairy**

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

ANIMAL MORTALITY MANAGEMENT SPECIFICATION
for Schoch Dairy

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION

for Schoch Dairy

Prepared for:

Dave and Casey Schoch
24335 NW West Union Road
Hillsboro, OR 97124
(503) 647-2638

Prepared by:

Jennifer Zwicke
1561 NE Greensword Dr.
Hillsboro, OR 97124
(443) 621-2189

Fields: Field 2 and Field 3

(See plan map in Section 5)

Acres: 52.15

Location:

Date: September 12, 2006

1.) GENERAL CONSIDERATIONS:

Purpose: Irrigation water management is applied as part of a conservation management system to support one or more of the following:

- Manage soil moisture to promote desired crop response
- Optimize use of available water supplies
- Minimize irrigation induced soil erosion
- Decrease non-point source pollution of surface and groundwater resources
- Manage air, soil, or plant micro-climate

Threatened and Endangered Species: If USDA cost-sharing will be provided, a Biological Evaluation (BE) for this practice demonstrating No Effect on species listed under the Endangered Species Act will be approved by NRCS before this practice begins.

Cultural Resources: This practice will not affect cultural resources; only cropland will be affected and soil will not be disturbed below the plow layer. This practice is not an undertaking as defined under NRCS Cultural Resources policy.

Permits: Under Oregon law all water is publicly owned and anyone planning to store or divert surface or groundwater for the purpose of irrigation must obtain a permit or water right from the Oregon Water Resources Department. These permits or water rights must be obtained prior to the use of the water. It is the responsibility of the Farmer to file for the necessary permits or water rights.

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Following are the basic formulas that may be helpful to apply the principles of irrigation water management:

Equation 1:

$$Q * T = d * A$$

where:

Q = flow rate (cfs or acre-in/hr)

T = time (hr)

d = gross depth applied (in)

A = area (acres)

Equation 2:

$$Q = \frac{453 * A * d}{f * H}$$

where:

Q = flow rate (gpm)

A = area (acres)

d = gross application depth (in)

f = irrigation frequency (days)

H = hours of operation per day

Water Flow Rates:

1 cubic foot per second (cfs)

= 448.8 gallons per minute

1 cfs for 1 hour = 0.99 acre-inch

1 cfs for 24 hr = 1.98 acre-ft

1,000 gpm = 2.23 cfs

1,000 gpm for 24 hr = 4.42 ac-ft

1 cfs = 40 miner's inches in

OR, AZ, MT, No. CA

1 cfs = 50 miner's inches in

ID, KS, NE, NM, ND, SD, So. CA

1 cfs = 38.4 miner's inches in CO

1 cfs = 28.32 liters/sec

1 cfs = 0.02832 cubic meters/s

1 cubic meter/sec = 35.3 cfs

1 liter/sec = 15.85 gpm

Pump Power Requirement:

Horsepower =

$\frac{\text{Pump Head in ft} * \text{gpm}}{3960 * \text{Pump Efficiency}}$

Water Volumes & Weights:

1 cubic foot = 7.48 gallons

= 62.4 lb

= 28.3 liters

1 acre-foot = 43,560 cubic feet

(1 acre covered 1 ft deep)

12 acre-inches = 1 acre-ft

1 million gallons = 3.07 acre-ft

1 acre-ft = 1,234 cubic meters

1 cubic meter = 1,000 liters

Pressure and Pressure Head:

1 psi = 2.31 ft of pressure head

1 atmosphere (sea level)

= 14.7 psi = 33.9 ft of head

Lengths and Areas:

1 mile = 5,280 ft = 1.61 km

1 meter = 3.28 ft = 39.37 inches

1 acre = 43,560 square ft

1 hectare = 2.47 acres

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

2.) EQUIP INCENTIVE PAYMENT:

This practice may be eligible for USDA cost-sharing. Please see the EQIP contract for details on cost-share rates. The participant must contact USDA-NRCS before beginning this practice if cost-sharing will be provided.

3.) SOILS:

See page 32 or page 126 of the Comprehensive Nutrient Management Plan (CNMP) for soils information.

4.) CROPS:

CROP	MATURE ROOT DEPTH (INCHES)	MAXIMUM ALLOWED DEPLETION	CRITICAL PERIOD
Grass Pasture/Hay	30	50%	July
Corn Silage	48	50%	July

Above data are from EM8713, *Western Oregon Irrigation Guides*, June 1998, OSU: Corvallis, OR and NRCS *Irrigation Guide (National Engineering Handbook, Part 652)*.

5.) IRRIGATION SYSTEM:

System	Flow (gpm)	Nozzle Size (in)	Pressure (psi)	Spacing (ft)	Application Rate (in/hr)
Big Gun Sprinkler	230	1.0	60	200	0.5

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

6.) TYPE OF MONITORING SYSTEM:

- ☐ Radio-relayed (remote access) capacitance probes.
- ☐ Gypsum blocks (recorded at least twice per week during irrigation season).
- ☐ Check-book method using daily data from Agri-met.
- ☐ Monitoring of plant appearance. Note: this level of monitoring is not sufficient for USDA cost-sharing.
- ☒ "Feel and Appearance Method" is digging soil in the root zone and then physically squeezing the soil to determine moisture level. Note: this level of monitoring is not sufficient for USDA cost-sharing.

The "Feel and Appearance Method" shown on the next page is one of several irrigation scheduling methods used in IWM. It is a way of monitoring soil moisture to determine when to irrigate and how much water to apply. Applying too much water causes excessive runoff and/or deep percolation. As a result, valuable water is lost along with nutrients and chemicals, which may leach into the ground water.

The feel and appearance of soil vary with texture and moisture content. Soil moisture conditions can be estimated, with experience, to an accuracy of about 5 percent. Soil moisture is typically sampled in one-foot increments to the root depth of the crop at three or more sites per field. It is best to vary the number of sample sites and depths according to crop, field size, soil texture, and soil stratification. For each sample the "Feel and Appearance Method" involves:

1. Obtaining a soil sample at the selected depth using a probe, auger, or shovel,
2. Squeezing the soil sample firmly in your hand several times to form an irregularly shaped "ball";
3. Squeezing the soil sample out of your hand between thumb and forefinger to form a ribbon;
4. Observing soil texture, ability to ribbon, firmness and surface roughness of ball, water glistening, loose soil particles, soil/water staining on fingers, and soil color. [Note: A very weak ball will disintegrate with one bounce of the hand. A weak ball disintegrates with two to three bounces];
5. Comparing observations with photographs and/or charts to estimate percent water available and the inches depleted below field capacity.

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

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Above data are from EM8713, *Western Oregon Irrigation Guides*, June 1998, OSU: Corvallis, OR and NRCS *Irrigation Guide (National Engineering Handbook, Part 652)*.

5.) IRRIGATION SYSTEM:

System	Flow (gpm)	Nozzle Size (in)	Pressure (psi)	Spacing (ft)	Application Rate (in/hr)
Stationary Big Gun Sprinkler	230	1.0	60	200	0.7

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

6.) TYPE OF MONITORING SYSTEM:

- ☐ Radio-relayed (remote access) capacitance probes.
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- ☐ Check-book method using daily data from Agri-met.
- ☐ Monitoring of plant appearance. Note: this level of monitoring is not sufficient for USDA cost-sharing.
- ☒ "Feel and Appearance Method" is digging soil in the root zone and then physically squeezing the soil to determine moisture level. Note: this level of monitoring is not sufficient for USDA cost-sharing.

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1. Obtaining a soil sample at the selected depth using a probe, auger, or shovel;
2. Squeezing the soil sample firmly in your hand several times to form an irregularly shaped "ball";
3. Squeezing the soil sample out of your hand between thumb and forefinger to form a ribbon;
4. Observing soil texture, ability to ribbon, firmness and surface roughness of ball, water glistening, loose soil particles, soil/water staining on fingers, and soil color. [Note: A very weak ball will disintegrate with one bounce of the hand. A weak ball disintegrates with two to three bounces];
5. Comparing observations with photographs and/or charts to estimate percent water available and the inches depleted below field capacity.

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

FEEL AND APPEARANCE METHOD OF DETERMINING SOIL MOISTURE

Clay, Clay Loam, and Silty Clay Loam Soils

Appearance of Clay, Clay Loam, and Silty Clay Loam Soils at Various Soil Moisture Conditions

AVAILABLE WATER CAPACITY = 1.6 TO 2.4 INCHES PER FOOT

Percent Available: Currently available soil moisture as a percent of available water capacity.

Inches per Foot Depleted: Inches of water needed to refill a foot of soil to field capacity.

0 TO 25 PERCENT AVAILABLE 2.4 TO 1.2 INCHES PER FOOT DEPLETED

Dry, soil aggregations separate easily, clods are hard to crumble with applied pressure. (Not pictured)

25 TO 50 PERCENT AVAILABLE 1.8 TO 0.8 INCHES PER FOOT DEPLETED

Slightly moist, forms a weak ball, very few soil aggregations break away, no water stains, clods flatten with applied pressure.



50 TO 75 PERCENT AVAILABLE 1.2 TO 0.4 INCHES PER FOOT DEPLETED

Moist, forms a smooth ball with defined finger marks, light soil/water staining on fingers, ribbons between thumb and forefinger.



75 TO 100 PERCENT AVAILABLE 0.6 TO 0.0 INCHES PER FOOT DEPLETED

Wet, forms a ball, uneven medium to heavy soil/water coating on fingers, ribbons easily between thumb and forefinger.



7.) SENSOR INSTALLATION:

If soil moisture sensors will be used for soil moisture monitoring, install them according to the following schedule:

# OF SITES	SENSORS/SITE	TOTAL SENSORS	DEPTHS

Notes:

8.) FARMER RESPONSIBILITIES:

- Regularly check soil moisture or crop evapotranspiration data and use this information to help decide when and how much to irrigate.
- Record irrigation, liquid manure application and rainfall data through irrigation season.
- If USDA cost-sharing is provided: Complete irrigation system calibration and irrigation system walk-through. Contact NRCS for more information.

This practice is job class: **II**

Approved by:

SchochCNMP.doc

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Farmer Acknowledgement Statement:

- a. The Farmer has received a copy of the specification and understands the contents and requirements.
- a. The Farmer will provide to NRCS the following information before this practice can be certified for cost-sharing approval:
- ☐ Irrigation water application records which include the dates and amounts of water applied.
 - ☐ Documentation showing the irrigation scheduling technique used.
 - ☐ Documentation showing an evaluation of the irrigation system.

Dave and Casey Schoch

Date

10.) PRACTICE COMPLETION CHECKLIST:

<i>Year</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>
Record Keeping					
Water applied at correct agronomic rate					
Water applied at correct time					
Calibration					
System walk-thru completed					
Does the practice meet specifications?	Yes No	Yes No	Yes No	Yes No	Yes No
NRCS Initials					
Date					

Rating System Used	E = Excellent	G = Good	F = Fair ¹	P = Poor ¹
¹ : Application at this level may not meet NRCS standards.				

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Irrigation Water Management Worksheet						
Crop Name:	Pasture/Hay Land					
Managed Rooting Depth:	30 inches					
Management Allowed Depletion, MAD:	50 %					
Irrigated Acres:	52					
Soil Name:	Helvetia					
Soil Depth (inches):	48					
Available Water Capacity (in/in):	0.18					
Soil Intake Rate (in/hr) :	0.5					
IRRIGATION REQUIREMENT HOW MUCH water to apply?	Month					
	April	May	June	July	August	Sept
Total Plant Available Water Capacity (in): <small>Soil on Root Depth * Available Water Capacity</small>	5.40	5.40	5.40	5.40	5.40	5.40
Net Irrigation Application (in): <small>Total Plant Available Water Capacity * MAD</small>	2.70	2.70	2.70	2.70	2.70	2.70
Irrigation System Application Rate (in/hr): <small>Determined based on the type of Irrigation System</small>	0.38	0.38	0.38	0.38	0.38	0.38
IRRIGATION TIMING WHEN to apply water?						
Net Irrigation Water Requirement (in):	1.57	3.15	4.57	6.22	5.12	3.46
Average Daily Crop Water Use (in/day):	0.05	0.10	0.15	0.20	0.17	0.12
Irrigation Frequency (days): <small>Net Irrigation Application / Daily Crop Water Use</small>	30	27	18	14	16	23
Irrigation System Set Time (hours):	7.5	7.5	7.5	7.5	7.5	7.5
Actual Net Irrigation Application (in): <small>Gross Application * System Application Efficiency</small>	2.00	2.00	2.00	2.00	2.00	2.00
Actual Irrigation Frequency (days): <small>Actual Net Irrigation Application / Daily Crop Water Use</small>	30	20	13	10	12	17
IRRIGATION SYSTEM CAPACITY						
System Application Efficiency (%): <small>Water Required / Water Applied</small>	70	70	70	70	70	70
Gross Irrigation Application (in): <small>System Application Rate * System Set Time</small>	2.85	2.85	2.85	2.85	2.85	2.85
Volume of Water per Irrigation (acre-in): <small>Gross Irrigation Application * Irrigated Acres</small>	148	148	148	148	148	148
Irrigation System Operation (hours/day):	16	16	16	16	16	16
Required System Flow Rate (gpm): <small>(Equation 2)</small>	140	210	323	420	350	247
Compare Required system flow rate with Measured flow noted on Irrigation Application Record						

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Farmer Acknowledgement Statement:

- a. The Farmer has received a copy of the specification and understands the contents and requirements.
- a. The Farmer will provide to NRCS the following information before this practice can be certified for cost-sharing approval:
 - ☐ Irrigation water application records which include the dates and amounts of water applied.
 - ☐ Documentation showing the irrigation scheduling technique used.
 - ☐ Documentation showing an evaluation of the irrigation system.

Dave and Casey Schoch

Date

10.) PRACTICE COMPLETION CHECKLIST:

Year	2007	2008	2009	2010	2011
Record Keeping					
Water applied at correct agronomic rate					
Water applied at correct time					
Calibration					
System walk-thru completed					
Does the practice meet specifications?	Yes No	Yes No	Yes No	Yes No	Yes No
NRCS Initials					
Date					

Rating System Used	E = Excellent	G = Good	F = Fair ¹	P = Poor ¹
¹ : Application at this level may not meet NRCS standards.				

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Irrigation Water Management Worksheet						
Crop Name:	Pasture/Hay Land					
Managed Rooting Depth:	30 inches					
Management Allowed Depletion, MAD:	50 %					
Irrigated Acres:	50					
Soil Name:	Helvetia					
Soil Depth (inches):	48					
Available Water Capacity (in/in):	0.18					
Soil Intake Rate (in/hr) :	0.6					
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> IRRIGATION REQUIREMENT HOW MUCH water to apply? </div>	Month					
	April	May	June	July	August	Sept
Total Plant Available Water Capacity (in): <small>Soil or Root Depth * Available Water Capacity</small>	5.40	5.40	5.40	5.40	5.40	5.40
Net Irrigation Application (in): <small>Total Plant Available Water Capacity * MAD</small>	2.70	2.70	2.70	2.70	2.70	2.70
Irrigation System Application Rate (in/hr): <small>Determined based on the type of Irrigation System</small>	0.7	0.7	0.7	0.7	0.7	0.7
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> IRRIGATION TIMING WHEN to apply water? </div>						
Net Irrigation Water Requirement (in):	1.57	3.15	4.57	6.22	5.12	3.46
Average Daily Crop Water Use (in/day):	0.05	0.10	0.15	0.20	0.17	0.12
Irrigation Frequency (days): <small>Net Irrigation Application / Daily Crop Water Use</small>	30	27	18	14	16	23
Irrigation System Set Time (hours):	7.5	7.5	7.5	7.5	7.5	7.5
Actual Net Irrigation Application (in): <small>Gross Application * System Application Efficiency</small>	2.89	2.89	2.89	2.89	2.89	2.89
Actual Irrigation Frequency (days): <small>Actual Net Irrigation Application / Daily Crop Water Use</small>	30	29	19	14	17	24
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> IRRIGATION SYSTEM CAPACITY </div>						
System Application Efficiency (%): <small>Water Required / Water Applied</small>	55	55	55	55	55	55
Gross Irrigation Application (in): <small>System Application Rate * System Set Time</small>	5.25	5.25	5.25	5.25	5.25	5.25
Volume of Water per Irrigation (acre-in): <small>Gross Irrigation Application * Irrigated Acres</small>	263	263	263	263	263	263
Irrigation System Operation (hours/day):	16	16	16	16	16	16
Required System Flow Rate (gpm): <small>(Equation 2)</small>	248	256	391	531	437	310
Compare Required system flow rate with Measured flow noted on Irrigation Application Record						

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Irrigation Water Management Worksheet						
Crop Name:	Corn Silage					
Managed Rooting Depth:	48 inches					
Management Allowed Depletion, MAD:	50 %					
Irrigated Acres:	50					
Soil Name:	Helvetia					
Soil Depth (inches):	48					
Available Water Capacity (in/in):	0.18					
Soil Intake Rate (in/hr) :	0.5					
IRRIGATION REQUIREMENT HOW MUCH water to apply?	Month					
	April	May	June	July	August	Sept
Total Plant Available Water Capacity (in): <small>Soil or Root Depth * Available Water Capacity</small>	8.64	8.64	8.64	8.64	8.64	8.64
Net Irrigation Application (in): <small>Total Plant Available Water Capacity * MAD</small>	4.32	4.32	4.32	4.32	4.32	4.32
Irrigation System Application Rate (in/hr): <small>Determined based on the type of Irrigation System</small>	0.38	0.38	0.38	0.38	0.38	0.38
IRRIGATION TIMING WHEN to apply water?						
Net Irrigation Water Requirement (in):	0	0.47	3.62	7.13	5.83	1.06
Average Daily Crop Water Use (in/day):	0.00	0.02	0.12	0.23	0.19	0.04
Irrigation Frequency (days): <small>Net Irrigation Application / Daily Crop Water Use</small>	0	31	30	19	23	30
Irrigation System Set Time (hours):	7.5	7.5	7.5	7.5	7.5	7.5
Actual Net Irrigation Application (in): <small>Gross Application * System Application Efficiency</small>	2.00	2.00	2.00	2.00	2.00	2.00
Actual Irrigation Frequency (days): <small>Actual Net Irrigation Application / Daily Crop Water Use</small>	0	31	17	9	11	30
IRRIGATION SYSTEM CAPACITY						
System Application Efficiency (%): <small>Water Required / Water Applied</small>	70	70	70	70	70	70
Gross Irrigation Application (in): <small>System Application Rate * System Set Time</small>	2.85	2.85	2.85	2.85	2.85	2.85
Volume of Water per Irrigation (acre-in): <small>Gross Irrigation Application * Irrigated Acres</small>	143	143	143	143	143	143
Irrigation System Operation (hours/day):	16	16	16	16	16	16
Required System Flow Rate (gpm): <small>(Equation 2)</small>	0	130	237	448	367	134
Compare Required system flow rate with Measured flow noted on Irrigation Application Record						

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Name: _____ Date: _____

IRRIGATION SYSTEM WALK-THROUGH INSPECTION EVALUATION

This form may be used to identify and evaluate those components of an irrigation system that directly affect irrigation system operation and water management. Other aspects not directly affecting irrigation water management, such as energy-use efficiency, may also be noted. Make additional copies as needed.

ITEM	OK	Needs attention	Comments
Irrigation water supply			
Adequate water supply for area irrigated	_____	_____	_____
Suitable quality of irrigation water supply	_____	_____	_____
Inflow controlled by valve and/or gate	_____	_____	_____
Inflow is measured easily and accurately	_____	_____	_____
Type of water measuring device: _____			
Source of irrigation water: _____			
Type of delivery schedule if applicable: _____			
Irrigation water conveyance			
Adequate capacity in ditch and/or pipe	_____	_____	_____
Ditch or pipe free of leaks	_____	_____	_____
Adequate water control devices	_____	_____	_____
Irrigation water application			
Adequate water control for uniform application	_____	_____	_____
Uniformity of application throughout field	_____	_____	_____
Wet and/or dry spots	_____	_____	_____
Excessive runoff	_____	_____	_____
Note: There should be no runoff from sprinkler-irrigated areas.			
Overall system condition			
General maintenance			
Other (note):			

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Irrigation Water Management Worksheet						
Crop Name:	Corn Silage					
Managed Rooting Depth:	48 inches					
Management Allowed Depletion, MAD:	50 %					
Irrigated Acres:	50					
Soil Name:	Helvetia					
Soil Depth (inches):	48					
Available Water Capacity (in/in):	0.18					
Soil Intake Rate (in/hr) :	0.6					
IRRIGATION REQUIREMENT HOW MUCH water to apply?	Month					
	April	May	June	July	August	Sept
Total Plant Available Water Capacity (in): <small>Soil or Root Depth * Available Water Capacity</small>	8.64	8.64	8.64	8.64	8.64	8.64
Net Irrigation Application (in): <small>Total Plant Available Water Capacity * MAD</small>	4.32	4.32	4.32	4.32	4.32	4.32
Irrigation System Application Rate (in/hr): <small>Determined based on the type of Irrigation System</small>	0.7	0.7	0.7	0.7	0.7	0.7
IRRIGATION TIMING WHEN to apply water?						
Net Irrigation Water Requirement (in):	0	0.47	3.62	7.13	5.83	1.06
Average Daily Crop Water Use (in/day):	0.00	0.02	0.12	0.23	0.19	0.04
Irrigation Frequency (days): <small>Net Irrigation Application / Daily Crop Water Use</small>	0	31	30	19	23	30
Irrigation System Set Time (hours):	7.5	7.5	7.5	7.5	7.5	7.5
Actual Net Irrigation Application (in): <small>Gross Application * System Application Efficiency</small>	2.89	2.89	2.89	2.89	2.89	2.89
Actual Irrigation Frequency (days): <small>Actual Net Irrigation Application / Daily Crop Water Use</small>	0	31	24	13	15	30
IRRIGATION SYSTEM CAPACITY						
System Application Efficiency (%): <small>Water Required / Water Applied</small>	55	55	55	55	55	55
Gross Irrigation Application (in): <small>System Application Rate * System Set Time</small>	5.25	5.25	5.25	5.25	5.25	5.25
Volume of Water per Irrigation (acre-in): <small>Gross Irrigation Application * Irrigated Acres</small>	263	263	263	263	263	263
Irrigation System Operation (hours/day):	16	16	16	16	16	16
Required System Flow Rate (gpm): <small>(Equation 2)</small>	0	240	310	572	495	248
Compare Required system flow rate with Measured flow noted on Irrigation Application Record						

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Name: _____ Date: _____

IRRIGATION SYSTEM WALK-THROUGH INSPECTION EVALUATION

This form may be used to identify and evaluate those components of an irrigation system that directly affect irrigation system operation and water management. Other aspects not directly affecting irrigation water management, such as energy-use efficiency, may also be noted. Make additional copies as needed.

ITEM	OK	Needs attention	Comments
Irrigation water supply			
Adequate water supply for area irrigated	_____	_____	_____
Suitable quality of irrigation water supply	_____	_____	_____
Inflow controlled by valve and/or gate	_____	_____	_____
Inflow is measured easily and accurately	_____	_____	_____
Type of water measuring device: _____			
Source of irrigation water: _____			
Type of delivery schedule if applicable: _____			
Irrigation water conveyance			
Adequate capacity in ditch and/or pipe	_____	_____	_____
Ditch or pipe free of leaks	_____	_____	_____
Adequate water control devices	_____	_____	_____
Irrigation water application			
Adequate water control for uniform application	_____	_____	_____
Uniformity of application throughout field	_____	_____	_____
Wet and/or dry spots	_____	_____	_____
Excessive runoff	_____	_____	_____
Note: There should be no runoff from sprinkler-irrigated areas.			
Overall system condition			
General maintenance			
Other (note):			

IRRIGATION WATER MANAGEMENT (PS449) SPECIFICATION for Schoch Dairy

Name: _____ Date: _____

Note: Use of this record keeping form is optional. Make additional copies of this form as needed.

Farmer's Name:	Dave and Casey Schoch	Field:		
Nickname:		Crop:		
Managed Soil:		Rooting Depth:		inches
Irrigation system provides:		Inches at speed of:		Feet per minute

	Big gun speed			Irrigation	Rainfall
DATE	Weather	(ft/min)	X	(inches)	(inches)
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Note: Use of this record keeping form is optional. Make additional copies of this form as needed.

Record Results of Soil Probing and/or Sensor Readings from Tensiometers or Resistance Blocks at Least Twice per Week

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IRRIGATION WATER MANAGEMENT (449) SPECIFICATION
for Schoch Dairy

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

Prepared for:

Dave and Casey Schoch
24335 NW West Union Road
Hillsboro, OR 97124
(503) 647-2638

Prepared by:

Jennifer Zwicke
1561 NE Greensword Dr.
Hillsboro, OR 97124
(443) 621-2189

Fields: Field 1, 2, 3, and 4

(See plan map in Section 5)

Acres: 58

Location:

Date: September 12, 2006

1.) GENERAL CONSIDERATIONS:

Purpose: Nutrient Management and Waste Utilization are applied as part of a conservation management system to:

- Budget and supply nutrients to improve or maintain yields.
- Properly utilize manure or organic by-products as a plant nutrient source to save money on fertilizer bills.
- Protect groundwater from nitrate contamination.
- Protect streams and rivers from phosphorus contamination.
- Help ensure the Farmer complies with local, state and federal laws regulating manure applications.

Threatened and Endangered Species: If USDA cost-sharing will be provided, a Biological Evaluation (BE) for this practice demonstrating No Effect on species listed under the Endangered Species Act will be approved by NRCS before this practice begins.

Cultural Resources: This practice will not affect cultural resources; only cropland will be affected and soil will not be disturbed below the plow layer. This practice is not an undertaking as defined under NRCS Cultural Resources policy.

Permits: In accordance with Oregon law any animal feeding operation where animals are stabled or confined for a total of 45 days or more in any 12 month period and vegetation are not sustained in the stabled or confined area must register under the Oregon CAFO General Permit. This also applies to any confined animal feeding operation where animals are confined to areas that have been prepared to support animals in wet weather and generates wastewater from the production facilities. It is the responsibility of the Farmer to file for the necessary permits with the Oregon Department of Agriculture Confined Animal Feeding Program if there animal feeding operation meets the permitting requirements.

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

Phosphorus: Many rivers in the Willamette Valley are polluted with excessively high phosphorus levels. This phosphorus causes algae blooms, which cause dissolved oxygen levels and pH to fluctuate greatly, thus harming fish and other aquatic organisms. Most crops do not respond to phosphorus fertilizer unless soil test P levels are low (below 50 ppm P).

Phosphorus fertilizer comes from mines. There is a limited supply of high quality phosphorus ores (a consideration for future generations of farmers).

Nitrogen: Nitrogen loss reduces profits. Nitrogen runoff to streams from cropland, however, is usually not a major environmental issue, except where manure is applied at a high rate or ammonium type fertilizers are applied between May 1 to October 31 and excessive irrigation water washes them into the stream. Well and moderately well drained soils (see table on previous page) have a moderate to high risk of nitrate leaching. Poorly and somewhat poorly drained soils have a very low to low risk of nitrate leaching.

Excessive N fertilization can increase de-nitrification, which produces nitrous oxide (a greenhouse gas). Due to the climate in the Willamette Valley, most soil nitrogen in the nitrate form going into winter will be lost from the field and not be available for crop uptake. Nitrogen fertilizer is manufactured by the Haber process, which involves burning natural gas (a non-renewable resource).

2.) EQUIP INCENTIVE PAYMENT:

This practice may be eligible for USDA cost-sharing. Please see the EQIP contract for details on cost-share rates. The participant must contact USDA-NRCS before beginning this practice if cost-sharing will be provided.

3.) SOILS:

See page 32 of the Comprehensive Nutrient Management Plan (CNMP) for soils information.

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

4.) SCHEDULE FOR TESTING:

In order to effectively apply nutrient management, soils, crops, irrigation water, manure, wastewater, dry stack solids need to be tested in accordance with the following schedule-

SAMPLE	2007	2008	2009	2010	2011	NOTES
Total ration	2	2	2	2	2	A
Solid manure	3	3	3	3	3	B
Liquid manure (first cell)	3	3	3	3	3	B
Liquid manure (main pond)	3	3	3	3	3	B
Normal soil tests	All Fields	All Fields	All Fields	All Fields	All Fields	D
Corn pre-sidedress nitrate soil tests	All Corn Fields	All Corn Fields	All Corn Fields	All Corn Fields	All Corn Fields	C
Fall nitrate soil tests	All Manured Fields	All Manured Fields	All Manured Fields	All Manured Fields	All Manured Fields	E

Key to Notes:

- A:** See Section 7 in the CNMP for guidance on sampling feed rations.
- B:** Sample liquid manure and solids during applications. Have each sample analyzed for Total Nitrogen (TKN), Ammonium Nitrogen (NH₄-N), Phosphorus (P) and Potassium (K) plus percent moisture.
- C:** Test fields with corn in accordance with **Oregon State University Extension publication EM 8650, "The Pre Side Dress Soil Nitrate Test"** located in Section 13 of the CNMP at V5 stage (when corn is approx. 12" tall).
- D:** Test soil for P, K, pH, SMP (optional: test for B, Ca, Mg and % Organic Mater) in accordance with **Oregon State University Extension publication PNW570-E, "Monitoring Soil Nutrients Using a Management Unit Approach"** located in Section 13 of the CNMP. This test can be done during any month.
- E:** Collect at least one soil sample from the manure application areas in accordance with **Oregon State University Extension publication EM8832-E, "Post Harvest Soil Nitrate Testing"** located in Section 13 of the CNMP every fall (September 15-October 15). Have soil samples analyzed for Nitrates (NO₃-N), Phosphorus (P) and Potassium (K). Ask lab to report results in parts per million (ppm).

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

5.) OPERATIONS FOR NUTRIENT APPLICATIONS:

Refer to the Waste Utilization part of this section for guidance in applying manure, wastewater, and other organic material to meet nutrient budget requirements for the planned crops. Always perform the following tasks annually before making manure applications:

- Review nutrient management component of this plan annually and make adjustments when needed. Nutrient applications must be based on soil and/or tissue tests and a nutrient budget prepared before application begins.
- N applications must be based on OSU recommendations or N nutrient uptake in harvested portion of crop.
- P applications must be based on OSU recommendations or P uptake in harvested portion of crop if P index is high or very high
- Credit must be taken for N supplied by previous legume crops, manure applications and sludge applications.
- If USDA cost-sharing is provided a Certified Crop Advisor or Certified Professional Agronomist must approve application plans for each field before nutrient application begins.
- Accurate records of rate, analysis and date of nutrient applications must be kept and maintained.
- Maintain records of nutrient application as required by state and local regulations.

The nutrient budget and phosphorus index worksheets on the following pages can be used to prepare annual nutrient budgets and to determine the site vulnerability index for phosphorus movement for fields if nutrient concentrations in the liquid and solid manure samples vary from the values use to prepare the CNMP.

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

Nutrient Budget Worksheet

Tract Number _____ Field number _____

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

Table 1. Field Conditions and Recommendations					
CROP SEQUENCE/ROTATION (circle current crop)					EXPECTED YIELD
CURRENT SOIL TEST LEVELS (ppm or lb/ac)					
N	P	K	pH	S.O.M. %	EC
RECOMMENDED NUTRIENTS/AMENDMENTS TO MEET EXPECTED YIELD					
N	P ₂ O ₅	K ₂ O	LIME	Other _____	Other _____

Table 2. Nutrient Sources							
Credits		N		P ₂ O ₅		K ₂ O	
		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							
Plant-Available Nutrients Applied to Field		N		P ₂ O ₅		K ₂ O	
(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)							
7. Fertilizer	Starter						
	Other						
8. Manure / Organic Materials							
9. Subtotal (sum of lines 6, 7 and 8)							
10. Nutrients Recommended (from Table 1)							
11. Nutrient Status (subtract line 10 from line 9)							
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.							

1. NUTRIENT MANAGEMENT SPECIFICATIONS

Amount to be Applied(lb./ac)	N		P ₂ O		K ₂ O	
------------------------------	---	--	------------------	--	------------------	--

Method, Form, and Timing of Application:

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for

Schoch Dairy

NRCS Agronomy Technical Note 26 – Appendix 1

October 2001

PHOSPHORUS INDEX WORKSHEET – WESTERN OREGON

Schoch Dairy		Tract No.	Field No(s):		Date:			
Soil Map Unit(s):	Soil Test: P – Planned: Current:	ppm ppm	Lab. Method: Weak Bray P1	Sample Depth: 12 inches				
Planner:	Notes:							
PHOSPHORUS LOSS RATING								
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Planned	Current
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)		
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)		
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)		
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)		
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft.. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)		
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)		
Transport Factors Subtotal (TFS)								

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

Tract :	Fields:	PHOSPHORUS LOSS RATING					Weighted Rating Value	
SOURCE FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Planned	Current
Soil Test P – ppm (Bray P-1)	1.00	(Soil Test P – 40) x 0.10 () - 40) x 0.10 = Assign 0 points if Soil Test P < 40 ppm						
Commercial P Fertilizer Application Rate	1.00	$\frac{\text{lbs/ac P}_2\text{O}_5 \times 0.02}{\text{lbs/ac P}_2\text{O}_5} \times 0.02 = \text{ }$						
Commercial P Fertilizer Application Method	1.00	None Applied (0)		Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	
Organic P Source Application Rate	1.00	$\frac{\text{lbs/ac P}_2\text{O}_5 \times 0.02}{\text{lbs/ac P}_2\text{O}_5} \times 0.02 = \text{ }$						
Organic P Source Application Method	1.00	None Applied (0)		Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	
Total Rating Value TFS + SFS	SITE VULNERABILITY CLASS	Transport Factors Subtotal (TFS)						
< 13.0	Low	Source Factors Subtotal (SFS)						
13.0 – 25.0	Medium	Total Rating Value (TFS + SFS)						
25.1 – 50.0	High	Site Vulnerability Class						
> 50.0	Very High							

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

6.) OPERATIONS FOR MANURE APPLICATIONS:

Always perform the following tasks annually to make manure and wastewater applications:

- Review current nutrient budgets to determine how much manure to apply. Refer to the Nutrient Management part of this specification for guidance on developing new nutrient budgets.
- Inspect and repair manure hauling and application equipment to minimize potential of accidental spillage.
- Avoid unnecessary exposure to manure and wastewater and wear protective clothing when necessary.
- Be aware of the location of sensitive areas, concerns of neighbors or concerns of the public, which require special application procedures. To reduce odor problems, apply manure and wastewater in mid morning when temperatures are warming and air is rising rather than in the afternoon or evening when air is cooling and settling. Avoid applications during periods of fog.
- Calibrate application equipment to ensure uniform distribution and accurate application rates in accordance with guidance given in the nutrient budget for the field applying to. Refer to the following pages for calibration worksheets and make copies as necessary to document the calibration of application equipment.
- Apply manure in accordance with the recommendations given on the nitrogen and phosphorus application worksheets located on the following pages. The example application rate calculations on the worksheets are based on the original nutrient budgets and estimated equipment calibrations done to prepare this plan. Use copies of the worksheets or other tools to document calculations made to determine new application rates based on revised nutrient budgets or calibrations of application equipment.
- Apply manure and wastewater in a manner that will cover no more than 25 percent of the leaf surface with solids unless clean water applications are planned immediately after wastes are applied. For pasture/hay land it is best to apply waste 7 days after harvesting forage by haying or grazing.
- When applying manure and wastewater, maintain a 100 foot setback from down-gradient surface waters, open tile line intake structures, sinkholes, well heads or other sensitive areas to prevent a prohibited discharge of manure and wastewater.
- Record manure and wastewater applications on the appropriate form in section 10 and maintain them for at least 5 years.
- Clean up residual materials from equipment and dispose of properly.

March 15th – August 30th: Apply manure at agronomic rates, using the following guidelines:

- Apply to land being prepared for crops. Till manure into soil within 3 days of application if possible.
- Or, apply to actively growing crops such as grass, clover or alfalfa after cutting.
- Do not apply within 35 feet of open water courses, seeps, ditches, tile inlets or wetlands.

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

September 1st – October 31st: Apply manure at minimum rates, using the following guidelines:

- Apply to land with actively growing crops such as grass, clover or alfalfa.
- Do not apply within 35 feet of open water courses, seeps, ditches, tile inlets or wetlands.

November 1 – March 15: Avoid application of manure. If manure application is needed because of an emergency situation during this period, use the following guidelines. **NOTE: THE FOLLOWING GUIDELINES ARE GOOD IDEAS, BUT SPREADING MANURE DURING THIS PERIOD MAY STILL VIOLATE STATE AND FEDERAL LAW:**

- Call the ODA CAFO inspector, Kathryn Higgs at (503) 986-4780 Micah Wells at (503) 986-6468 Chris Anderson at (541) 955-9873 and report why an emergency application is needed and where the application will be made if different than the field areas identified on the plan map in Section 5 of the CNMP as emergency application areas..
- Apply it only to actively growing crops such as grass, clover or alfalfa.
- Minimize application rates by using the maximum travel rates for the application equipment.
- Do not apply within 100 feet of open water courses, seeps, ditches, tile inlets or wetlands.
- Do not apply during rainfall.
- Do not apply to saturated or flooded soils.
- Do not apply to slopes greater than 7%.
- Maintain records of emergency applications and do not apply manure or commercial fertilizer to fields receiving emergency applications unless soil tests indicate to do so.

Fields that are subsurface (TILE) drained and require additional precautions when manure is applied. Manure applied to these fields can follow soil macropores directly to the tile drains creating a surface water pollution hazard from direct tile discharge. Tillage prior to manure application that can disrupt/close (using horizontal fracturing) the preferential flow paths (worm holes, cracks, root channels) in the soil will reduce the risk of a manure discharge to surface waters. Any pre-application tillage should leave as much residue as possible on the soil surface. Water control structures installed in subsurface drainage systems should be managed to prevent discharge of manure and wastewater during periods of application.

Sampling Liquid Manure

Liquid manure samples submitted for analysis should meet the following requirements:

- Manure samples submitted to a laboratory should represent the average composition of the material that will be applied to the field.
- Place sample in a sealed, clean plastic container with about a 1-pint volume. Glass is not suitable because it is breakable and may contain contaminants.
- Leave at least 1 inch of air space in the plastic container to allow for expansion caused by the release of gas from the manure material.
- Refrigerate or freeze samples that cannot be shipped on the day they are collected, minimizing chemical reactions and pressure buildup from gases.

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

Following are guidelines for obtaining liquid manure samples:

Wastewater. Premixing the surface liquid in the storage structure is not needed, provided it is the only component that is being pumped. Operators with multistage systems should draw samples from the storage structure they intend to pump for application to crops.

Samples should be collected using a clean, plastic container similar to the one shown in figure for liquid manure sampling on the next page. One pint of material should be taken from at least eight sites around the storage structure and then mixed in the larger clean, plastic container. Effluent should be collected at least 6 feet from the storage structure's edge at a depth of about a foot. Shallower samples from storage structure may be less representative than deep samples because oxygen transfer near the surface sometimes alters the chemistry of the solution. Floating debris and scum should be avoided.

One pint of mixed material should be sent to the lab. Galvanized containers should never be used for collection, mixing, or storage due to the risk of contamination from metals like zinc in the container. These recommendations are adequate for making applications that draw the liquid level in the storage structure down a few feet. If an entire storage structure is to be emptied, more frequent sampling with many more sampling points is recommended.

Slurry. Manure materials applied as a slurry from a storage structure should be mixed prior to sampling. A liquid sampling device can be used to obtain a sample from agitated storage structure. If you wish to sample a storage structure without agitation, you must use a composite sampling device as the one shown in the figure on the next page.

Samples should be collected from approximately eight areas around the storage structure and mixed thoroughly in a clean, plastic container. An 8- to 10-foot section of 0.5- to 0.75-inch plastic pipe can also be used: extend the pipe into the pit with ball plug open, pull up the ball plug (or press your thumb over the end to form an air lock), and remove the pipe from the manure, releasing the air lock to deposit the manure in the plastic container.

One pint of mixed material should be sent to the lab. Galvanized containers should never be used for collection, mixing, or storage due to the risk of contamination from metals like zinc in the container.

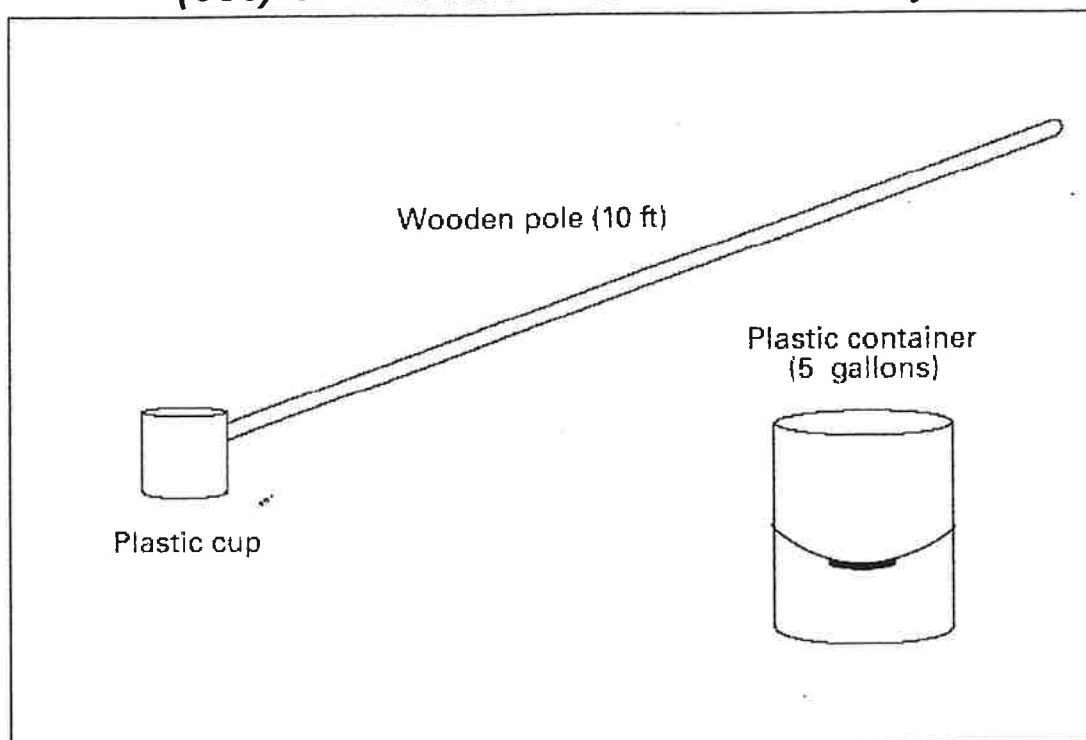
Sludge. Sludge is somewhat more difficult to obtain a representative sample. Two common methods are used.

One method requires pumping the storage structure down to the sludge layers. Then, during sludge agitation, a composite sampling device as shown in the figure on the next page can be used to obtain a sample.

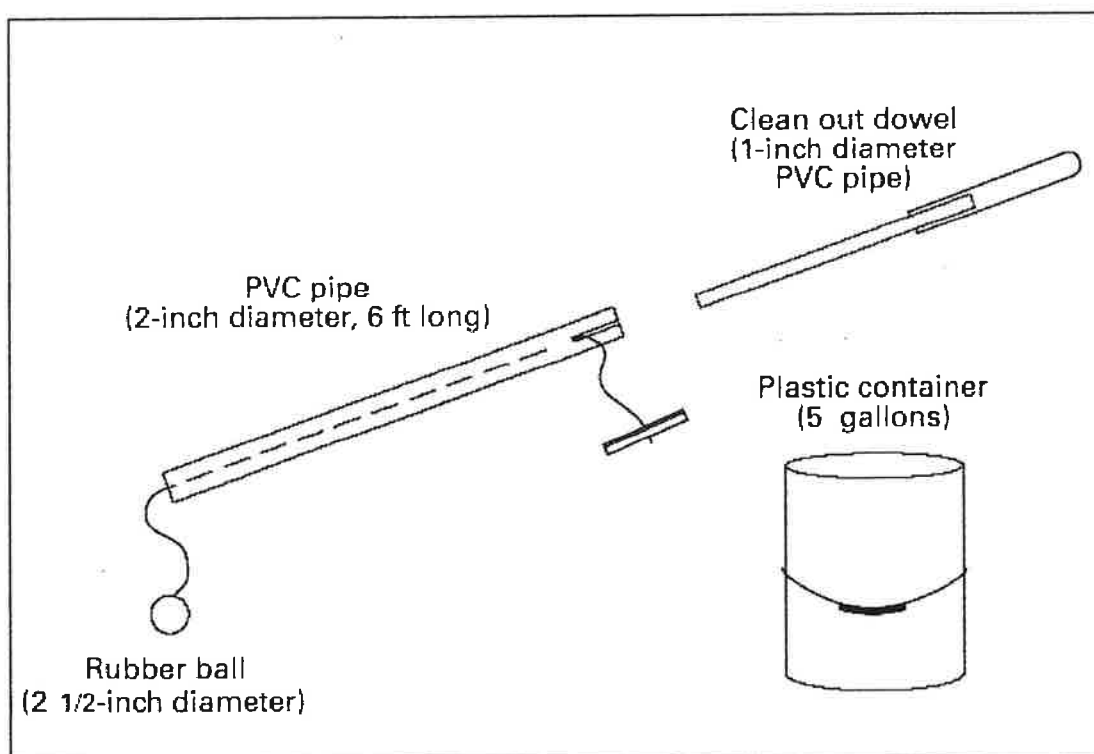
The other method requires insertion of a probe to the bottom of the storage structure to obtain a column of material. The sludge component of this column is then released into a clean plastic bucket, and several (12-20) other sampling points around the storage structure are likewise collected to obtain a composite, representative sample.

For analysis, most labs require at least 1 pint of material in a plastic container. The sample should not be rinsed into the container because doing so dilutes the mixture and distorts nutrient evaluations. However, if water is typically added to the manure prior to land application, a proportionate quantity of water should be added to the sample.

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy



Typical Sampling Equipment for Liquids

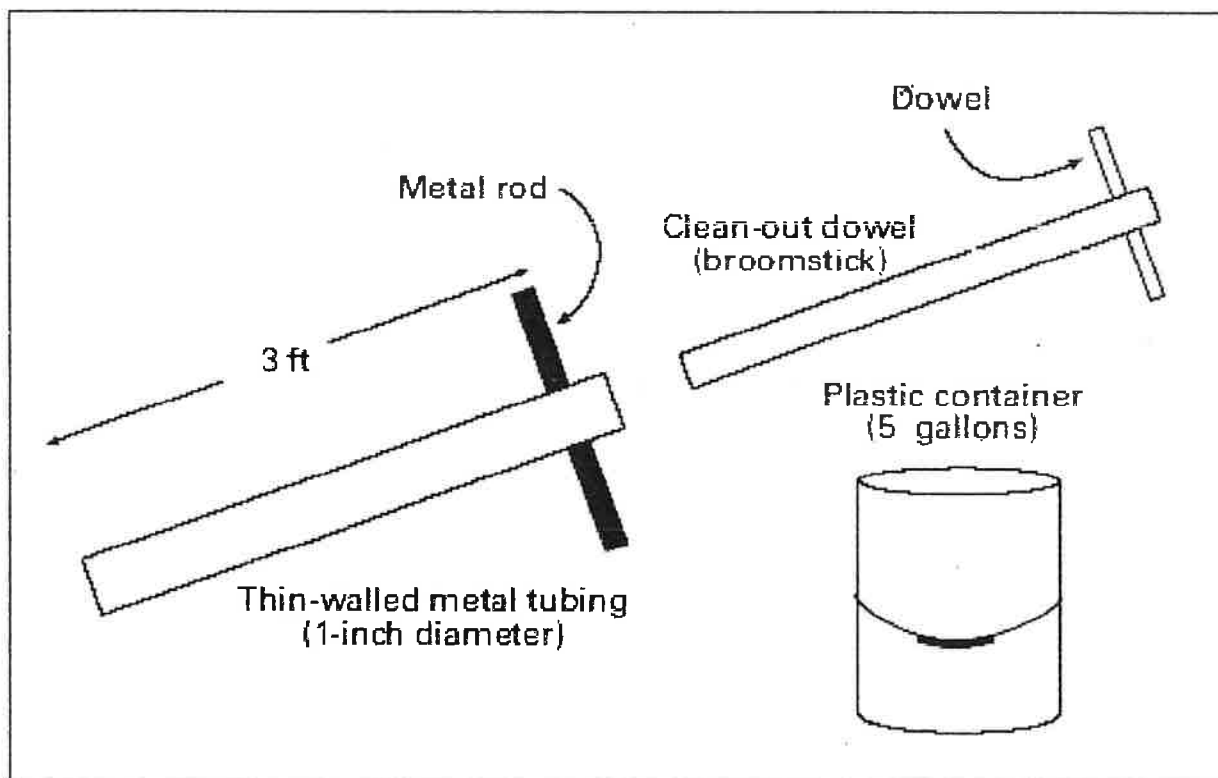


Typical Sampling Equipment for Obtaining Composite Samples

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

Sampling Solid Manure

Solid manure samples should represent the manure's average moisture content. A 1-quart sample is adequate for analysis. Samples should be taken from approximately eight different areas in the manure pile at a depth of 18 inches, placed in a clean plastic container, and thoroughly mixed. Approximately 1 quart of the mixed sample should be placed in a plastic bag, sealed, and shipped directly to the lab. It is recommended to ship the samples early in the week so it doesn't sit in a post office or shipping area of the laboratory for several days. Samples stored for more than two days should be refrigerated. The figure below shows a device that can be constructed and used for sampling solid manure.



Typical Solids Sampling Equipment

Typical Nutrient Availability After Application

Typical nutrient content of animal manure retained after application:			
Application Method	Percent of original nutrient content of manure retained after application		
	N	P ₂ O ₅	K ₂ O
Injection	95%	100%	100%
Sprinkling	75%	100%	100%
Broadcast (Incorporated 1 day after application)	90%	100%	100%
Broadcast (Incorporated 4 days after application)	80%	100%	100%
Broadcast (Incorporated 7 or more days after application)	70%	100%	100%

Name: _____ Date: _____

SchochCNMP.doc

**NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION
(633) SPECIFICATION for Schoch Dairy
Spreader Equipment Calibration
(Using a Full Spreader Load)**

Name: _____ Date: _____

Perform the following operations to calibrate the solids spreader equipment:					
✓ Determine the weight of the waste material loaded in the spreader by using truck scales to weigh the spreader equipment when it is empty and full.					
✓ Spread the loaded spreader on the field using consistent speed and spreader settings to cover the field uniformly. Spread in a rectangular pattern so the area calculation will be simple. Record engine rpm and gear settings used.					
✓ Measure the length and width covered by the full load and compute the application rate in tons per acre using this worksheet.					
Data and Calculations:					
Steps	ID of Calibration Test				
	A	B	C	D	E
1. Date of calibration test-					
2. Engine RPM during spreading -					
3. Gear selected during spreading -					
4. Weight of empty spreader (lb) =					
5. Weight of loaded spreader (lb) =					
6. Weight of Waste in spreader (lb) - line 5 – line 4 =					
7. Length of spreading area (ft) =					
8. Width of spreading area (ft) =					
9. Area spread (sq ft) - line 7 x line 8 =					
10. Waste applied (lb/sq ft) – line 6 ÷ line 9=					
11. Convert to tons per acre - Line 10 x 21.78=					
12. Average Application Rate (tons per acre) – Sum of values in cells A11 through F11 divided by the total number of calibrations completed =					
Additional Notes:					

[illegible]

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy Traveling Big Gun Sprinkler Calibration

Name: _____ Date: _____

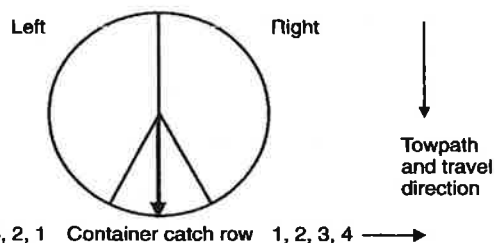
Perform the following operations to calibrate the traveling big gun sprinkler:

- ✓ Use 5 to 10 catch cans to collect the sprinkler-irrigated waste. Use straight-sided buckets for catch cans. Two pound coffee cans work well. Make sure all of the catch cans have the same diameter.
- ✓ Place one of the catch cans on a level surface and fill it with water to a known depth (1-3 inches). Pour the water from the catch can into a large measuring cup. Determine how many measuring cups of water are equal to an inch of water in the catch can.
- ✓ Place at least five catch cans across the towpath of the big gun sprinkler. Try to space the catch cans uniformly from the center of the towpath to the outer edge of the wetted area of the sprinkler. Stake the catch can in place or put a rock in the bottom of the catch can to keep it upright. Allow the traveling big gun sprinkler to completely pass over the catch cans. Use the measuring cup previously used to calibrate the catch cans to measure the amount of liquid collected in each can and convert the volume to inches. Be sure to add together the amount measured from the catch cans that would receive overlap from the adjacent towpath. For example, if catch can #4 will receive liquids from the adjacent towpaths, add the amount from container #4 on the left to container #4 on the right side to compute the total amount applied at the location of container #4 on the right and left sides of the towpath.

Catch Can Calibration:

Example: 1 inch = 5 Cups
 1 cup = 0.2 Inches

Your Catch 1 inch = _____ Cups
 Cans: 1 cup = _____ Inches


Travel Rate Setting During Test:

Data and Calculations:

Catch Can ID	Volume of Liquid							
	Cups	Inches	Cups	Inches	Cups	Inches	Cups	Inches
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
Average =								

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

Planned Manure Exports

Export Date	Exported To	Quantity	Units	TKN	NH ₄ -N	Org-N	NO ₃ -N	P205	K20
03/15/2007	Nursery	300	Ton	7.4	3.7	3.7	0	3.4	4.7
06/15/2007	Nursery	300	Ton	7.4	3.7	3.7	0	3.4	4.7
09/15/2007	Nursery	300	Ton	7.4	3.7	3.7	0	3.4	4.7
03/15/2007	Neighbor	950	th gals	11.35	0	11.35	0	7.6	10.7
06/15/2007	Neighbor	950	th gals	11.35	0	11.35	0	7.6	10.7
09/15/2007	Neighbor	950	th gals	11.35	0	11.35	0	7.6	10.7

Nutrient Application Plan

Notes and Assumptions:

- Outlets to tile drained fields must be controlled if liquid manure is applied.

Tract Number	Allocation Date	Field Name	Spreadable Acres	Nutrient Source	Application Equipment	Amount Applied per Field	Pounds N Lb/Acre	Pounds P205 Lb/Acre	Pounds K20 Lb/Acre
T3375	03/15/2007	T3375-2	11.61	Waste Holding Pond	Big gun irrigation system	34.83 th gals or 0.11 inches	23	23	32
T3375	06/15/2007	T3375-2	11.61	Waste Holding Pond	Big gun irrigation system	40.635 th gals or 0.13 inches	27	27	37
T3375	09/15/2007	T3375-2	11.61	Waste Holding Pond	Big gun irrigation system	36.688 th gals or 0.12 inches	24	24	34
Total Nutrients Applied to Field T3375-2-							74	74	103
T3376	03/15/2007	T3376-3	40.54	Waste Holding Pond	Big gun irrigation system	121.62 th gals or 0.11 inches	23	23	32
T3376	06/15/2007	T3376-3	40.54	Waste Holding Pond	Big gun irrigation system	141.89 th gals or 0.13 inches	27	27	37
T3376	09/15/2007	T3376-3	40.54	Waste Holding Pond	Big gun irrigation system	128.106 th gals or 0.12 inches	24	24	34
Total Nutrients Applied to Field T3376-3-							74	74	103
T3376	03/15/2007	T3376-4	3.38	Roofed manure storage	Box spreader: tractor pulled	10.14 tons or 1 loads	16	10	14

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for **Schoch Dairy**

Tract Number	Allocation Date	Field Name	Spreadable Acres	Nutrient Source	Application Equipment	Amount Applied per Field	Pounds N Lb/Acre	Pounds P2O5 Lb/Acre	Pounds K2O Lb/Acre
T3376	06/01/2007	T3376-4	3.38	Roofed manure storage	Box spreader; tractor pulled	9.937 tons or 1 loads	16	10	14
Total Nutrients Applied to Field T3376-4-							32	20	28

TRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION

Schoch Dairy

and Manure Exports

	Exported To	Quantity	Units	TKN	NH4-N	Org-N	NO3-N	P205	K2O
7	Nursery	300	Ton	6.8	3.4	3.4	0	3.1	4.3
7	Nursery	300	Ton	6.8	3.4	3.4	0	3.1	4.3
7	Nursery	300	Ton	6.8	3.4	3.4	0	3.1	4.3
7	Neighbor	950	th gals	10.2	6.8	10.2	0	6.9	9.7
7	Neighbor	950	th gals	10.2	6.8	10.2	0	6.9	9.7
7	Neighbor	950	th gals	10.2	6.8	10.2	0	6.9	9.7

nt Application Plan

nd Assumptions:

ets to tile drained fields must be controlled if liquid manure is applied.

Location Date	Field Name	Spreadable Acres	Nutrient Source	Application Equipment	Amount Applied per Field	Pounds N Lb/Acre	Pounds P205 Lb/Acre	Pounds K2O Lb/Acre
03/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	34.08 th gals or 0.11 inches	22	21	29
06/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	34.08 th gals or 0.11 inches	22	21	29
09/15/2007	T3375-2	11.36	Waste Holding Pond	Big gun irrigation system	22.72 th gals or 0.07 inches	15	14	19
rients Applied to Field T3375-2-						59	56	77
03/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	161.48 th gals or 0.15 inches	30	28	39
06/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	161.48 th gals or 0.15 inches	30	28	39
09/15/2007	T3376-3	40.37	Waste Holding Pond	Big gun irrigation system	201.85 th gals or 0.18 inches	37	35	48
rients Applied to Field T3376-3-						97	91	126

S

TRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION
Schoch Dairy

Allocation Date	Field Name	Spreadable Acres	Nutrient Source	Application Equipment	Amount Applied per Field	Pounds N Lb/Acre	Pounds P2O5 Lb/Acre	Pounds K2O Lb/Acre
03/15/2007	T3376-4	3.38	Roofed manure storage	Box spreader: tractor pulled	16.9 tons or 1 loads	24	16	22
05/15/2007	T3376-4	3.38	Roofed manure storage	Box spreader: tractor pulled	16.9 tons or 1 loads	24	16	22
rients Applied to Field T3376-4-						48	32	44

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy Nitrogen Based Waste Application

Name: _____ Date: _____

Planned Application:				
Pasture/Hay Land is being grown and the recommended nutrient application from the nutrient management section is 150 pounds of nitrogen (N) per acre. A traveling big gun sprinkler will be used to make 1 application of liquids from a waste storage pond and a tractor pulled box spreader will be used to make 1 application of solids from a dry stacking facility that will not be incorporated into the field.				
Waste application rates and amounts:				
Steps	Planned Application		Current Application	
	Liquid	Solids	Liquid	Solids
1. Crop receiving waste-	Pasture/Hayland			
2. Number of applications to be made-	3	0		
3. Desired nitrogen application rate, lb/acre-	24.3	0		
4. Nutrient concentrations in storage from laboratory analysis:	<u>lb/1000 gal</u>	<u>lb/ton</u>	<u>lb/1000 gal</u>	<u>lb/ton</u>
Nitrogen (N)-	11.35	7.4		
Phosphorus (P₂O₅)-	7.6	3.4		
Potassium (K₂O)-	10.7	4.7		
5. Plant availability of nitrogen-	100 %	100 %	%	%
6. Nitrogen retained, in percent, after application from page 144-	75 %	70 %	%	%
7. Calculate nitrogen availability- N line 4 x line 5 x line 6 ÷ 10,000=	<u>lb/1000 gal</u> 8.51	<u>lb/ton</u> 5.18	<u>lb/1000 gal</u>	<u>lb/ton</u>
8. Determine nitrogen application rate from charts on pages 153 and 154:	<u>inches/acre</u>	<u>tons/acre</u>	<u>inches/acre</u>	<u>tons/acre</u>
Nitrogen (N)-	0.11	0		
9. Determine the amount of phosphorus and potassium applied from nutrient concentration data on line 4 and nutrient application charts:	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>
Phosphorus (P₂O₅)-	23	0		
Potassium (K₂O)-	32	0		
10. Total Nutrients Applied, lb/acre:				
Nitrogen (N)- (Sum of Nitrogen Application Rates from line 3 x Number of Applications on line 2)	73 lb/acre		lb/acre	
Phosphorus (P₂O₅)- (Sum of Phosphorus Application Rates from line 9 x Number of Applications on line 2)	69 lb/acre		lb/acre	
Potassium (K₂O)- (Sum of Potassium Application Rates from line 9 x Number of Applications on line 2)	96 lb/acre		lb/acre	

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy Phosphorus Based Waste Application

Name: _____ Date: _____

Planned Application:				
Pasture/Hay Land is being grown and the recommended nutrient application from the nutrient management section is 50 pounds of phosphorus (P ₂ O ₅) per acre. A traveling big gun sprinkler will be used to make 1 application of liquids from a waste storage pond.				
Waste application rates and amounts:				
Steps	Planned Application		Current Application	
	Liquid	Solids	Liquid	Solids
1. Crop receiving waste-	Pasture/Hayland			
2. Number of applications to be made-	3	0		
3. Desired phosphorus application rate, lb/acre-	24.3	0		
4. Nutrient concentrations in storage from laboratory analysis:	<u>lb/1000 gal</u>	<u>lb/ton</u>	<u>lb/1000 gal</u>	<u>lb/ton</u>
Nitrogen (N)-	11.35	7.4		
Phosphorus (P₂O₅)-	7.6	3.4		
Potassium (K₂O)-	10.7	4.7		
5. Determine phosphorus application rate from charts on pages 153 and 154:	<u>inches/acre</u>	<u>tons/acre</u>	<u>inches/acre</u>	<u>tons/acre</u>
Phosphorus (P₂O₅)-	0.12	0		
6. Plant availability of nitrogen in percent-	100 %	100 %	%	%
7. Nitrogen retained, in percent, after application from page 144-	75 %	70 %	%	%
8. Calculate nitrogen availability- N line 4 x line 6 x line 7 ÷ 10,000=	<u>lb/1000 gal</u> 8.51	<u>lb/ton</u> 5.18	<u>lb/1000 gal</u>	<u>lb/ton</u>
9. Determine the amount of nitrogen and potassium applied from nutrient concentration data on line 4 and nutrient application charts:	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>
Nitrogen (N)-	28	0		
Potassium (K₂O)-	35	0		
10. Total Nutrients Applied, lb/acre:				
Nitrogen (N)- (Sum of Nitrogen Application Rates from line 9 x Number of Applications on line 2)	84 lb/acre		lb/acre	
Phosphorus (P₂O₅)- (Sum of Phosphorus Application Rates from line 3 x Number of Applications on line 2)	73 lb/acre		lb/acre	
Potassium (K₂O)- (Sum of Potassium Application Rates from line 9 x Number of Applications on line 2)	105 lb/acre		lb/acre	

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy Nitrogen Based Waste Application

Name: _____ Date: _____

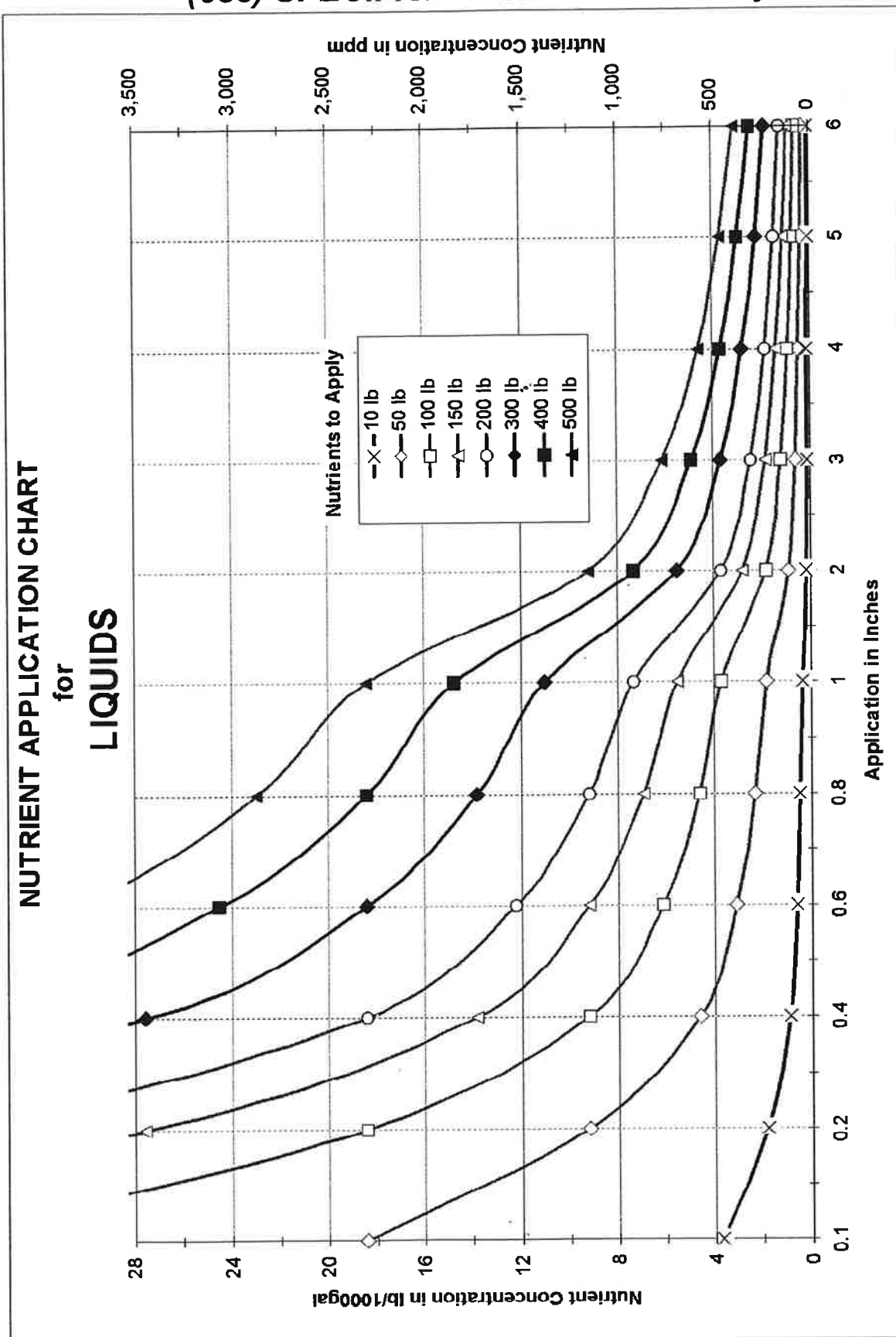
Planned Application:				
Pasture/Hay Land is being grown and the recommended nutrient application from the nutrient management section is 150 pounds of nitrogen (N) per acre. A traveling big gun sprinkler will be used to make 1 application of liquids from a waste storage pond and a tractor pulled box spreader will be used to make 1 application of solids from a dry stacking facility that will not be incorporated into the field.				
Waste application rates and amounts:				
Steps	Planned Application		Current Application	
	Liquid	Solids	Liquid	Solids
1. Crop receiving waste-	Pasture/Hayland			
2. Number of applications to be made-	3	0		
3. Desired nitrogen application rate, lb/acre-	74.67	0		
4. Nutrient concentrations in storage from laboratory analysis:	<u>lb/1000 gal</u>	<u>lb/ton</u>	<u>lb/1000 gal</u>	<u>lb/ton</u>
Nitrogen (N)-	10.2	6.8		
Phosphorus (P ₂ O ₅)-	6.9	3.1		
Potassium (K ₂ O)-	9.7	4.3		
5. Plant availability of nitrogen-	100 %	100 %	%	%
6. Nitrogen retained, in percent, after application from page 144-	75 %	70 %	%	%
7. Calculate nitrogen availability- N line 4 x line 5 x line 6 ÷ 10,000=	<u>lb/1000 gal</u> 7.65	<u>lb/ton</u> 4.76	<u>lb/1000 gal</u>	<u>lb/ton</u>
8. Determine nitrogen application rate from charts on pages 153 and 154:	<u>inches/acre</u>	<u>tons/acre</u>	<u>inches/acre</u>	<u>tons/acre</u>
Nitrogen (N)-	0.36	0		
9. Determine the amount of phosphorus and potassium applied from nutrient concentration data on line 4 and nutrient application charts:	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>
Phosphorus (P ₂ O ₅)-	67	0		
Potassium (K ₂ O)-	95	0		
10. Total Nutrients Applied, lb/acre:				
Nitrogen (N)- (Sum of Nitrogen Application Rates from line 3 x Number of Applications on line 2)	224 lb/acre		lb/acre	
Phosphorus (P ₂ O ₅)- (Sum of Phosphorus Application Rates from line 9 x Number of Applications on line 2)	201 lb/acre		lb/acre	
Potassium (K ₂ O)- (Sum of Potassium Application Rates from line 9 x Number of Applications on line 2)	285 lb/acre		lb/acre	

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy Phosphorus Based Waste Application

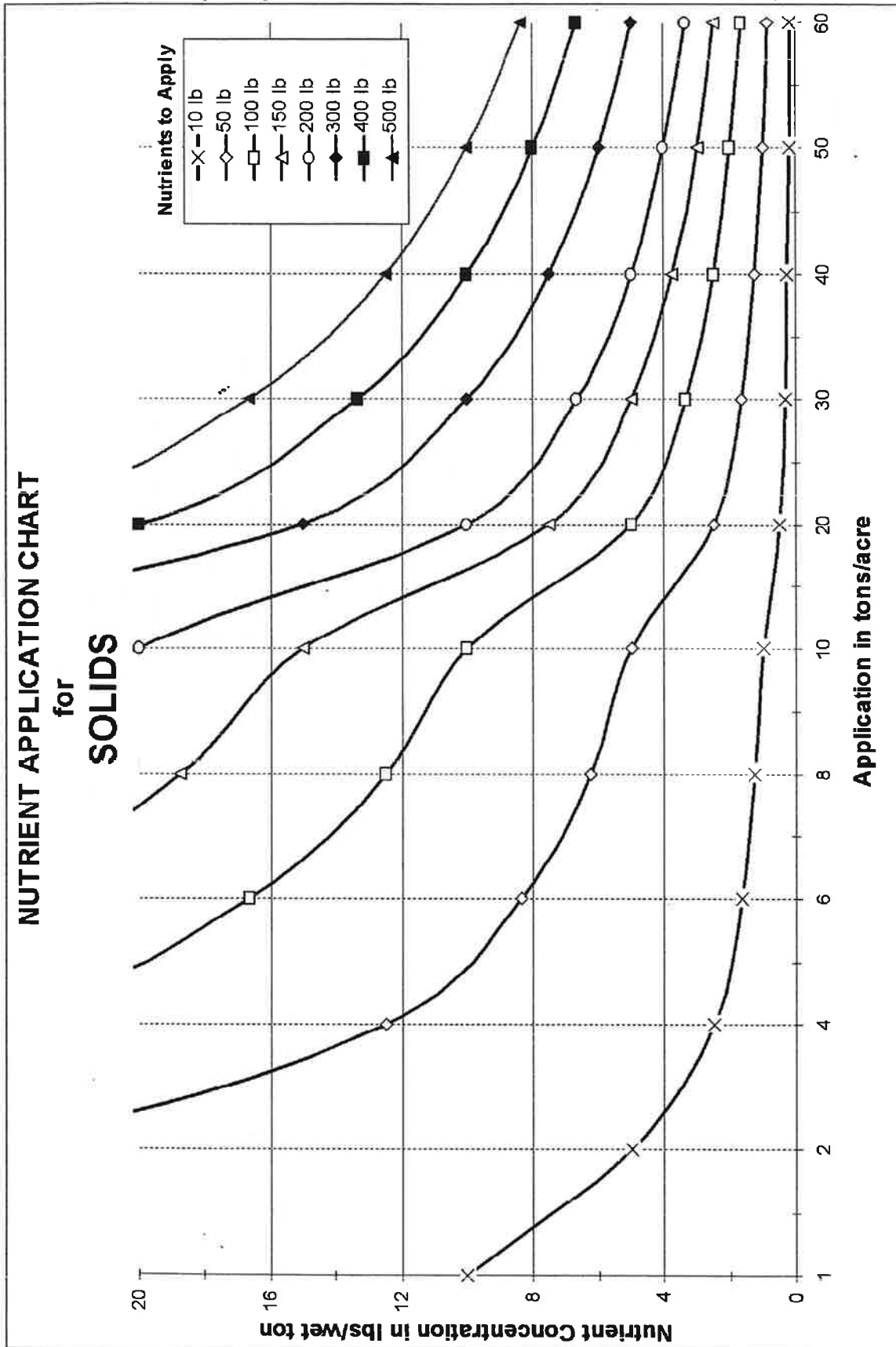
Name: _____ Date: _____

Planned Application:				
Pasture/Hay Land is being grown and the recommended nutrient application from the nutrient management section is 50 pounds of phosphorus (P_2O_5) per acre. A traveling big gun sprinkler will be used to make 1 application of liquids from a waste storage pond.				
Waste application rates and amounts:				
Steps	Planned Application		Current Application	
	Liquid	Solids	Liquid	Solids
1. Crop receiving waste-	Pasture/Hayland			
2. Number of applications to be made-	3	0		
3. Desired phosphorus application rate, lb/acre-	24.3	0		
4. Nutrient concentrations in storage from laboratory analysis:	<u>lb/1000 gal</u>	<u>lb/ton</u>	<u>lb/1000 gal</u>	<u>lb/ton</u>
Nitrogen (N)-	10.2	6.8		
Phosphorus (P_2O_5)-	6.9	3.1		
Potassium (K_2O)-	9.7	4.3		
5. Determine phosphorus application rate from charts on pages 153 and 154:	<u>inches/acre</u>	<u>tons/acre</u>	<u>inches/acre</u>	<u>tons/acre</u>
Phosphorus (P_2O_5)-	0.13	0		
6. Plant availability of nitrogen in percent-	100 %	100 %	%	%
7. Nitrogen retained, in percent, after application from page 144-	75 %	70 %	%	%
8. Calculate nitrogen availability- N line 4 x line 6 x line 7 ÷ 10,000=	<u>lb/1000 gal</u>	<u>lb/ton</u>	<u>lb/1000 gal</u>	<u>lb/ton</u>
	7.65	4.76		
9. Determine the amount of nitrogen and potassium applied from nutrient concentration data on line 4 and nutrient application charts:	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>	<u>lb/acre</u>
Nitrogen (N)-	27	0		
Potassium (K_2O)-	34	0		
10. Total Nutrients Applied, lb/acre:				
Nitrogen (N)- (Sum of Nitrogen Application Rates from line 9 x Number of Applications on line 2)	81 lb/acre		lb/acre	
Phosphorus (P_2O_5)- (Sum of Phosphorus Application Rates from line 3 x Number of Applications on line 2)	73 lb/acre		lb/acre	
Potassium (K_2O)- (Sum of Potassium Application Rates from line 9 x Number of Applications on line 2)	102 lb/acre		lb/acre	

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy



NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy



NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

7.) NUTRIENT AND MANURE APPLICATION PLAN:

(Dave and Casey Schoch may choose a Certified Crop Advisor or Certified Professional Agronomist to develop their plan. NRCS does not endorse individual contractors).

Dave and Casey Schoch has chosen the following to develop the nutrient application plan:

Name: _____

Organization: _____

Phone: _____

If USDA cost-sharing is provided, the application plan will be approved by the following certified Crop Advisor or Professional Agronomist:

Name: _____

Organization: _____

Phone: _____

8.) ADDITIONAL REQUIRED INFORMATION:

- Record keeping forms in Section 10 of the CNMP may be used document manure and fertilizer applications. If other forms or tools are used to document manure and fertilizer applications, contact NRCS for review and approval if cost sharing will be provided.
- A manure application plan is needed that shows planned applications of manure and commercial fertilizer. The manure application plan developed for the CNMP is located in Section 6. The manure application plan will document that N applications do not exceed harvested N on any field and it will document that P₂O₅ applications do not exceed harvested P on fields with high or excessively high P indices.

NOTE TO CONSULTANTS: You may use the fillable forms in the NRCS Nutrient Management and Waste Utilization job sheets to develop the manure application plan. If you want to use different forms please contact NRCS in advance.

9.) SPECIFICATION CHANGES:

This specification is based on current USDA-NRCS standards and federal, state and local regulations. Any changes in these standards or regulations may necessitate a change in this specification.

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

10.) SIGNATURES:

This practice is job class: **I**

CONTROLLING FACTOR	UNITS	JOB CLASS				
		I	II	III	IV	V
AREA	Acres	160	320	640	All	All

Approved by: _____

Date

Farmer Acknowledgement Statement:

- a. The Farmer has received a copy of the specification and understands the contents and requirements.
- b. The Farmer will provide to NRCS the following information before this practice can be certified for cost-sharing approval:
 - ☐ Nutrient and manure application records including soil, water plant and organic by-product test results.
 - ☐ Documentation showing date, crop, amount, rate, form and application method of nutrients applied.
 - ☐ Calibration records for manure.
 - ☐ Annual review of nutrient management including adjustments made.

Dave and Casey Schoch

Date

NUTRIENT MANAGEMENT (590) AND WASTE UTILIZATION (633) SPECIFICATION for Schoch Dairy

11.) PRACTICE COMPLETION AND CERTIFICATION CHECKLIST:

<i>Year</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>
Record Keeping					
Sampling					
N applied at correct agronomic rate					
P applied at correct agronomic rate					
Does the practice meet specifications	Yes No	Yes No	Yes No	Yes No	Yes No
Certified by (intitials)					
Date					

Rating System Used	E = Excellent	G = Good	F = Fair ¹	P = Poor ¹
¹ : Application at this level does not meet standards.				

NRCS Representative

Date

***PRESCRIBED GRAZING (528) AND FORAGE HARVEST
MANAGEMENT (511) SPECIFICATION
for Schoch Dairy***

PRESCRIBED GRAZING (528) AND FORAGE HARVEST MANAGEMENT (511) SPECIFICATION for Schoch Dairy

Prepared for:

Dave and Casey Schoch
24335 NW West Union Road
Hillsboro, OR 97124
(503) 647-2638

Prepared by:

Jennifer Zwicke
1561 NE Greensword Dr.
Hillsboro, OR 97124
(443) 621-2189

Fields: Field 1, 2, 3, 4

(See plan map in Section 5)

Acres: 58

Location:

Date: September 12, 2006

1.) GENERAL CONSIDERATIONS:

Purpose: Prescribed Grazing and Forage Harvest Management are applied as part of a conservation management system to:

- Improve or maintain the health and vigor of plant communities.
- Improve or maintain quantity and quality of forage for livestock health and productivity.
- Improve or maintain water quality and quantity.
- Reduce accelerated soil erosion, and maintain or improve soil condition.
- Improve or maintain the quantity and quality of food and/or cover available for wildlife.
- Promote economic stability through grazing land sustainability.

Threatened and Endangered Species: If USDA cost-sharing will be provided, a Biological Evaluation (BE) for this practice demonstrating No Effect on species listed under the Endangered Species Act will be approved by NRCS before this practice begins.

Cultural Resources: This practice will not affect cultural resources; only pasture and hay land will be affected and soil will not be disturbed below the plow layer. This practice is not an undertaking as defined under NRCS Cultural Resources policy.

Permits: It shall be the responsibility of the Farmer to obtain all necessary permits and/or rights, and to comply with all ordinances and laws pertaining to the application of this practice.

2.) EQIP INCENTIVE PAYMENT:

This practice may be eligible for USDA cost-sharing. Please see the EQIP contract for details on cost-share rates. The participant must contact USDA-NRCS before beginning this practice if cost-sharing will be provided.

**PRESCRIBED GRAZING (528) AND FORAGE HARVEST
MANAGEMENT (511) SPECIFICATION
for Schoch Dairy**

3.) GRAZING MANAGEMENT PLAN:

(Dave and Casey Schoch may choose a Certified Grazing Management Specialist to develop their plan. NRCS does not endorse individual contractors).

Dave and Casey Schoch has chosen the following to develop the grazing management plan:

Name:

Organization:

Phone:

If USDA cost-sharing is provided, the grazing management plan will be approved by the following certified Grazing Management Specialist:

Name:

Organization:

Phone:

PRESCRIBED GRAZING (528) AND FORAGE HARVEST MANAGEMENT (511) SPECIFICATION

for Schoch Dairy

4.) OPERATIONS:

- ☐ The perennial grass-legume pasture shall be grazed on a rotational basis. A minimum of 3 units are required and each unit shall be rested for a period of not less than 20 days or until plants are 6 to 8 inches in height. Grazing shall begin when plants are 6 to 8 inches in height and discontinued when the plants are grazed to a height of 3-4 inches. Overgrazing can cause the quantity and quality of forage to be reduced. Provide dry roughage to reduce the bloat hazard when cattle are grazing on pasture with more than 40 percent legumes. Avoid grazing when soil is saturated.
- ☐ Apply fertilizer and animal waste in accordance with the guidance given in the NUTRIENT MANAGEMENT and WASTE UTILIZATION specification.
- ☐ The pasture shall be clipped and dragged a minimum of twice annually to promote uniform grazing and avoid damage to the plants and/or a reduction in forage production. Clipping and dragging after each grazing period will promote optimum pasture conditions.
- ☐ If rodent, insect or weed control becomes a problem, a pest management program may need to be included. See your local OSU Extension Agent for recommended pest control methods.
- ☐ Follow stocking rates in the grazing plan. If no grazing plan has been developed, use a stocking rule of thumb of one adult animal per acre. To maintain forage production, turn animals on pasture when grass is 6 to 10 inches high and pull them off when grass is 3 inches high.. If it is not practical or desirable to harvest all of the grazeable forage with livestock, consideration should be given to harvest the excess forage as hay. The perennial grass-legume pastures should be cut for hay between the heading and flowering stage.
- ☐ When making hay, cut grasses when they are in the boot stage to produce hay with high quality protein and insure the minimum plant height after cutting is 3 inches to maximize production. Before harvest, clear fields of debris that could damage machinery, or if ingested by livestock, lead to sickness or death.
- ☐ Delay harvest if prolonged or heavy precipitation is forecast that would seriously damage cut forage or forage swaths or windrows would smother underlying plants before removal from the field. Where weather conditions make it difficult to harvest the desired quality of forage, use mechanical or chemical conditioners and/or ensile. When harvested for ensilage forage should be chopped to a size that allows adequate packing to produce the anaerobic conditions necessary to ensure the proper ensiling process.
- ☐ Harvest silage/haylage crops at the ideal moisture range for the type of storage planned. Treat direct cut hay crop silage with chemical preservatives or add dry feed stuffs to avoid fermentation and seepage digestible dry matter losses. For optimal forage quality, rake, ted, or invert swaths, and bale when hay has sufficient moisture to prevent leaf loss. Bale at optimum moisture levels to preserve forage quality and quantity. Approximate percent moisture should be as follows:
 - Bale field cured hay at 15 to 20 percent moisture.
 - Bale forced air dried hay at 20 to 35 percent moisture.
 - Rake hay at 30 to 40 percent moisture.
 - Ted or invert swaths when moisture is above 40 percent.
- ☐ Inspect and repair harvesting equipment following the manufacturer's preventative maintenance procedures. All shields shall be in place during machine operation to prevent injury or death. Shut off machinery before working on or unplugging moving parts.
- ☐ Keep records of grazing and haying to document yields.

**PRESCRIBED GRAZING (528) AND FORAGE HARVEST
MANAGEMENT (511) SPECIFICATION
for Schoch Dairy**

5.) SIGNATURES:

This practice is job class: **III**

CONTROLLING FACTOR	UNITS	JOB CLASS				
		I	II	III	IV	V
AREA	Acres	All	All	All	All	All
ANIMAL UNITS	AUE	50	100	250	350	All
LOWER PRECIP LIMIT NON- IRRIGATED	Inches Per Year	20	16	12	9	All

Approved by: _____

_____ Date

Farmer Acknowledgement Statement:

- a. The Farmer has received a copy of the specification and understands the contents and requirements.
- b. The Farmer understands that the items in the operations section must be followed to ensure successful implementation of the prescribed grazing and forage harvest management practices.
- c. The Farmer will provide to NRCS the following information before this practice can be certified for cost-sharing approval:
 - ☐ Grazing management records that show grazing unit ID, number of animals grazed, date on grazing unit, and date off grazing unit.
 - ☐ Harvest records showing dates of harvest and number of bales harvested or tons of forage harvested.

Dave and Casey Schoch

_____ Date

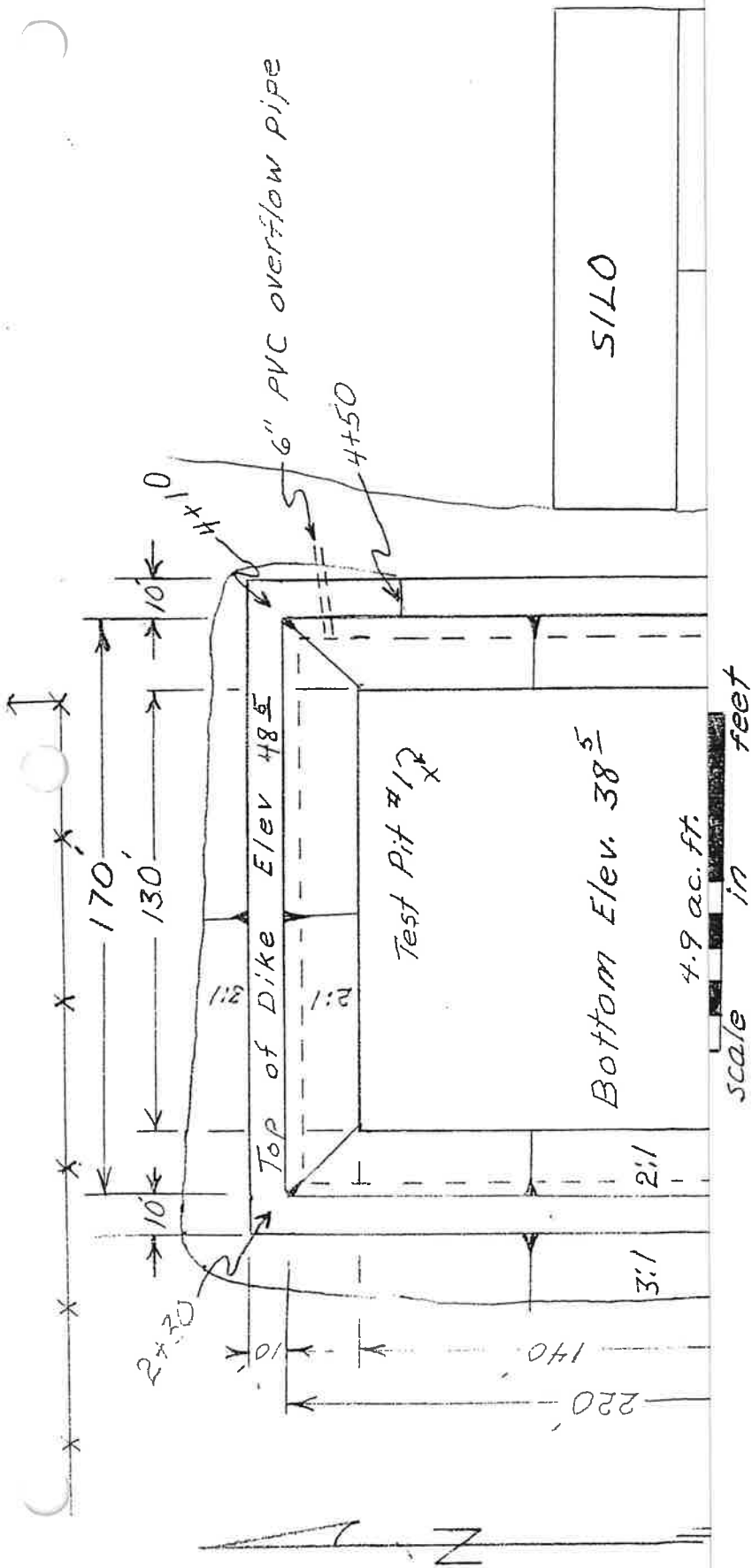
**PRESCRIBED GRAZING (528) AND FORAGE HARVEST
MANAGEMENT (511) SPECIFICATION
for Schoch Dairy**

6.) PRACTICE COMPLETION AND CERTIFICATION CHECKLIST:

<i>Year</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>
Record Keeping					
Grazing Plan					
Does the practice meet specifications	Yes No	Yes No	Yes No	Yes No	Yes No
Certified by (intitials)					
Date					

Rating System Used	E = Excellent	G = Good	F = Fair ¹	P = Poor ¹
¹ : Application at this level does not meet standards.				

***PRESCRIBED GRAZING (528) AND FORAGE HARVEST
MANAGEMENT (511) SPECIFICATION
for Schoch Dairy***



***AS-BUILT DRAWINGS AND DOCUMENTATION
FOR EXISTING PRACTICES***

***AS-BUILT DRAWINGS AND DOCUMENTATION
FOR EXISTING PRACTICES***

Monitoring Soil Nutrients Using a Management Unit Approach

M.L. Staben, J.W. Ellsworth, D.M. Sullivan, D. Horneck,
B.D. Brown, and R.G. Stevens



What's in this publication?

This publication focuses on how to design a soil nutrient monitoring strategy that fits today's requirements for record keeping and increased accuracy in managing nitrogen (N), phosphorus (P), and other nutrients. We advocate the use of management units or zones for soil testing and nutrient application. To measure a real change in soil test values over time, you will need to use consistent management units over many growing seasons.

In this publication, a management unit is considered an area in a field that is soil-sampled and fertilized separately for one or more nutrients. Different management unit delineations may be more appropriate for insect, weed, and disease control; irrigation water management; and other cultural practices.

The management unit approach is designed to provide better information to make nutrient management decisions at a reasonable cost. This approach combines the ease of traditional whole-field sampling and the power of an intensive grid sampling method (see pages 2–3). With a management unit approach, a grower can vary the amount and type of nutrient applications within a field without the need for grid sampling.

A monitoring strategy will answer only the questions it was designed to answer. Each field will have a specific soil sampling strategy. Key questions to consider when developing a soil testing strategy for nutrient management are discussed in this publication, including time of sampling, depth of sampling, number of subsamples, and location for sampling in the management unit.

A soil sampling protocol designed to measure changes in soil nutrient status over time must minimize random variability in soil test results. This is especially important when soil sampling is part of a required nutrient management plan. This publication suggests strategies for minimizing random variability.

Two examples of nutrient monitoring are provided to illustrate the process of deciding when, where, and how to sample, as well as how to interpret the soil test results. One example uses reference sampling areas

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within management units, and the other uses random sampling throughout the management unit. These examples are intended to illustrate the process of using management units to make nutrient management decisions.

What are the advantages of the management unit approach?

The sidebars on this page and the following page describe two approaches to sampling: whole-field sampling and grid sampling. Each sampling strategy has limitations that can be overcome by adopting a management unit approach, as described in this publication.

The goal of using a management unit approach is to save money, and often time,

compared to grid-based sampling methods, while obtaining more accurate data than that provided by whole-field sampling. The management unit approach is designed to provide many of the benefits of grid sampling while overcoming its high cost and other limitations. In many cases, this process allows growers to make fertilizer or amendment applications without the use of global positioning system (GPS) units and expensive variable-rate controllers.

Developing and using management units can allow a producer to apply amendments in varying amounts within a field. Higher levels of a particular nutrient can be applied in areas of the field that are likely to respond or have not reached a critical limit, while less or none can be applied in areas that have higher values and are less likely to respond. In most cases, this type of sampling plan satisfies many regulatory requirements while allowing the crop to be managed in a reasonable way.

Whole-field sampling

The whole-field soil sampling approach is a simple protocol used for many cropping systems. Soil cores are collected from the entire field, mixed together, and a single composite sample is sent to a laboratory for analysis.

The problem with whole-field sampling is that it treats the entire field the same regardless of differences in landscape position, soil characteristics, or cropping history. Thus, conclusions drawn from the soil test may not be appropriate for each part of the field. Often, average nutrient levels are found in only a small part of the field. The rest of the field is either higher or lower than the average. Basing fertilizer application on the field average means that some areas will be overfertilized and others will be underfertilized.

What criteria are used to divide a field into management units?

When deciding how to divide a field into management units, both soil features and the grower's needs and priorities for managing each field should be considered. The goal is to divide fields into areas that are more uniform than the field as a whole.

The basis for consideration can include inherent variability (soil texture, topography, mineralogy, drainage, soil test values), variability associated with current management (tillage, irrigation water distribution), and historical variability (previous crop yields, manure application, field leveling, old fence lines) within a field. The minimum size of a management unit should be defined by equipment size, so that each management unit is large enough to be fertilized separately.

Grid sampling

The most accurate picture of the characteristics of a field would be produced by sampling every point within the field. Since it is impractical to do so, grid sampling can be used as an improvement over whole-field sampling. First, a field is systematically divided into areas of uniform size and shape (called cells) to form a grid. Cells often consist of 1 to 5 acres. Then, samples (consisting of a composite of 10 or more cores) are taken from each cell and analyzed. Thus, each cell has its own sample and analysis result.

The purpose of grid sampling is to create a detailed map of the field that allows the grower to identify areas that will receive a unique management practice. Using software that estimates soil test results between cells, patterns of estimated nutrient availability can be determined and a nutrient application map created.

The main challenge of grid sampling is its expense. A 125-acre field can have as many as 125 individual samples (if the field is divided into 1-acre cells). On a farm of several hundred acres, the cost of sampling (labor and equipment) and lab fees can become prohibitive. On the other hand, some labs give a substantial discount to growers who grid sample.

Grid sampling does not need to be done every year for most soil tests. The cost could be spread over a rotation by sampling intensively before one crop to create management units and then taking a few samples in subsequent years to verify the spatial patterns of soil nutrients.

Another limitation to grid sampling is that the grid spacing chosen may either obscure or exaggerate variability caused by a regular pattern such as wheel rows or movable sprinkler lines. However, modified versions of grid sampling patterns can overcome this potential weakness.

Dividing a field into management units is a combination of art and science. The management unit approach for soil sampling described in this publication enables growers to use their knowledge of the field to help define management units. Often, management units can be delineated on the basis of soil color or other landscape features that are easy to identify visually.

Certain field features, such as areas where soil was removed for field leveling, are not clearly delineated on most maps. However, you might be able to obtain cut-and-fill maps from the operator who did the leveling. Such maps can be quite useful in delineating nutrient management units.

Consider using other sources of information to delineate management units. Maps produced from remote sensing data (e.g., aerial photos or satellite imagery) and yield monitors are useful visual aids. Other tools include geographic information systems (GIS) software and GPS units.

Time and skill are required to manipulate the raw map data into a format that allows overlay of maps for the same field. After a multiple layer map is created, many factors can be considered simultaneously to delineate management units. These maps are also useful for recording soil sampling locations within the field.

Where should I collect soil samples from within a management unit?

Collect soil cores throughout each management unit (unit sampling) or from a smaller reference sampling area within a management unit (Figure 1). Select one of these approaches, and use it consistently.

In the center-pivot irrigated field shown in Figure 1, each of the three management units is delineated by one or more soil properties or management practices. For example, Management Unit 1 may be an eroded hilltop, Management Unit 2 may consist of side slopes with shallow topsoil,

and Management Unit 3 may consist of bottomlands with poor drainage and high organic matter. The sampling plan for the field on the left (A) uses a zigzag pattern to collect subsamples, or cores, across the entire management unit. Soil cores collected within each management unit are composited into one sample for that management unit. In the field on the right (B), reference sampling areas are established away from the edges of the field but near access points such as the pivot road.

The sampling location for each core may or may not be recorded (georeferenced).

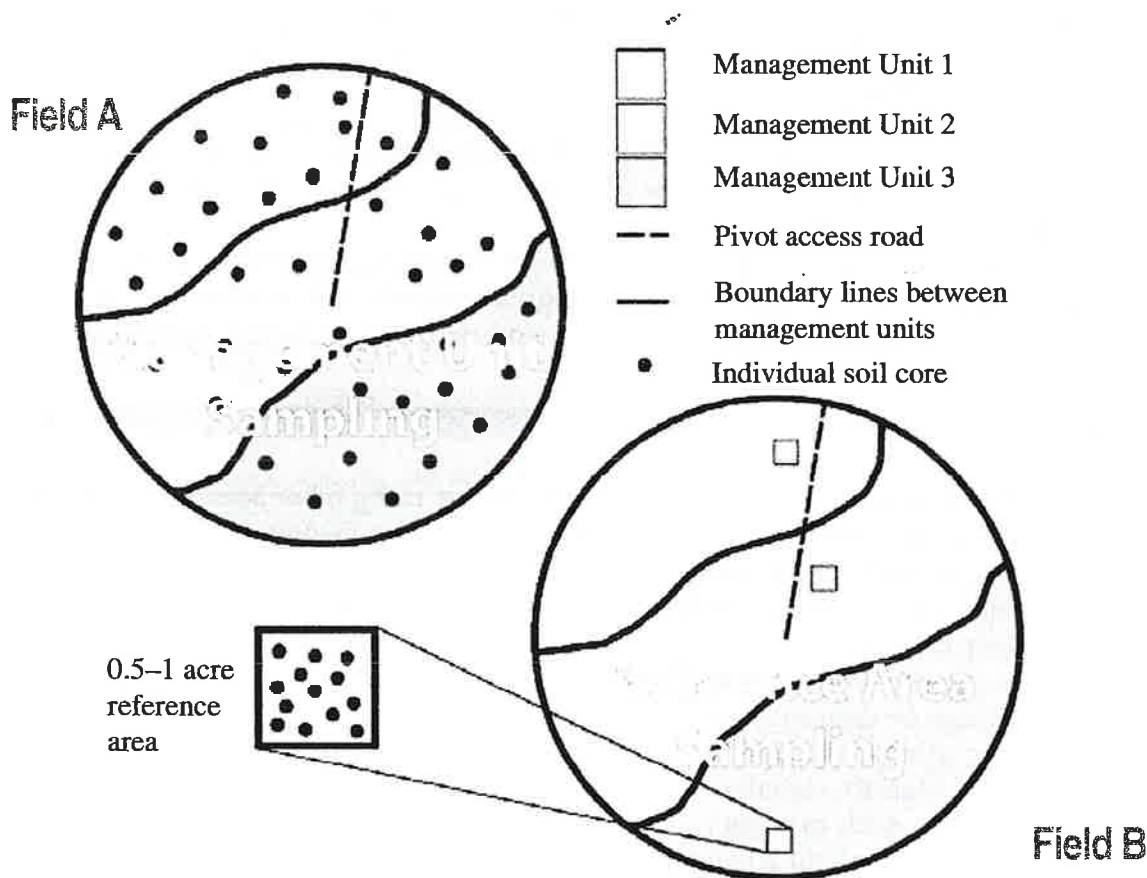


Figure 1.—Aerial view of two fields with a center-pivot overhead sprinkler irrigation system that have been divided into three management units. The top left field (A) illustrates a random sampling approach for sampling within each management unit. The lower right field (B) illustrates the reference sampling area approach for sampling within each management unit.

The benefit of georeferencing sampling locations is that in subsequent years you can return to the same areas with some degree of accuracy and minimize year-to-year variability. Georeferencing commonly is done with a GPS unit. Currently, the least expensive units can be accurate to ± 15 to 20 feet, under ideal conditions. Alternatively, it may be possible to install markers in the field that will withstand farming practices, allowing them to be found for future sampling.

For either the unit or reference sampling approach, avoid collecting samples from small, atypical areas such as animal feeding areas, gate and watering areas, corral and home sites, old roads, field edges, and eroded hilltops. It might be useful to analyze such samples separately for possible consideration as separate management units.

Management unit sampling approach

Take individual soil cores (10 or more) randomly over the entire management unit and mix them into a composite (Figure 1a).

Advantages of sampling randomly within management units include:

- One sample represents the entire management unit.
- Likely to provide better data than the reference sampling area approach when uniformity in soil or management practices (e.g., manure application) is uncertain.

Disadvantages of sampling randomly within management units include:

- Sample collection requires more time compared to sample collection by the reference sampling area approach (described at right).
- Heavy sampling equipment, if required, must be moved across the management unit.

Reference sampling area approach

Reference sampling areas are smaller sampling areas within a management unit. They can be used for representative soil sampling and other crop monitoring activities, such as plant tissue sampling, soil moisture measurement, or crop yield estimates. This method is most beneficial when heavy sampling equipment is used or when the management unit is very uniform.

The intensity of management and variability of the field should dictate how large an area can be represented by one reference sampling area. A local expert (university Extension personnel; private certified crop advisor, agronomist, or soil scientist; or Natural Resources Conservation Service personnel) can be consulted to assist you in determining what might be appropriate for your situation.

Reference sampling areas should be representative of the entire management unit and easy to access. To make sure a reference sampling area is representative, compare soil test values from proposed reference sampling area(s) with soil test values for a composite sample taken from the entire management unit (see "Management unit sampling approach").

Within each management unit, select an area of 0.5 to 1 acre for each reference sampling area (Figure 1b). Plan to georeference the four corners of the sampling area to minimize year-to-year variability. Ways to georeference reference sampling areas, besides using GPS, include using specific tree numbers in an orchard, measuring the distance from a fence or fixed equipment, or installing markers.

Advantages of reference sampling areas include the following.

- Fields can be sampled more quickly.
- It is easier to georeference sampling locations.

- You can use more than one reference sampling area within a management unit to allow for differences in known management variables (e.g., irrigation water distribution).
- There is more year-to-year consistency due to less spatial variability.

Disadvantages of reference sampling areas include the following.

- The reference sampling area may not represent the management unit as a whole.
- If georeference coordinates or field markers are lost, the exact location of the reference sampling area may be lost.
- Heavy traffic within the reference area may occur if care is not taken.
- The sampling area will be compromised if a nutrient or other amendment spill occurs within the reference sampling area.

The reference sampling area approach often is used for in-season testing for soil nitrate, because:

- More soil cores can be collected in a given amount of time.
- Fixed soil moisture monitoring sites (e.g., neutron probe) can be located within the same reference sampling area.
- Reduced sampling equipment traffic over the field reduces crop damage and soil compaction.

How to develop a plan for soil nutrient monitoring

Soil test data will answer only the questions the test was designed to answer. The following steps and questions can help you design a monitoring system tailored to your needs (Table 1). Two examples of how to develop a plan are included (see Examples 1 and 2, pages 10–13).

Table 1.—Considerations and questions for designing a soil nutrient monitoring plan.

Soil monitoring considerations	Specific questions
Objectives	<ul style="list-style-type: none"> • What is (are) your objective(s) for nutrient monitoring? • What nutrients or other soil chemical properties do you want to measure? • Are you required by any agreement to monitor specific nutrients or soil chemical properties?
Where to sample	<ul style="list-style-type: none"> • Should you collect samples throughout the management unit, or use a reference sampling area? • Do you plan to georeference locations where soil cores are collected? • What method will you use to georeference sampling locations?
How to sample	<ul style="list-style-type: none"> • When should samples be collected? • What soil sampling depth(s) are appropriate? • How many soil cores will be collected for each composite sample sent to a laboratory for analysis? • Should you sample using a zigzag approach or a systematic sampling method within the sampling area?

Table 2.—Typical frequency for assessment of changes in soil test values.

As needed for specific cropping system	Annually**	Periodic (once per crop rotation or every 3 to 5 years)	Once, if necessary, for initial site assessment
Nitrate-N (NO ₃ -N)*: preplant, in-season, or postharvest	extractable boron (B), total or sulfate-sulfur (S)***, electrical conductivity (EC)	pH, lime requirement, Bray or Olsen P, extractable bases (K, Ca, Mg, Na), extractable micronutrients (DTPA-Zn, Mn, Cu, Fe)	soil texture, cation exchange capacity (CEC), organic matter

* Soil testing frequency for nitrate-N varies widely for different cropping systems.

** For cropping systems with high-sodium (Na) irrigation water, an annual test for sodium absorption ratio (SAR) is recommended. The SAR test includes determination of exchangeable calcium (Ca), magnesium (Mg), and sodium (Na).

*** For sulfur (S), plant-tissue testing is preferred over soil testing. Soil test sulfur (sulfate-S or total S) is not a good predictor of crop yield response to S fertilizer in many situations.

Objectives

Think carefully about your objectives. Soil testing can be used just to monitor nutrient levels for record-keeping requirements, or it can be used to guide nutrient application decisions. Agricultural professionals (university Extension personnel; private certified crop advisors, agronomists, or soil scientists; and Natural Resources Conservation Service personnel) often can help in designing a customized sampling strategy.

What nutrients or other soil chemical properties do you want to measure?

Soil tests that provide useful information for nutrient management purposes are listed in Table 2.

One of the goals of a soil testing program may be to avoid excessive application of nutrients or salts. Repeated application of organic materials, such as compost, manure, or biosolids, typically results in buildup of one or more nutrients, and

possibly soluble salts. As an example, if manure application rates are based on supplying enough N for the crop, other nutrients (e.g., phosphorus and potassium) usually are added at rates greater than crop utilization. Soil testing can be used to track nutrient accumulation over time.

Because each organic material (e.g., manure, biosolids, compost) contains a unique balance of nutrients, a nutrient analysis of the organic material often is helpful in deciding which soil tests are appropriate. General information about the nutrient concentrations present in various organic materials can be found in Extension publications (see "For more information").

Several tests commonly offered by agricultural testing laboratories—organic matter, ammonium-N (NH₄-N), and sulfur (S)—are less useful in assessing management effects on soil fertility. Their shortcomings are discussed briefly here.

Soil sampling for ammonium-N ($\text{NH}_4\text{-N}$) is not recommended unless fertilizer or other organic amendments have been applied during the past 30 days, or if soil has remained dry or cold since N application. In most situations, ammonium-N is rapidly converted to nitrate-N ($\text{NO}_3\text{-N}$) in soil.

Soil organic matter testing often is part of a "routine" soil test, but it has limited value for nutrient management. Most fertilizer guides for irrigated crops do not use soil organic matter as a basis for nutrient management recommendations. (Some dryland fertilizer guides use soil organic matter values to adjust N recommendations.)

Soil organic matter content changes very slowly in response to management changes (tillage or organic amendment addition). Annual testing of soil organic matter is not recommended because random measurement error usually obscures small changes in organic matter content over time. Periodic soil organic matter testing (once per crop rotation or every 5 years) may be useful in measuring the impact of long-term management changes that are expected to build soil organic matter.

For sulfur (S), plant-tissue testing is preferred over soil testing. Soil test sulfur (sulfate-S or total S) is not a good predictor of crop yield response to S fertilizer in many situations.

Are you required by any agreement to monitor specific nutrients or soil chemical properties?

Nutrient management plans required by state or federal agencies often specify required soil analyses and sampling frequency. At a minimum, a sampling plan should meet agency requirements (if applicable). For example, landowners who participate in the Natural Resources Conservation Service (NRCS) Environmental

Quality Incentives Program (EQIP) for nutrient management often are required to collect soil test data according to NRCS specifications.

Where to sample

Collect soil cores throughout each management unit (unit sampling) or from a reference sampling area within each management unit, as discussed previously in "Where should I collect soil samples from within a management unit?"

How to sample

When should samples be collected?

The recommended sampling frequency is based on the rate of change in soil test values over time (Table 2). Tests for soil characteristics that do not change greatly in response to fertilizer or organic amendment addition (e.g., soil texture and cation exchange capacity) often are not necessary.

Timing of soil sampling is most critical for nitrate-nitrogen, because this form of N is mobile in soil water. Generally, it is best to collect soil samples for nitrate-N analysis close to N fertilizer application time.

Soil tests for soil characteristics that change slowly in response to management (periodic soil tests in Table 2) are recommended once per crop rotation or every 3 to 5 years. For these tests, small variations occur seasonally due to soil biological processes, crop residue decomposition, soil water status, and tillage. In determining management effects on these soil test values, develop a consistent protocol for the timing of sample collection.

What soil sampling depth(s) are appropriate?

Consult university fertilizer guides or nutrient management guides for the crop. Determine the soil sampling depth and any other special considerations for soil sampling in a particular cropping system. For many agronomic crops, interpretive tables

for soil test values are based on a sample taken to a 0- to 6-inch or a 0- to 12-inch depth. However, some N recommendations are based on sample depths up to 24 or 48 inches.

Using shallower sampling depths, in some cases, can allow for the detection of changes in soil nutrient status before they would be detected using a traditional sampling depth (6 or 12 inches). For pastures and some perennial crops where tillage is absent, nutrients with limited mobility (e.g., P and K) may accumulate near the soil surface. Sampling closer to the soil surface increases the probability of detecting changes in soil test values over time.

In some cases it is useful to split a sample by depth. For example, if the uni-

versity guide is based on a 12-inch depth, it might be useful to collect two samples, 0 to 3 inches deep and 3 to 12 inches deep. Splitting the samples by depth allows you to compare soil test values for the 0- to 12-inch depth (weighted average of 0- to 3- and 4- to 12-inch depths) with the fertilizer guide, while also evaluating changes in surface soil test values (0 to 3 inches) over time. Table 3 shows how to calculate a weighted average.

How many soil cores should you collect for a composite sample?

Increasing the number of soil cores (subsamples) taken in a sampling area generally increases the accuracy of the data. Fewer soil cores are needed to represent a smaller sampling area (Table 4). Mix soil cores thoroughly and submit a

Table 3.—Calculating a weighted average.

How measured	Sample depth (inches)	Soil core length (inches)	Soil test value (ppm)
Sampled	0-3	3	40
Sampled	4-12	9	20
Calculated*	0-12	12	25

*Weighted average of 0- to 3- and 4- to 12-inch depths is derived by:

$[(\text{core length} \times \text{soil test value}) + (\text{core length} \times \text{soil test value})] \div \text{total sample depth}$

Example: $[(3 \times 40) + (9 \times 20)] \div 12 = 25$

Table 4.—Minimum number of cores per sample and size of sampling areas.

	Whole field	Entire management unit	Reference sampling area within management unit
Minimum cores/sample	20	10	5-8
Minimum acres/site	100% of field	varies	1% or less of management unit

composite sample to the laboratory. Check with the laboratory to determine the amount of soil needed for the desired analyses.

Should you sample in a zigzag pattern or use a systematic sampling method within the sampling area?

For some crops, a zigzag pattern or other haphazard approach to collecting soil cores is appropriate. Systematic sampling perpendicular to a furrow-irrigated bed, fertilizer band, or perennial crop row sometimes is used to reduce variability in test results. If you choose a systematic sampling method, you must use it consistently in order to compare soil test values over time.

Sampling checklist

Consistent sampling techniques are essential. Make sure each of the following aspects (each was discussed above) will be handled before going to the field to take soil samples:

- Nutrients to be monitored
- Size and location of management units or reference sampling areas
- Sampling depth(s)
- Number of cores per composite sample
- Systematic sampling instructions (if applicable)

See "For more information" for publications describing routine soil sampling collection and handling techniques.

Example 1: Monitoring nitrogen in a silage corn field

Two years ago a grower purchased a 75-acre field. The new owner has no soil test data and little information on how the field was managed. He plans to conventionally till the field and plant it to silage corn and is concerned about how best to manage nitrogen fertilization. He uses best management practices to ensure timely

and even distribution of irrigation water via overhead sprinklers.

The grower has a 20-year old aerial photo of the field and the soil survey report for the area. The photo shows that there was a corral in a part of the field. The grower decides that the former corral area will need to be a separate management unit (Management Unit 1), and the rest of the field will be the second management unit (Management Unit 2).

Developing a monitoring plan

Nutrient monitoring objectives

The grower wants to determine an appropriate nitrogen application rate for silage corn in this field. From a longer term perspective, by creating management units, he will be able to more closely meet the nutritional needs of the crops and, ideally, to reduce his fertilizer expenses and possible nitrate loss from the field.

Because part of the field has been a corral, the grower suspects this area may have a higher nutrient-supplying capacity than the rest of the field. The grower does not own livestock and will not be applying manure to the field.



Table 5.—PSNT and at-harvest stalk nitrate-nitrogen for Example 1.

	Nitrate-nitrogen (mg/kg or ppm)	
	Management Unit 1 (old corral site)	Management Unit 2 (rest of field)
Soil test (PSNT) at six-leaf growth stage	30	10
Corn stalk at harvest	4,500	5,500

Sampling approach

The grower wants to keep his sampling plan fairly simple by using reference sampling areas in the two management units. The reference sampling areas are located on the same side of the field and are fairly close to the road for easy access. Should plant tissue testing become necessary, those samples also will be taken from the reference sampling areas.

The grower has a GPS unit and uses it to record the location of the four corners of the reference sampling areas in the two management units. He collects 10 cores (5 cores is the minimum per unit) in each reference sampling area to create a representative sample.

Both soil and plant tissue testing will be used to monitor crop N status. Soil samples (0- to 12-inch depth) will be collected at the six-leaf growth stage. Plant tissue (corn stalks) will be collected at harvest. A university nutrient management guide, *The Presidedress Soil Nitrate Test (PSNT) for Western Oregon and Western Washington*, will be used to determine methods used in soil and plant tissue sampling. The guide also will be used to interpret soil test and plant tissue test results.

Results

Table 5 shows the results of soil and tissue testing for both management units.

The presidedress soil nitrate test value for Management Unit 1 (previous corral

site) was above the 25 ppm nitrate-N sufficiency level given in the nutrient management guide. Thus, fertilizer N was not applied to this unit. Nitrogen was applied at sidedress time to Management Unit 2 at a rate of 100 lb N per acre as recommended in the guide.

The at-harvest stalk nitrate-N concentration in corn from Management Unit 1 was in the range required for optimum yield (above 3,500 ppm) given in the nutrient management guide. This result confirmed the decision not to sidedress N fertilizer in that management unit. Corn in Management Unit 2 had an at-harvest stalk nitrate value of 5,500 ppm, indicating that sufficient N was present for maximum yield. By using the management unit approach, yields were maintained and N fertilizer use was reduced.

Example 2: Monitoring soil phosphorus over a 6-year period

A grower has a 105-acre field that is irrigated with overhead sprinklers mounted on a wheel line. He wants to utilize composted manure from a drylot dairy and commercial fertilizers to supply nutrients for potatoes, a spring small grain crop, and a winter small grain crop grown in a 3-year rotation.

The grower worked with a consulting soil scientist to define management units for this field. The field was leveled many

Table 6.—Nutrient management strategies for Example 2.

Management unit	Initial soil test P	Strategy
1	15	Apply compost every year.
2	21	Apply compost every third year.
3	29	No compost applied.

years ago when it was furrow irrigated. Bare-soil aerial photographs were used to delineate management units defined by the amount of exposed subsoil. Soil color was directly related to topsoil depth, soil organic matter content, and soil test values. The management unit with the lightest color on the aerial photo, Management Unit 1, had the lowest organic matter content and the lowest soil test P value (15 ppm bicarbonate extractable P). Management Unit 3 had the highest organic matter content and the highest soil test P (29 ppm). Management Unit 2 had intermediate organic matter and intermediate soil test P (21 ppm).

Developing a monitoring plan

Nutrient monitoring objectives

The goal of the soil testing program is to efficiently use a combination of composted manure and fertilizer P to satisfy crop needs. Composted manure will be applied each year to Management Unit 1 (lowest soil test P) and every third year to Management Unit 2 (intermediate soil test P). Management Unit 3 will not receive composted manure application because it has higher soil test P values. (See Table 6.)

The phosphorus fertilizer rate for each crop will be determined using university nutrient management guides in conjunction with P soil test values for Management Unit 2 (intermediate soil test P) (Table 6). Phosphorus fertilizer (if needed for a particular crop) will be placed near the row

at a single rate across the entire field. The grower does not have equipment capable of delivering a variable rate fertilizer application.

Sampling approach

Annual sampling will be used to track changes in soil test P over time. Because composted manure distribution across the field is not always uniform, the grower chooses a random sampling scheme, collecting soil cores in a zigzag pattern through each management unit. He records each management unit boundary and soil core collection location with a GPS unit to minimize year-to-year variation.

Management units will be sampled every year in the late winter or early spring. Samples will be taken at the 0- to 12-inch depth, as this is the depth recommended in university fertilizer guides for this region. From each management unit, 10 cores will be taken and composited into a single sample.

Results

Figure 2 (page 13) shows that soil test P values remained relatively constant in each management unit in the field over a 6-year period. All crops received adequate P for maximum yield.

The management unit approach allowed the grower to continue composted manure application to the portion of the field where additional P has agronomic benefit (Management Unit 1), while avoiding excess P buildup in the portion of the field

with higher soil test P values (Management Unit 3). Fertilizer costs were reduced because a portion of crop P needs was supplied by composted manure.

For more information

Franzen, D.W. and L.J. Cihacek. Soil Sampling as a Basis for Fertilizer Application, SF-990 (North Dakota State University, revised 1998).

Mahler, R.L. and T.A. Tindall. Soil Sampling, Bulletin 740 (University of Idaho, revised 1994).

Marx, E.S., N.W. Christensen, J. Hart, M. Gangwer, C.G. Cogger, and A.I. Bary. The Pre-sidedress Soil Nitrate Test (PSNT) for Western Oregon and Western Washington, EM 8650 (Oregon State University, reprinted 1997).

Marx, E.S., J. Hart, and R.G. Stevens. Soil Test Interpretation Guide, EC 1478 (Oregon State University, reprinted 1999).

Many OSU Extension Service publications, including fertilizer guides for a variety of crops, may be viewed or downloaded from the Web. Visit the Publications and Videos catalog at <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 or contact us by fax (541-737-0817), e-mail (puborders@oregonstate.edu), or phone (541-737-2513).

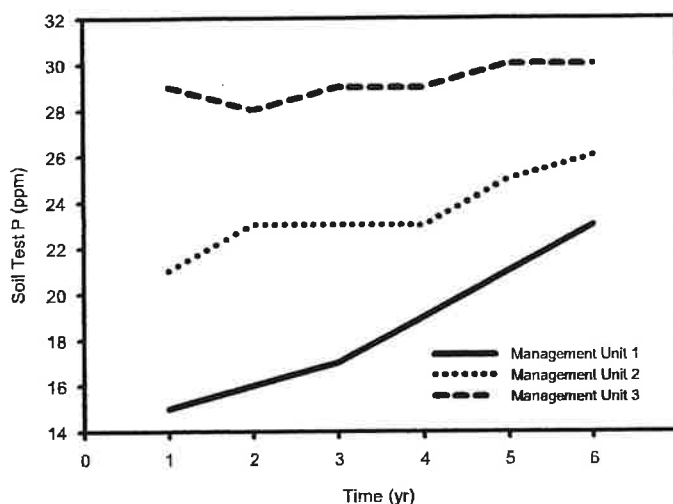


Figure 2.—Soil test P values for three management units in Example 2.

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.

The authors acknowledge the review comments on the draft publication provided by the following members of the CSREES Western Region Coordinating Committee (Nutrient Management and Water Quality; WCC-103): Stewart Pettygrove, University of California Cooperative Extension, Davis, CA; Russell Yost, University of Hawaii, Honolulu, HI; Nat Dellavalle, Dellavalle Laboratory, Inc., Fresno, CA; Robert Miller, Colorado State University, Fort Collins, CO.

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Published October 2003.

NUTRIENT MANAGEMENT
FOR DAIRY PRODUCTION

The pre-sidedress soil nitrate test (PSNT)

for Western Oregon and Western Washington

E.S. Marx, N.W. Christensen, J. Hart, M. Gangwer, C.G. Cogger, and A.I. Bary

What is the Pre-sidedress Soil Nitrate Test (PSNT)?

The Pre-sidedress Soil Nitrate Test (PSNT) evaluates nitrogen fertilizer needs for field corn. The PSNT can help ensure maximum yields without excessive nitrogen fertilizer applications. The benefits are reduced fertilizer purchases and reduced risk of environmental contamination.

Who can benefit from the PSNT?

Anyone producing corn for feed can potentially benefit from the PSNT. Growers who apply manure to their fields are especially likely to benefit. The organic matter in manure contributes nitrogen that is not well accounted for by other soil test methods.

Why does the PSNT tell more about nitrogen availability than early spring soil tests?

Soil tests performed in early spring do not tell how much nitrogen might be available later in the growing season. Most soil nitrogen is held in organic matter and is unavailable to growing plants. As the soil warms up, increased biological activity converts organic nitrogen into

plant-available inorganic forms (Figure 1). An early spring soil test does not take this nitrogen into account. Thus, if you base fertilization on an early spring test, you might apply too much fertilizer.

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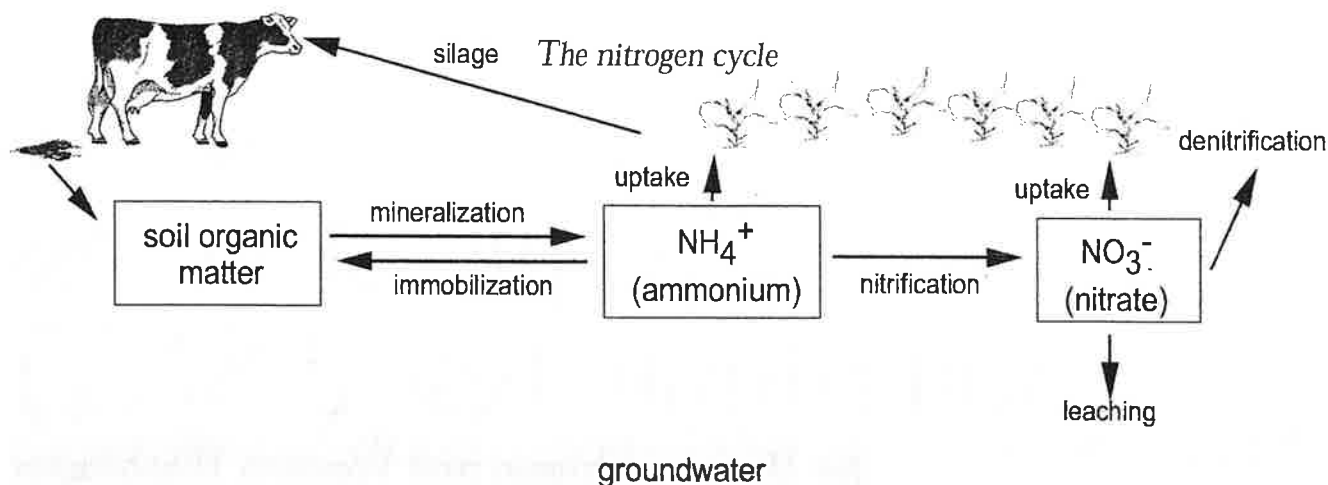


Figure 1.—Organic nitrogen in soil is converted through mineralization to plant-available inorganic forms (NH₄⁺ and NO₃⁻), which are taken up by growing plants.

The PSNT measures soil nitrate (NO₃⁻-N) during the growing season, after some nitrogen has become plant-available and just prior to the crop's period of greatest need.

How much N should I apply before planting?

If needed, apply no more than 40 lb N/acre as a starter in spring. Most fields with a history of manure applications require no starter N fertilizer. If starter N is needed, it can be supplied by manure or commercial fertilizers.

Delay as much N fertilization as possible until midseason. If the midseason PSNT shows low N levels, make a sidedress fertilizer application.

When is the best time to measure soil nitrate?

Corn plants begin their greatest uptake of nitrogen around the 5-leaf stage, or when the plants are

about 12 inches tall at the center of the whorl. The best time to evaluate soil nitrogen is just prior to this period of rapid uptake (Figure 2).

How much N is enough?

A PSNT value of 25 ppm or greater is sufficient for maximum silage corn yields. If the PSNT value is below 25 ppm, apply nitrogen at the rates shown in Table 1.

Nitrogen can be supplied by manure or commercial fertilizer. Most dairies produce enough manure to supply needed N, making fertilizer purchases unnecessary. See EM 8585, *Manure Application Rates for Forage Production*, for more information.

What if I apply more N than the crop needs?

Excess nitrogen will not be used by the crop and will remain in the soil after harvest. During winter, rain may wash nitrate from the soil into surface and ground waters. This poses a threat to human and environmental health and wastes fertilizer dollars.

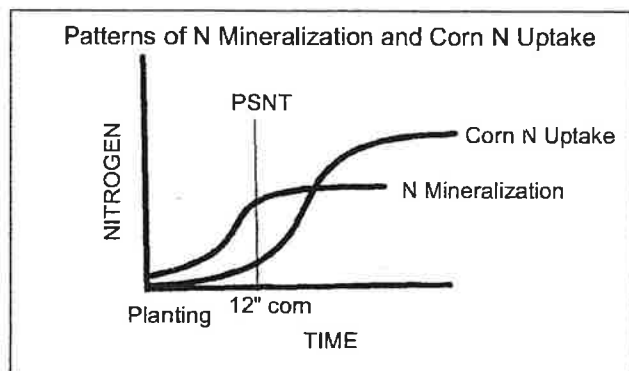


Figure 2.—Perform the PSNT when corn is 12 inches tall (before rapid nitrogen uptake by corn and after some nitrogen mineralization has occurred).

Table 1.—Suggested N fertilization rates based on PSNT values.

PSNT value (ppm NO ₃ ⁻ -N)	Estimated N to apply (lb N/acre)
0-10	100-175
10-20	50-100
20-25	0-50
over 25	0

Soil sampling and handling procedures

- 1** **When to sample.** Sample soil when the corn has 5 *collared leaves*, or at least a week before planned sidedressing. This usually coincides with a plant height of about 12 inches at the center of the whorl.



- 2** **Where to sample.** Sample between rows, away from fertilizer bands. Avoid irregularities in the field, such as low areas or places where manure has accumulated.
- Collect a composite sample of 15–20 cores. The more cores you collect, the better your chance of getting an accurate measurement.



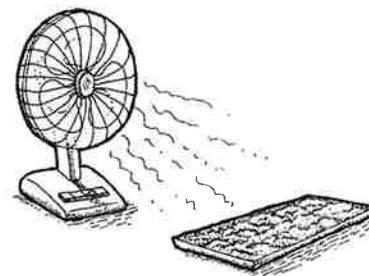
- 3** **How to sample.** Sample soil to a depth of 12 inches.



- 4** **Preparing the sample.** Mix the sample thoroughly in a clean container. Save a subsample sufficient to fill a soil sample bag.

Dry this sample immediately. Drying is important to stop biological activity, which could alter soil nitrate content. Dry the sample by spreading it on a clean piece of paper in a warm, well-ventilated area. A fan can increase air flow. Do not use a microwave oven to dry the sample.

If you cannot dry the sample immediately, refrigerate it in a cooler and dry it later the same day. If you cannot dry or deliver the sample to a lab the day it is collected, freeze it.



- 5** **Soil analysis.** Send the sample to a soil testing lab to be analyzed for nitrate-nitrogen ($\text{NO}_3\text{-N}$). See FG 74, *A List of Analytical Laboratories Serving Oregon*, for a list of labs.



- 6** **Interpreting results.** If soil nitrate levels are above 25 ppm, no additional nitrogen fertilizer is needed. If soil nitrate levels are below 25 ppm, apply fertilizer at the rates shown in Table 1.

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Hart, J. *A List of Analytical Laboratories Serving Oregon*, FG 74 (Oregon State University, Corvallis, revised 1996). No charge

Hart, J., M. Gangwer, M. Graham, and E.S. Marx. *Manure Application Rates for Forage Production*, EM 8585 (Oregon State University, Corvallis, 1996). \$1.00

Hart, J., E.S. Marx, and M. Gangwer. *Dairy Manure as a Fertilizer Source*, EM 8586 (Oregon State University, Corvallis, reprinted 1996). \$1.00

Other publications

Magdoff, F. Understanding the Magdoff Pre-sidedress Nitrate Test for Corn. *Journal of Production Agriculture* 4 (1991): 297-305.

Marx, E.S. *Evaluation of Soil and Plant Analyses as Components of a Nitrogen Monitoring Program for Silage Corn* (Master's thesis, Oregon State University, 1995).

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.



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Post-harvest Soil Nitrate Testing for Manured Cropping Systems West of the Cascades

D.M. Sullivan and C.G. Cogger

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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)

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

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

The post-harvest test and how to use it

What the post-harvest test measures

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

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

Use the post-harvest test to:

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

Soil sampling protocols

Sampling depth

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

Composite soil sample

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

What fields to sample

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

When to sample

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

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

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

continues on page 5

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

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

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

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

Using the test as part of a nutrient management program

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

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

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

Limitations to test results

Interpretive values for post-harvest soil nitrate are:

- ◆ Calibrated only for high-rainfall portions of the Pacific Northwest (west of the Cascades). Extrapolation to other environments is not recommended.

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

How *not* to use the post-harvest test

The test will *not*:

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

Crop and soil response to excess plant-available N

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

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

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

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

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

- ◆ Grass has a greater capacity to take up N supplied in excess of that needed for maximum yield. After enough N has been supplied

for maximum yield, grass protein content increases in response to increased N supply. With grass, soil nitrate increases only when the available N supply exceeds that required to produce near-maximum protein. Corn does not take up additional N after the maximum yield is reached. Corn silage protein does not increase much in response to excess N supply.

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

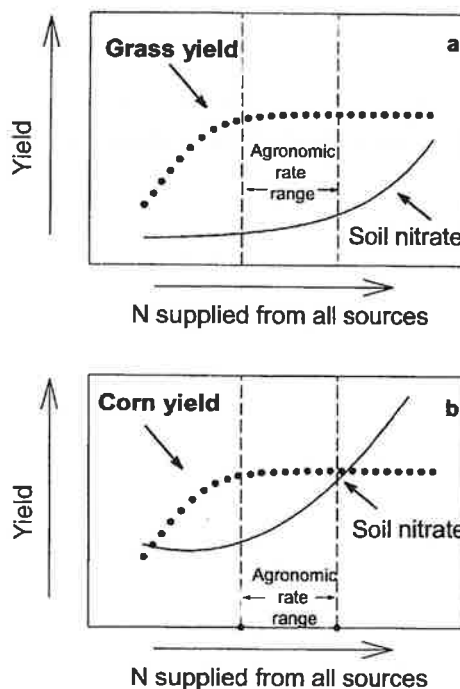


Figure 1.—Crop yield and soil nitrate response to increased N supply. Agronomic rate range = range of N supplied from all sources that results in near-maximum crop yield with acceptable post-harvest nitrate accumulation. Above the agronomic rate range, excess N accumulates as nitrate in soil. More nitrate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

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

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

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

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

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

Units used in soil nitrate testing

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

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

Name	Interpretation	Equivalent units
nitrate-N or NO ₃ -N	N present in the nitrate form, soil dry weight basis	mg/kg or ppm (dry weight basis)

about 3.5 million pounds (3.5 lb per acre-foot = 1 ppm).

Interpreting soil nitrate test results

Data quality and variability

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

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

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

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

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

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

Interpretation for individual fields

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

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

Annual averages across grass and corn crops

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

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

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

Using the interpretive tables (Tables 3 and 4)

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

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

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

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

- ◆ Continue present N management.

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

- ◆ Reduce or eliminate sidedress N fertilizer application. Use the pre-sidedress nitrate test (PSNT). Apply sidedress N only when PSNT indicates a need.
- ◆ Reduce lagoon water application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Total applied manure-N + fertilizer-N should be less than 125 percent of documented crop N removal.
- ◆ Reduce manure application on fields where corn follows grass sod plow-down.
- ◆ Plan to reduce manure-N application by 10 to 25 percent.
- ◆ Improve whole farm N balance.

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

- ◆ Apply only starter N (20 to 40 lb N/acre at planting).
- ◆ Plan not to sidedress N fertilizer in June. Apply sidedress N only when PSNT indicates a need.
- ◆ Eliminate lagoon water application after August 1.
- ◆ Keep records to document crop yield, dry matter, and crop N removal. Apply manure N at a rate less than or equal to crop N removal (approximately 200 lb total N per acre).
- ◆ Eliminate manure application on a few fields or a few strips within a field next year to determine the contribution of mineralized N vs. current-season application of manure.
- ◆ Plan to reduce manure-N application by 25 to 40 percent.
- ◆ Consult experts to improve whole farm nutrient balance.

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

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

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

- ◆ Continue present N management.

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

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

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

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

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

Detailed suggestions for soil sampling and planning

Collecting, preserving, and analyzing the soil sample

Tools for field sampling

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

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

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

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

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

A mud auger or bucket auger is the best tool for hand-sampling at sites that are difficult to sample with push probes. Use an auger for compacted, muddy, rocky, or dry soils. Augers can be purchased from several manufacturers. A 2- to 4-inch diameter mud auger (open-sided) works best for most situations because it is easy to remove the sample from the bucket. Use a larger

diameter auger for soils with large rocks. Augers sample a 4- to 6-inch depth. You will need to take several bites from the same hole to sample to 12-inch depth. You will collect a larger sample volume, about 5 to 10 times that collected with a push tube. Because of the extra effort required for auger sampling, use this method only if other sampling methods are difficult or impossible.

Field sampling protocol

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

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

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

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

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

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

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

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

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

Sample handling

Mixing. If it is not too hard to break up the soil cores, break them, mix them all together, and homogenize thoroughly. Take a 1-cup subsample for shipment to the lab. If

the soil cores are too hard to break apart, send the entire sample to the lab, where they can pass the sample through a mechanical grinder. Check with the lab to make sure they will grind and mix the *entire* sample before subsampling.

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

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

Working with an analytical laboratory

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

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

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

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

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

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

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

Developing a sampling plan

Nutrient management plans can be voluntary, required by regulatory agencies, or a part of an agreement with a conservation planning agency (e.g., Natural Resources Conservation Service or conservation district). If your nutrient management plan is not voluntary, consult the agency that supervises your nutrient management plan to determine whether they have specific requirements for how often fields must/should be sampled.

Suggestions given here for sampling frequency are general in nature and are not intended to serve as policy for any agency.

Representative fields for long-term monitoring

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

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

Other fields

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

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

Sampling priority

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

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

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

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

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

Samples collected shortly after manure application are not a good indicator of the

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

Questions and answers

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

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

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

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

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

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

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

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

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

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

Drying of soils after sampling releases ammonium-N from microbial biomass. Most dried soils have 2 to 20 ppm ammonium-N

that is caused by the soil drying process. Dry soil ammonium-N concentrations are poorly correlated with other indices of N availability in controlled experiments.

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

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

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

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

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. Homeck, 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.

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Published May 2003.

Soil Test Interpretation Guide

E.S. Marx, J. Hart, and R.G. Stevens



Regular soil testing is an important element in nutrient management. You can use soil tests as a diagnostic tool or to identify trends through time. To obtain meaningful test results, you must sample soil correctly, at the same time each year, and you must maintain records. For more information, see EC 628, *How to take a soil sample. . . and why* (see "For more information," page 7).

Soil testing laboratories use different test methods, which may influence results and sufficiency ranges. Therefore, the sufficiency ranges in this publication are accurate only for the test methods listed.

Soil tests used to evaluate fertility measure the soil nutrients that are expected to become plant-available. They do not measure total amounts of nutrients in the soil. Measurements of total nutrient content are not useful indicators of sufficiency for plant growth, because only a small portion of the nutrients are plant-available.

Adequate soil nutrient levels vary depending on plant species. Similarly, plant tolerance of excessive nutrient levels, nutrient imbalances, or less-than-optimum growing conditions varies. If excessive nutrient levels exist, review management to determine the cause.

Nutrient concentrations vary with soil depth. Depth of sampling, therefore, affects test results. To determine the proper sampling depth, you must consider the purpose of the soil test. To estimate nutrient availability for a crop prior to planting, sample soil to the depth where most root activity will occur. Shallow sampling sometimes is used to evaluate surface conditions in

perennial crops where fertilizers have been applied to the soil surface. Deep sampling may be necessary to diagnose problems in orchards.

Soil test values do not vary greatly from year to year. Drastic changes in test values may indicate an unrepresentative soil sample or a laboratory error. When in doubt, submit a new sample or ask the lab to repeat the analysis.

This publication provides general guidelines for interpreting soil test results. Fertilizer guides for many individual crops are available from your county office of the OSU Extension Service or Washington State University Cooperative Extension, or from Extension and Experiment Station Communications, Oregon State University (see "For more information").

Nitrogen (N)

Plant-available nitrogen (nitrate and ammonium)

Plant-available forms of nitrogen are nitrate (NO_3^- -N) and ammonium (NH_4^+ -N). Soil concentrations of NO_3^- -N and NH_4^+ -N depend on biological activity, and therefore fluctuate with changes in conditions such as temperature and moisture. Nitrate is easily leached from the soil with high rainfall or excessive irrigation. Soil tests can determine NO_3^- -N and NH_4^+ -N concentrations at the time of sampling, but do not reflect future conditions.

When you collect samples for nitrogen testing, keep them cold, or dry them immediately to prevent NO_3^- -N and NH_4^+ -N concentrations from changing.



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Ammonium-nitrogen ($\text{NH}_4^+\text{-N}$)

Ammonium-nitrogen does not accumulate in the soil, as soil temperature and moisture conditions suitable for plant growth also are ideal for conversion of $\text{NH}_4^+\text{-N}$ to $\text{NO}_3^-\text{-N}$. Ammonium-nitrogen concentrations of 2–10 ppm are typical. Soil $\text{NH}_4^+\text{-N}$ levels above 10 ppm may occur in cold or extremely wet soils, or if the soil contains fertilizer residue.

Nitrate-nitrogen ($\text{NO}_3^-\text{-N}$)

West of the Cascades. Soil nitrate-nitrogen measurements are most useful as a post-harvest “report card” to evaluate N management. Nitrate remaining in the soil after harvest can leach during winter rains, contaminating surface and groundwater. If residual nitrate levels are consistently high, reduce fertilizer N inputs in future growing seasons.

Table 1.—Residual soil nitrate-nitrogen for evaluating N management.

	$\text{NO}_3^-\text{-N}$ in surface foot (ppm)*
low	<10
medium	10–20
high	20–30
excessive	>30

*See Table 13 (page 7) for conversion of ppm to lb/acre.

Mid-season measurement of soil nitrate is used for field corn production. See EM 8650, *The Pre-sidedress Soil Nitrate Test (PSNT) for Western Oregon and Western Washington*, for more information.

East of the Cascades. In arid regions, soil nitrate ($\text{NO}_3^-\text{-N}$) is evaluated by measuring $\text{NO}_3^-\text{-N}$ to the expected rooting depth of the crop to be grown. If test results are reported in ppm, convert to lb/acre using Table 13 (page 7). Then subtract the soil nitrate from the crop requirement to determine a fertilizer rate.

Failure to account for $\text{NO}_3^-\text{-N}$ in the soil can lead to over-application of nitrogen fertilizers. Also, irrigation water should be analyzed for $\text{NO}_3^-\text{-N}$ content, and fertilizer rates reduced accordingly. Proper irrigation increases N use efficiency and reduces nitrate leaching.

Total nitrogen

Total nitrogen analysis measures N in all organic and inorganic forms. Total nitrogen does *not* indicate plant-available N, and is not included in standard soil testing programs.

A typical agricultural soil in the Willamette Valley contains about 0.10 to 0.15 percent N, or approximately 5,000 lb N/acre in the surface foot. Only 1 to 4 percent of this total N becomes plant-available during a growing season. East of the Cascades, soils tend to have smaller amounts of total N.

Total N analysis, while not recommended as part of a standard soil testing program, may be better than organic matter analysis for estimating soil N supplying capability.

Phosphorus (P)

The Bray P1 (for acid soils) and the Olsen sodium bicarbonate (NaHCO_3) (for alkaline soils) tests estimate plant-available phosphorus. Soil testing laboratories also use several other extraction methods. For interpretation of results from other extraction methods, contact the laboratory that performed the analysis.

Phosphorus soil tests are an index of P availability. The test values cannot be used to calculate available lb P_2O_5 /acre.

When sampling soil, you must be aware of previous P management. Phosphorus is relatively immobile in soil. If phosphorus has been applied in a fertilizer band, concentrations of P may persist where the band was placed. Avoid fertilizer bands when collecting soil samples.

Table 2.—Phosphorus soil test.

	West of Cascades (Bray P1 test) ppm P	East of Cascades (Olsen test) ppm P
low	<20	<10
medium	20–40	10–20
high	40–100	20–40
excessive	>100	>40

The phosphorus application rate necessary to correct P deficiencies varies depending on soil properties. Phosphorus availability decreases in cool, wet soils. In many situations, banded phosphorus applications are more effective than broadcast applications.

Phosphorus applications generally are not recommended if tests are high or excessive. High soil phosphorus combined with surface runoff can cause excessive growth of plants and algae in surface waters, damaging aquatic ecosystems.

Cations

Of the three primary cations (potassium, calcium, and magnesium), potassium requires the most management attention. Few crops have responded to calcium and magnesium in the Pacific Northwest.

If extremely high levels of a single cation exist, plant deficiencies of other cations may occur due to competition for plant uptake.

The soil test ranges in Tables 3, 4, and 5 are for the ammonium acetate extraction method. If a sodium bicarbonate (NaHCO_3) extraction is used, test values may be slightly lower.

Potassium (K)

Excessive soil potassium levels can result in elevated K levels in grass forage crops, which may be detrimental to animal health.

Table 3.—Extractable potassium (K).

	K
low	<150 ppm* <0.4 meq/100 g soil
medium	150–250 ppm 0.4–0.6 meq/100 g soil
high	250–800 ppm 0.6–2.0 meq/100 g soil
excessive	>800 ppm >2.0 meq/100 g soil

*See Table 13 (page 7) for conversions from ppm to meq/100 g soil.

Calcium (Ca)

Calcium deficiencies usually are found only on very acid soils. They can be corrected by liming with calcium carbonate (CaCO_3).

Table 4.—Extractable calcium (Ca).

	Ca
low	<1,000 ppm* <5 meq/100 g soil
medium	1,000–2,000 ppm 5–10 meq/100 g soil
high	>2,000 ppm >10 meq/100 g soil

*See Table 13 (page 7) for conversions from ppm to meq/100 g soil.

Magnesium (Mg)

Magnesium deficiencies on acid soils can be corrected by liming with dolomitic lime.

Magnesium toxicity can occur on serpentine soils in southwest Oregon.

Table 5.—Extractable magnesium (Mg).

	Mg
low	<60 ppm* <0.5 meq/100 g soil
medium	60–180 ppm 0.5–1.5 meq/100 g soil
high	>180 ppm > 1.5 meq/100 g soil

*See Table 13 (page 7) for conversions from ppm to meq/100 g soil.

Sulfate-sulfur ($\text{SO}_4^{2-}\text{-S}$)

Plants absorb sulfur in the sulfate ($\text{SO}_4^{2-}\text{-S}$) form. In high rainfall areas west of the Cascades, SO_4^{2-} is readily leached, and soil test data are not well correlated with plant growth. In arid regions east of the Cascades, soil test information may be useful. Also, irrigation water may contain significant amounts of sulfate-sulfur. Plant analysis often is useful for diagnosing sulfur deficiency.

Table 6.—Sulfate-sulfur, east of the Cascades.

	$\text{SO}_4^{2-}\text{-S}$ (ppm)
low	<2
medium	2–10
sufficient	>10

Micronutrients

Deficiencies of micronutrients other than boron and zinc are uncommon. Availability of most micronutrients is largely pH-dependent; availability decreases as pH increases (except for molybdenum, which becomes more available as pH increases). Deficiencies rarely occur in soils with pH below 6.5.

Soil testing for micronutrients other than boron and zinc is recommended only when a deficiency is suspected. If you suspect a micronutrient deficiency, plant tissue testing may be a better diagnostic tool than soil testing.

Boron (B)

Crops such as alfalfa, table beets, brassicas, caneberries, and root crops have responded to boron fertilization on B-deficient soils in western Oregon. Tree fruits and alfalfa are examples of crops sensitive to low boron levels east of the Cascades.

While low levels of boron may limit plant growth, high concentrations can be toxic. When applying boron, apply uniformly and mix thoroughly with the soil.

Table 7.—Boron by the hot water extraction method.*

	B (ppm)
low	<0.5
medium	0.5–2
high	>2

*The hot water extraction method for boron may result in incorrectly high values on soils with high organic matter content.

Zinc (Zn)

Zinc values above 1.0 ppm using the DTPA extraction method are sufficient. Zinc deficiencies have been identified in some crops in certain regions. Corn, beans, grapes, hops, onions, and deciduous fruit trees are especially sensitive to low levels of available zinc. Deficiencies sometimes are associated with high soil P concentrations, soils high in fine clay and silt, or soils with high pH.

Copper (Cu)

Copper values above 0.6 ppm using the DTPA extraction method are sufficient. Copper deficiencies are uncommon. Deficiencies have been identified on muck soils such as those in the Klamath area in Oregon and the Colville area in Washington.

Manganese (Mn)

Manganese values above 1.5 ppm using the DTPA extraction method are sufficient. Manganese deficiencies generally occur only in soils with pH 7.0 or above. Manganese toxicity may occur on acid soils. On alkaline soils east of the Cascades, Mn availability may increase in acidified microzones where fertilizers have been placed. These acidified microzones can alleviate Mn deficiencies sometimes encountered on high pH soils. In some instances, however, acidic microzones can result in Mn toxicity.

Iron (Fe)

Soil testing for iron is not recommended. Most test methods do not discern between forms of iron, and therefore have little meaning for plant nutrition.

Iron deficiencies are uncommon on acid soils in the Pacific Northwest. Where deficiencies occur, they often are associated with acid soil plants, such as azaleas or rhododendrons, growing on soils with unsuitably high pH. Acidifying fertilizers such as ammonium sulfate will help correct problems.

Iron applications on alkaline soils are inefficient unless a chelated form is used. Lowering soil pH to increase iron availability on a field scale is not economical. However, adding acidifying materials such as elemental sulfur to fertilizer mixes can acidify microzones around the fertilizer material and increase Fe availability.

Foliar applications of Fe sometimes are used to correct deficiencies in fruit, turf, and other high-value crops.

Molybdenum (Mo)

Soil Mo concentrations are too low for most labs to evaluate. Molybdenum deficiencies are rare, and are of concern mostly for leguminous crops. Molybdenum-deficient legumes appear chlorotic. Liming to raise soil pH may alleviate deficiencies. Molybdenum-coated seed also can be used.

Excessive molybdenum in forage can harm animal health. If you suspect excessive molybdenum in your forage, determine Mo content by forage analysis.

Chloride (Cl)

Soil testing for chloride is not a common practice, and little data exists for interpretation of test results. Evidence indicates that wheat sometimes benefits from chloride applications. The values in Table 8 are based on wheat research in Montana and South Dakota. Little information exists on chloride soil testing in Washington and Oregon.

Table 8.—Chloride soil test ranges for wheat in Montana and South Dakota, 2-foot sampling depth.

	ppm	lb/acre
low	0–4	0–32
medium	4–8	32–64
high	>8	>64

pH, lime requirement (LR)

Soil pH is a measure of soil acidity. Most crops grow best if the soil pH is between 6.0 and 7.5.

Table 9.—Soil pH ranges.

	pH
strongly acid	below 5.1
moderately acid	5.2–6.0
slightly acid	6.1–6.5
neutral	6.6–7.3
moderately alkaline	7.4–8.4
strongly alkaline	above 8.5

Soil pH can be increased by liming. The soil pH test indicates *if* lime is needed. The lime requirement test determines *how much* lime is needed. Accurate lime recommendations cannot be made without performing an SMP or similar test.

SMP* lime requirement test

The SMP lime requirement test is used to estimate the amount of lime required to raise the pH of 6 inches of soil. The SMP test is performed by mixing soil with a buffered pH 7.5 solution and determining the pH of the mixture. During the reaction, the soil's reserve acidity lowers the pH of the SMP solution. Soils with low SMP values have high reserve acidity and high lime requirements.

Some soils may have a low pH (<5.3) and a fairly high SMP buffer value (>6.2). This condition can be caused by the application of fertilizer. In this case, the low pH value is temporary, and the pH of the soil will increase as the fertilizer completes its reaction with the soil.

Sandy soils also may have a low pH and high SMP buffer value. This condition occurs because sandy soils have low amounts of reserve acidity due to low cation exchange capacity (CEC). In such cases, a light application of lime (1 to 2 t/a) should suffice to neutralize soil acidity.

Table 10 is used to determine the amount of lime required, based on the SMP test, to raise soil pH to a desired level. The target pH is determined by the crop to be grown and possibly by other factors.

*SMP stands for Shoemaker, MacLean, and Pratt—the people who developed the test.

Without an SMP or similar test, there is no way to know how much lime is required to adjust soil pH to a desired level. Accurate lime recommendations cannot be made solely on the basis of soil pH.

Table 10.—SMP lime requirement—field scale.

SMP buffer	Tons/acre of 100-score lime needed to raise pH of surface 6 inches of soil to the following pH's			
	5.3	5.6	6.0	6.4
6.7	—	—	—	—
6.6	—	—	—	1.1
6.5	—	—	1.0	1.7
6.4	—	—	1.1	2.2
6.3	—	—	1.5	2.7
6.2	—	1.0	2.0	3.2
6.1	—	1.4	2.4	3.7
6.0	1.0	1.7	2.9	4.2
5.9	1.4	2.1	3.3	4.7
5.8	1.7	2.5	3.7	5.3
5.7	2.0	2.8	4.2	5.8
5.6	2.3	3.2	4.6	6.3
5.5	2.6	3.6	5.1	6.8
5.4	2.9	3.9	5.5	7.3
5.3	3.2	4.3	6.0	7.8
5.2	3.6	4.7	6.4	8.3
5.1	3.9	5.0	6.9	8.9
5.0	4.2	5.4	7.3	9.4
4.9	4.5	5.8	7.7	9.9
4.8	4.8	6.2	8.2	10.4

Example: If the "SMP buffer" value is 5.9, the amount of lime needed to raise the pH to 6.0 is 3.3 tons of 100-score lime/acre.

Table 11.—SMP lime requirement—gardens.

If the SMP lime requirement test is	Apply this amount of lime (lb/1,000 ft ²)
5.4 or below	250
5.5–6.0	150–250
6.0–6.5	100–150
above 6.5	0

Some plants, such as blueberries, rhododendrons, azaleas, and cranberries, grow best in acid soils. Fertilizers such as ammonium sulfate can help maintain acidic conditions.

Sodium (Na)

Sodium is not a plant nutrient and therefore is not necessary for plant growth. High levels of sodium are detrimental to soil tilth and plant growth.

Sodium levels are evaluated based on Exchangeable Sodium Percentage (ESP). The ESP is the percent of the cation exchange capacity (CEC) occupied by Na.

ESP values above 10 percent are of concern. Excessive sodium levels can occur naturally or can result from irrigation with high-sodium water. Reclamation involves establishment of drainage followed by gypsum application and leaching with low-sodium water.

Soluble salts (SS)

Soluble salt problems usually are associated with arid regions such as eastern Oregon and Washington. Soils with high levels of soluble salts are called saline soils. Soils high in sodium are called sodic soils (see "Sodium"). Saline-sodic soils are high in both soluble salts and sodium. Soluble salts are measured by electrical conductivity (EC) of a saturated paste soil extract.

Table 12.—Soluble salts.

	Conductivity (mmhos/cm*)	ppm salt**
low	<1.0	<640
medium	1.0–2.0	640–1,280
high	>2.0	>1,280

*mmhos/cm is equivalent to decisiemen/m.

**Multiply mmhos/cm by 640 to estimate ppm salt.

Because salts move readily with water, salt problems often are transient. Salt toxicity can occur, and salts may leach before soil is tested. Low salt values, therefore, do not always rule out salt toxicity as a cause of problems.

Salt tolerance varies greatly among plant species. Seedlings are especially sensitive to high salt concentrations. Excessive salts may inhibit seed germination. Excessive fertilization and poor irrigation water quality are sources of salts.

Organic matter

Maintenance of soil organic matter is one of the most important goals of soil management. Accurate measurement of soil organic matter is difficult.

Many laboratory methods are used. Most methods are indirect; they measure soil carbon and make an assumption about the percent carbon content of organic matter. The Walkley-Black method is common and gives consistent results. The loss on ignition method can give inconsistent results and tends to overestimate organic matter.

When estimating potential nitrogen release of a soil, total N testing is preferred to organic matter determination. Neither approach provides accurate estimates of soil N availability. If you are monitoring changes in organic matter over time, use the same lab for all analyses.

Cation exchange capacity (CEC)

CEC is a measure of a soil's capacity to retain and release elements such as K, Ca, Mg, and Na. Soils with high clay or organic matter content tend to have a high CEC. Sandy soils have a low CEC. Soil CEC is relatively constant over time, so there is no need for repeated analyses.

CEC often is determined by the ammonium acetate (NH_4OAc) or sodium acetate (NaOAc) methods. While these methods are standard in many regions, there are potential sources of error. Errors are most likely to occur for soils containing appreciable amounts of CaCO_3 or gypsum.

Some labs estimate CEC based on soil texture, organic matter content, cations, and pH. Such estimates often are inaccurate. The "sum of bases" method for calculating CEC of alkaline soils can give inaccurate results, especially if there are significant amounts of free CaCO_3 .

CEC determination can be important for predicting behavior of pesticides and other chemicals in soils.

Base saturation

Base saturation is the percentage of the CEC that is occupied by cations other than hydrogen (H) and aluminum (Al). Soils with low base saturation generally are acidic. Base saturation and pH increase together.

For more information

Hart, J. *Analytical Laboratories Serving Oregon*,
FG 74 (Oregon State University, Corvallis, reprinted
1997). No charge

Hart, J. *How to take a soil sample. . . and why*, EC 628
(Oregon State University, Corvallis, revised 1995).
No charge

Marx, E.S., N.W. Christensen, J. Hart, M. Gangwer,
C.G. Cogger, and A.I. Bary, *The Pre-sidedress Soil
Nitrate Test (PSNT) for Western Oregon and
Western Washington*, EM 8650 (Oregon State
University, Corvallis, reprinted 1997). 75¢

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Table 13.—Conversions.

To convert column 1 into column 2, <i>divide by</i>	Column 1	Column 2	To convert column 2 into column 1, <i>multiply by</i>
390	ppm K	meq K/100 g soil	390
200	ppm Ca	meq Ca/100 g soil	200
121	ppm Mg	meq Mg/100 g soil	121
230	ppm Na	meq Na/100 g soil	230
1	meq/100 g soil	cmol/kg soil	1
2*	lb/acre (7 inch depth)	ppm	2*
3.65*	lb/acre (1 foot depth)	ppm	3.65*
43.56	lb/acre	lb/1,000 sq ft	43.56
43,560	square feet	acres	43,560
2.471	acres	hectares	2.471

*These values vary with soil bulk density.



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NUTRIENT MANAGEMENT
FOR DAIRY PRODUCTION

Manure application rates for forage production

J. Hart, E.S. Marx, and M. Gangwer

Most dairies can supply all the nitrogen, phosphorus, potassium, and other nutrients needed for forage production by applying manure to forage crops. As a manager, your goal is to match nutrient supply with crop needs by deciding when and how much manure to apply.

This publication explains how to estimate the amount of manure to apply for forage production. To do so, you need:

- A current manure analysis for your dairy (or see EM 8586, *Dairy Manure as a Fertilizer Source*)
- A list of forage crops to be produced
- A soil test from each field where manure will be applied

Too much manure results in excess plant uptake of nutrients such as potassium. High-potassium grass forages can lead to health problems, especially in dry cows. In addition, excess manure contributes to nutrients and microorganisms in runoff water and potential nutrient leaching to groundwater.

John Hart, Extension soil scientist; E.S. Marx, former research assistant in soil science; and Mike Gangwer, Extension agent, Marion County; Oregon State University.

The application rates in this publication are based on soil tests and growing conditions in western Oregon.

Manure analysis

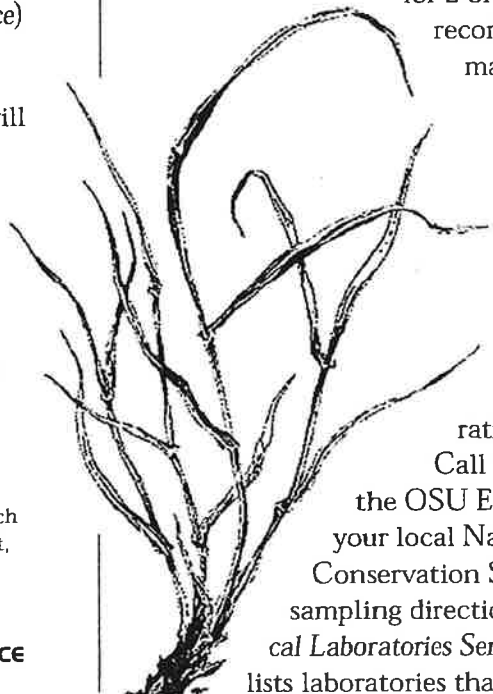
Analyzing your manure is critical to determining the correct application rate. If you don't test your dairy's manure, you can only guess its nutrient value.

Manure testing in western Oregon has shown more variation among dairies than within one dairy. Develop a manure nutrient history for your dairy by testing manure two or three times a year

for 2 or 3 years. These records will help you manage nutrient resources.

Also test manure when you expect a change in nutrient content; for example, when you make a large change in the ration.

Call your county office of the OSU Extension Service or your local Natural Resources Conservation Service office for sampling directions. A *List of Analytical Laboratories Serving Oregon* (FG 74) lists laboratories that test manure.



OREGON STATE UNIVERSITY EXTENSION SERVICE

Crop nitrogen requirements

Nitrogen (N) is the nutrient needed for crop production on dairies. Tables 1 and 2 show the estimated nitrogen removal rate (or uptake) for average yields of the most common forage crops grown on dairies.

Determining manure application rate

Your goal is to match manure nutrient application rates with crop removal. Table 1 and Figures 1–3 provide the information you need for perennial crops, and Table 2 and Figures 4–6 apply to annual crops. Instructions on how to use them follow. (An example is illustrated on page 3.)

Perennial crops

1. In Table 1, find the crop you will grow and the average yield per cutting. Let's assume you grow perennial ryegrass. Table 1 shows that an average yield per cutting is 1.2 tons per acre of dry matter (about 3 tons of harvested grass).

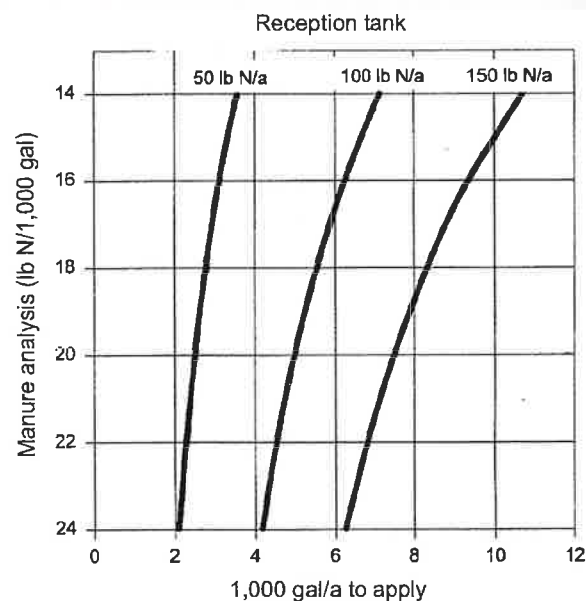


Figure 1.—Determining application rate for reception tank manure.

2. Now find the nitrogen removal rate for the average yield. Table 1 shows that perennial ryegrass takes up about 60 pounds of N per acre for each cutting. Thus, you should apply about 60 lb N/a after cutting the ryegrass.
3. Find the figure below (Figures 1–3) that represents the type of manure you want to apply. Let's assume you want to apply lagoon effluent, so you'll use Figure 2.
4. Figure 2 contains three lines representing N application rates of 50, 100, and 150 lb N/a. Find the line that is closest to the rate you need to apply. You'll use the line for 50 lb/a because it is closest to 60 lb/a.
5. Select your manure analysis for nitrogen on the left side of the graph. Let's assume a manure test shows that the effluent contains 6 lb/1,000 gallons or 750 ppm N. Move to the right across the graph until you meet the line for the application rate you have chosen (50 lb N/a).

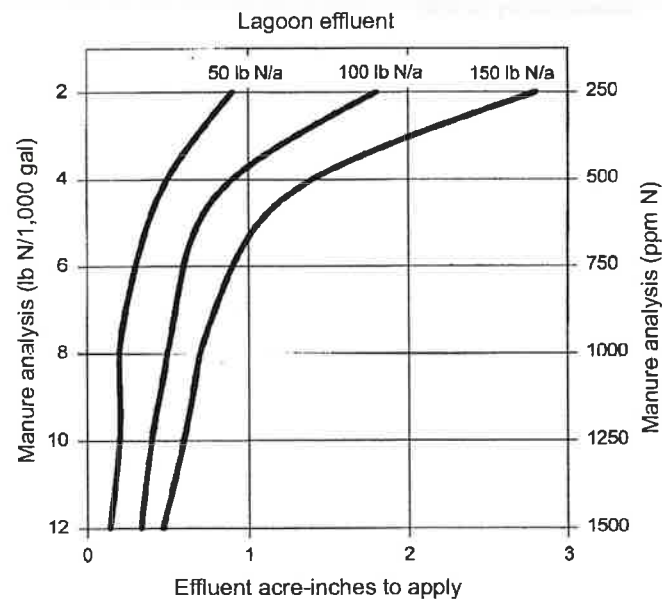


Figure 2.—Determining application rate for lagoon effluent.

Note: Recommendations in Figures 1–6 assume that nitrogen applications should not exceed crop removal. We assume that N mineralization will offset any volatile losses that occur during application.

Table 1.—Approximate nitrogen removal by perennial forage crops and suggested nitrogen application rates.

Crop	Average yield per cutting (t/a)	N removal rate for average yield per cutting (lb N/a)	Suggested N application rate (lb N/t of forage*)
Orchard grass	1.4	70	50–60
Perennial ryegrass	1.2	60	50–60
Tall fescue	1.4	70	50–60

*All rates are on dry matter basis unless noted otherwise.

6. Now move down to the line labeled “effluent acre-inches to apply.” Estimate the number of acre-inches of effluent to apply (about 0.3 acre-inch). Remember that you will need about 10 percent more nitrogen because no line exists for the 60 lb N/a required by ryegrass. Your final result will be about 0.4 acre-inch.

Note: If you know your own yield per cutting, you can figure your nitrogen need more accurately. To do so, multiply your tons per acre per cutting by the “suggested N application rate (lb N/t of forage)” in Table 1. The result is your N removal rate. Use the line in the appropriate figure that is closest to that rate.

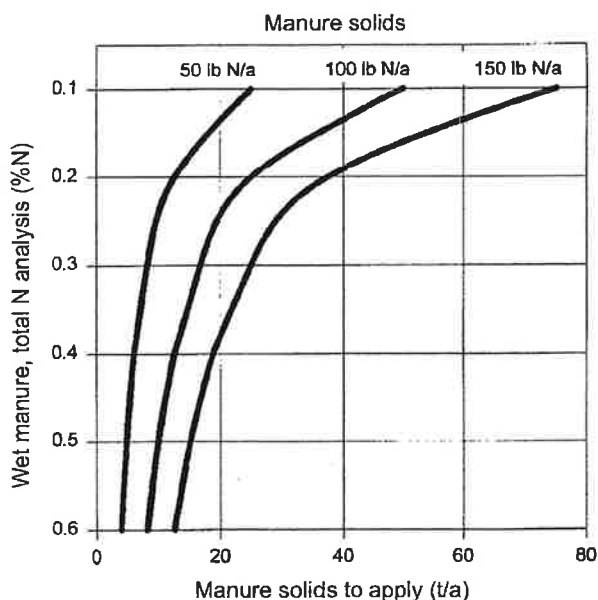


Figure 3.—Determining application rate for manure solids.

Example

Crop: perennial ryegrass

Manure: lagoon effluent

1. Average yield per cutting = 1.2 t/a (Table 1).
2. Nitrogen removal rate = 60 lb N/a per cutting (Table 1).
3. Find the lagoon effluent graph (Figure 2).
4. Use the 50 lb/a line because it is closest to the 60 lb/a you need to apply.
5. Your manure test shows 6 lb/1,000 gal. Find this line on the left of the graph. Move across to the 50 lb/a line.
6. Move down to the bottom line to find the number of acre-inches to apply (0.3 acre-inch).

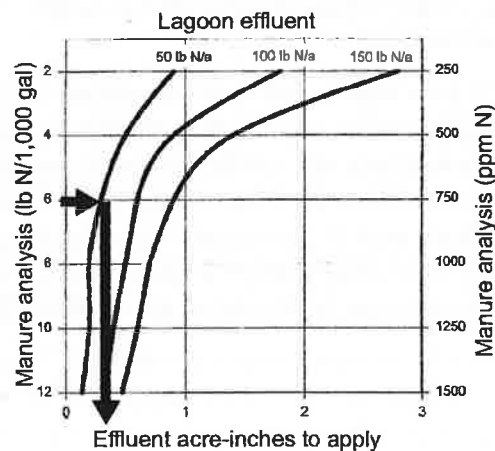


Table 2.—Approximate nitrogen removal by annual forage crops and suggested nitrogen application rates.

Crop	Average total yield (t/a)	N removal rate for average yield (lb N/a)	Suggested N application rate (lb N/t of forage*)
Silage corn			
75% moisture	30	180	5–7
dry matter basis	7	180	20–30
Annual ryegrass	5	100	15–25
Triticale	8	160	15–25
Oats	4	80	15–25
Sudan grass	5	250	50–60

*All rates are on dry matter basis unless noted otherwise.

Annual crops

You can follow a similar procedure to estimate the amount of manure needed for annual crops. For example:

1. From Table 2, find the total amount of N that is needed by the annual crop you will grow. We will use silage corn as an example. A 30-ton yield of silage corn requires 180 lb N/a.
2. Find the figure (Figures 4–6) that represents the type of manure you want to apply. Let's assume you'll apply separated solids, so use Figure 6.
3. Figure 6 contains three lines representing N application rates of 50, 100, and 150 lb N/a. Find the line that is closest to the rate you need to apply. You'll use the line for 150 lb/a since it is the closest to the rate you need to apply (180 lb/a).
4. Find your manure analysis for nitrogen on the left side of the graph. Let's assume your manure test shows that the solids contain 5 pounds of N/t or 0.25 percent N on a wet basis. Since 0.25 percent N is not on the graph, estimate a point halfway between 0.2 and 0.3. Move to the right until you meet the line for 150 lb N/a.
5. Now move down to the line labeled "manure solids to apply (t/a):" You should find 30 tons. Remember that 20 percent more nitrogen will be needed because no line exists for the 180 lb N/a

required by the silage corn. The total estimated amount of solids required should be 35 t/a.

Note: If you know your own yield, you can figure your nitrogen need more accurately. To do so, multiply your tons per acre by the "suggested N application rate (lb N/t of forage)" in Table 2. The result is your N removal rate. Use the line in the appropriate figure that is closest to that rate.

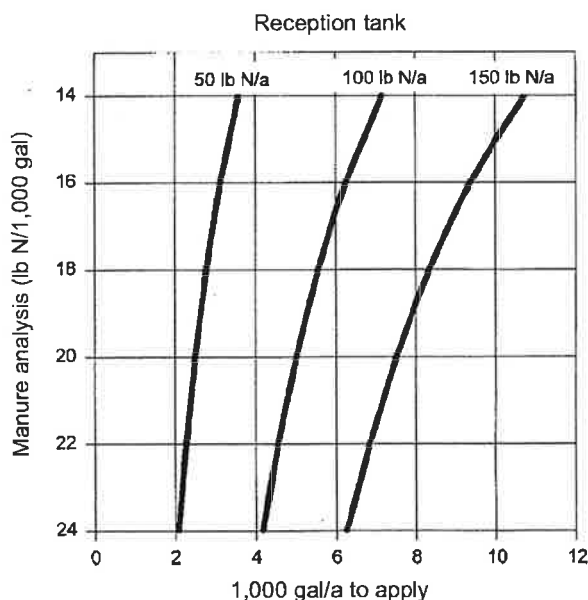


Figure 4.—Determining application rate for reception tank manure.

Special cases

The manure application rates in this publication are based on the assumption that manure already has been applied to fields for at least 4 consecutive years, not including the current year.

If your fields have received manure for less than 4 years, increase rates as shown in Table 3 if you use reception tank, separated solids, or dry stack material. Lagoon effluent provides sufficient available N for any situation when applied during the growing season.

Checking your application rate for silage corn

With silage corn, you can confirm that you applied sufficient manure by using the pre-side-dress soil nitrate test (PSNT). When the corn is 12 inches tall or at the five-leaf development stage, sample soil between rows to a depth of 12 inches. Have the sample analyzed for nitrate nitrogen ($\text{NO}_3\text{-N}$).

Compare the soil test results to Table 4. Apply the appropriate amount of lagoon effluent or fertilizer N to the growing crop based on the PSNT and Table 4.

It is important to handle samples properly. For more information, see *The Pre-sidedress Soil Nitrate Test (PSNT)*, EM 8650.

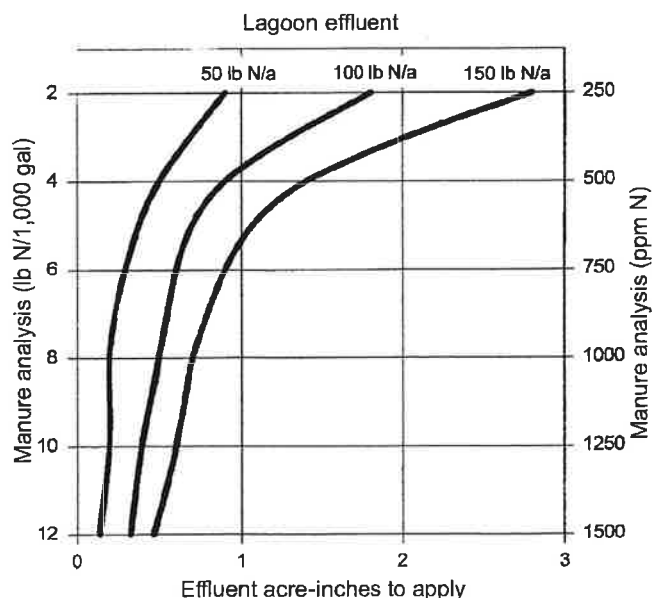


Figure 5.—Determining application rate for lagoon effluent.

Table 3.—Manure application rates based on number of years field has received manure.

If your field has received manure this many years:	Multiply suggested application rate by:
0	3.0
1	2.5
2	2.0
3	1.5
4 or more	Use suggested rates

Table 4.—Amount of nitrogen to apply for silage corn production based on the PSNT.

PSNT (ppm)	Nitrogen (lb/a)
0-10	100-150
10-20	50-100
20-25	0-50
above 25	0

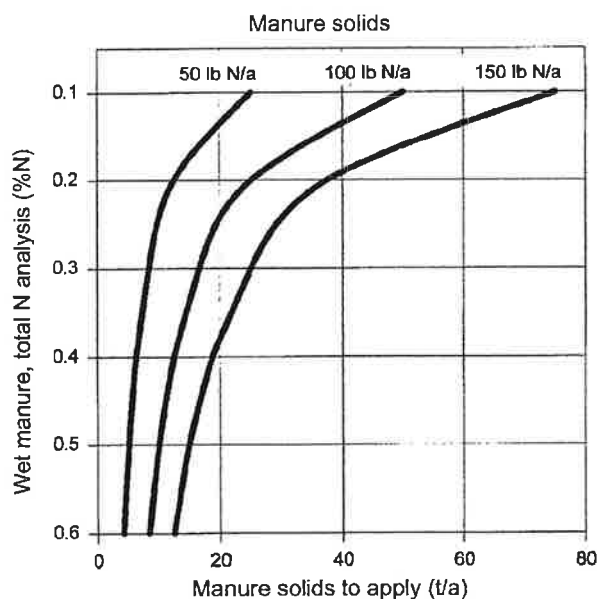


Figure 6.—Determining application rate for manure solids.

Testing your soil for P and K

Test your soil for phosphorus (P) and potassium (K) before applying manure. Table 5 provides interpretations of P and K soil tests.

If you've applied manure for more than 5 years, additions of P and K usually are not needed. For example, potassium usually is not deficient in soils where manure has been applied unless the applications were light and a high yield of grass hay was removed.

A manure application that meets crop nitrogen needs usually supplies sufficient amounts of P and K. Manure contains as much, if not more, K than N. For more information, see EM 8586, *Dairy Manure as a Fertilizer Source*.

In fact, fields that have received manure for a decade or more often have high soil test values for P and K. Fields with soil test K above 1,000 ppm can produce grass forage with a high K concentration. When grass forage with more than 3 percent K is fed to dry cows, serious illness or death may occur.

In some cases, a soil test shows excessive K, but N is needed. In this case, you have two options:

- Apply separated solids, which are lower in K than other forms of manure.
- If another area is available for manure application, apply manure there and buy N fertilizer for the area that has excess K.

Contact your county office of the OSU Extension Service for additional information.

New plantings

Little N is needed by new plantings. After N, phosphorus is the nutrient most likely to limit forage production. For new plantings or annual crops where manure has not been applied, apply 30 lb P_2O_5/a in a band-placed starter fertilizer. For more information, see FG 63, *Pastures Fertilizer Guide*.

Table 5.—Interpretation of soil tests for P and K.

Soil status	Nutrient	
	Phosphorus (P)	Potassium (K)
	(ppm)	
deficient	below 25	below 150
sufficient	25–50	150–500
high	50–75	500–1,000
excess	above 75	above 1,000

If P is deficient (see Table 5), also apply one of the following :

- 25 tons of separated solids
- 5,000 gallons of reception tank manure
- 5 wet tons of dry stack manure

End-of-season testing

The tables and figures in this publication provide only an estimate of manure application rates. An end-of-season soil test for nitrate nitrogen or stalk nitrate test for silage corn can aid in adjusting next season's manure application rates.

“Report card” soil testing

1. Sample soil to a depth of 12 inches as described for PSNT sampling. Sample from between rows, and avoid fertilizer bands. See EM 8650 for more information.
2. Prepare and handle the sample as described for PSNT sampling.
3. Have the sample analyzed for nitrate nitrogen (NO_3-N).

If soil NO_3-N test results are above 15 ppm, nitrogen probably was supplied in excess of crop needs. (To convert ppm to lb/a, multiply by 3.65.)

Corn stalk nitrate testing at harvest

1. Collect 10 mature corn plants by cutting the stalks just above the brace roots. Select representative plants away from edges of the field.
2. Cut an 8-inch section of stalk from the bottom of each harvested plant.
3. Remove the dried outer leaves from each 8-inch section.
4. Split each section of stalk lengthwise to aid in drying.
5. Place the split stalks together in a bag and send to a lab for nitrate nitrogen ($\text{NO}_3\text{-N}$) analysis.
6. Use Table 6 to interpret results.

Table 6.—Interpretation of corn stalk nitrate tests.

Stalk $\text{NO}_3\text{-N}$ concentration at harvest	Interpretation
<3,500 ppm	N may have limited yield
3,500–5,500 ppm	N sufficient for optimum yield
>5,500 ppm	N supplied in excess of crop demand

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Hart, J. *A List of Analytical Laboratories Serving Oregon*, FG 74 (Oregon State University, Corvallis, revised 1996). No charge

Hart, J., G. Pirelli, L. Cannon, and S. Fransen. *Pastures Fertilizer Guide*, FG 63 (Oregon State University, Corvallis, 1993). No charge

Hart, J., M. Gangwer, M. Graham, and E.S. Marx. *Dairy Manure as a Fertilizer Source*, EM 8586 (Oregon State University, Corvallis, reprinted 1996). \$1.00

Marx, E.S., N.W. Christensen, J. Hart, M. Gangwer, C.G. Cogger, and A.I. Bary. *The Pre-sidedress Soil Nitrate Test*, EM 8650 (Oregon State University, Corvallis, 1996). \$1.00

Other publications

Marx, E. *Evaluation of Soil and Plant Analyses as Components of a Nitrogen Monitoring Program for Silage Corn* (Master's thesis, Oregon State University, 1995).



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NUTRIENT MANAGEMENT FOR DAIRY PRODUCTION

Dairy manure as a fertilizer source

J. Hart, M. Gangwer, M. Graham, and E.S. Marx

Most dairies need no commercial fertilizer if they use manure properly. In most cases, manure can supply all the nitrogen, phosphorus, potassium, and several other nutrients needed for forage production.

More than half the nutrients in dairy rations are excreted in manure. The key to managing manure is to treat it as a resource by recycling these nutrients to produce forage. For example, one lactating dairy cow's manure can supply enough nitrogen for 1.5 acres of silage corn.

This publication examines several aspects of the nutrient content and value of dairy manure:

- Nutrient flow through a dairy
- Distribution of nutrients in manure
- Dairy manure nutrient content
- Value of manure

Nutrient flow through a dairy

Nutrients enter your farm in feed and fertilizer. Cows remove nutrients from feed for metabolism and milk production.

Some nutrients leave the farm in milk, but most are excreted in manure and remain on the farm. Manure applications return nutrients to the soil, where they can be reused to produce more feed.



John Hart, Extension soil scientist, Oregon State University; Mike Gangwer, Extension agent, Marion County, Oregon State University; Monte E. Graham, soil conservationist, USDA Natural Resource Conservation Service; and E.S. Marx, former research assistant in soil science, Oregon State University.



OREGON STATE UNIVERSITY EXTENSION SERVICE

Figure 1 illustrates nutrient flow through a dairy.

Figure 2 shows a cow's daily feed intake and where the nutrients end up. **Note that more than half the nutrients in feed are excreted in manure.**

Each year, a 1,400-pound lactating cow producing 70 pounds of milk per day excretes the following nutrients in manure:

- 300 pounds of nitrogen
- 45 pounds of phosphorus
- 165 pounds of potassium

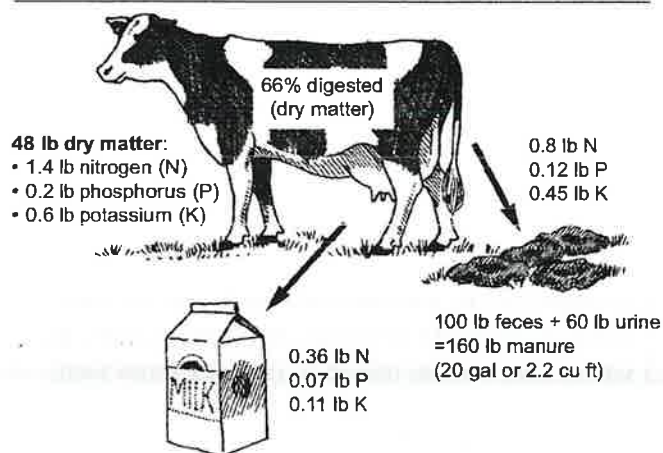


Figure 2.—Daily nutrient flow for a lactating cow.

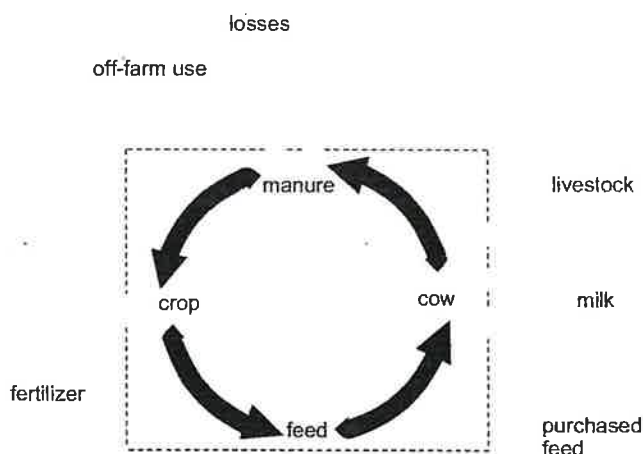


Figure 1.—Nutrient flow through a dairy.

Contrast these amounts to the smaller quantities of nutrients that leave the farm each year in milk:

- 100 pounds of nitrogen
- 20 pounds of phosphorus
- 30 pounds of potassium

Only 15 to 25 percent of the nutrients in feed end up in milk. The majority remain in manure, a valuable fertilizer resource for forage production. Figure 3 illustrates the proportions of nitrogen, phosphorus, and potassium excreted in manure and leaving the farm in milk.

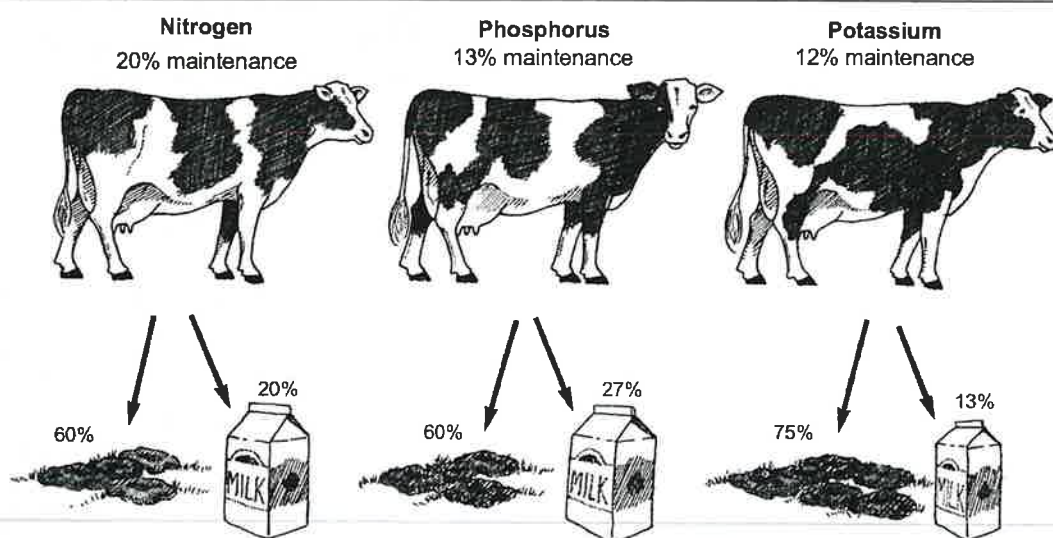


Figure 3.—Fate of nutrients in feed.

Distribution of nutrients

Not all nutrients are divided evenly between the feces and urine. Most of the phosphorus is found in the feces, while most of the potassium is excreted in the urine. Nitrogen is evenly divided between feces and urine. Figure 4 shows how the nutrient output is divided.

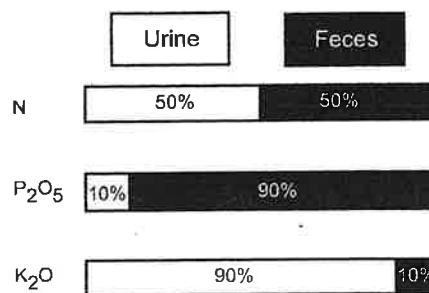


Figure 4.—Distribution of nutrients in manure.

Source: *Field Application of Manure, A Supplement to Manure Management for Environmental Protection*, Robert E. Graves, ed. (Pennsylvania Department of Environmental Resources, Harrisburg, 1986).

Dairy manure nutrient content

The approximate nutrient composition of manure in four common handling systems is shown in Table 1. Use Table 1 to estimate nutrient amounts remaining for crop use.

For example, 1 acre-inch of typical storage pond effluent provides more than twice the nitrogen needed for one cutting of grass forage or more than half the nitrogen needed for a corn silage crop.

Nutrient amounts are expressed in the same way as a fertilizer analysis:

- Total nitrogen (N)
- Phosphorus (P) as P₂O₅
- Potassium (K) as K₂O

The second column in Table 1 indicates the amount of ammonium N (NH₄-N). Ammonium N is readily available to plants. Most of the nitrogen found in storage ponds is in the form of ammonium nitrogen, and therefore is available to crops.

In contrast, nitrogen in other forms is only slowly available to plants. This is why only half the nitrogen from separated solids is available to plants during the growing season.

Potassium from any of the sources is readily available to plants. Most of the phosphorus is available the season manure is applied.

Table 1.—Nutrient composition of dairy manure.

Manure Type	Total N Nitrogen	Ammonium Nitrogen	Total P ₂ O ₅ Phosphorus	Total K ₂ O Potassium
Dry stack (lb/ton wet manure)	10	3	10	15
Separated solids (lb/ton wet solids)	5	NA ¹	2	2
Reception tank (lb/1,000 gallons)	20	8	7	18
Storage pond (lb/acre-inch)	135	109	30	135

¹Little if any ammonium nitrogen is found in separated solids.

Sources of data: storage pond and separated solids—Willamette Valley, Oregon; dry stacks—Yakima area, Washington; reception tank—Whatcom County, Washington.

Sample and analyze manure from your dairy. Nutrient content varies widely from farm to farm. For example, Table 2 shows the low, average, and high nitrogen content of solids from 51 Willamette Valley separators. Nitrogen content varies almost sixfold from the low to high analysis.

Value of manure

Nitrogen generally is the limiting nutrient to plant growth and the most expensive to purchase. Nitrogen in commercial fertilizer costs approximately 30 cents per pound and \$5 per acre to apply. Phosphorus costs 20 cents per pound, and potassium costs 15 cents per pound.

Figure 5 shows the annual fertilizer value of manure from 100 dairy cows. This illustration does not take into account loss during storage or handling or incomplete availability of nutrients.

If losses and incomplete availability are taken into account, **the annual value of nutrients in manure from 100 lactating cows exceeds \$10,000.**

Proper management of manure can increase farm profits and reduce risk of environmental damage.

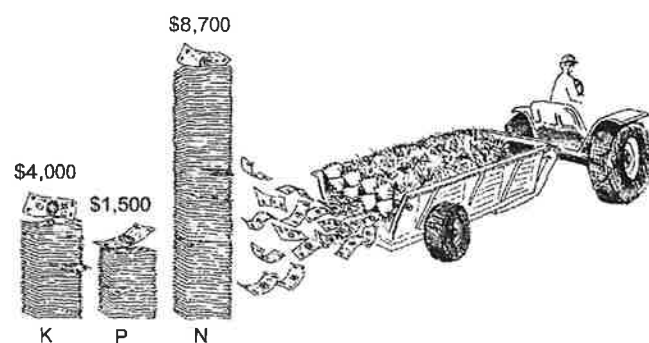


Figure 5.—Annual value of manure from 100 cows.

Table 2.—Nutrient contents from solids.

	Low	Average	High
Nitrogen (N)	0.29%	1.22%	1.88%
Phosphorus (P)	0.09%	0.21%	0.83%
Potassium (K)	0.09%	0.46%	1.34%

Based on samples from 51 Willamette Valley separators.

Source: *Analysis of Separated Manure Solids from Selected Manure Separators in Willamette Valley, Oregon Dairy Facilities*, SR 945, by Mike Gangwer and Monte Graham (Oregon State University, Corvallis, 1995).

For more information

The following publications can be ordered from:
Mike Gangwer

Marion County Office

OSU Extension Service

3180 Center St. NE, Room 160

Salem, OR 97301

Analysis of Separated Manure Solids from Selected Manure Separators in Willamette Valley, Oregon Dairy Facilities, SR 945, by Mike Gangwer and Monte Graham (Oregon State University, Corvallis, 1995). No charge.

Wastewater Volume and Nitrogen Concentrations in Willamette Valley, Oregon Dairy Ponds, SR 939, by Mike Gangwer and Monte Graham (Oregon State University, Corvallis, 1994). No charge.

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NUTRIENT MANAGEMENT FOR DAIRY PRODUCTION

Which test is best?

Customizing dairy manure nutrient testing

D. Sullivan, C. Cogger, and A. Bary

Manure is a nutrient resource. To get the most value from this resource, you need accurate information on manure nutrient content. A regular manure testing program will:

- Help you save money on fertilizer
- Assist in refining application rates to meet, but not exceed, crop needs
- Demonstrate your commitment to protecting surface and groundwater quality
- Establish the value of manure for off-farm marketing
- Serve as a reliable data source for long-term farm plans

Both laboratory analyses and on-farm quick tests of manure nutrient content play an important role in manure management. Laboratory testing is the most reliable method of manure nutrient testing and is valuable for long-term planning and as a check on quick test results. Quick tests are valuable for rapid assessment of manure N content. Quick tests help guide daily management decisions.

Dan M. Sullivan, Extension soil scientist, Oregon State University; Craig G. Cogger, Extension soil scientist, Washington State University; and Andy I. Bary, scientific assistant, Washington State University.

This publication discusses the following aspects of a successful manure testing program:

- Collecting a manure sample that reflects average nutrient composition
- Selecting an analytical laboratory
- Requesting key nutrient analyses and usable reporting units from analytical labs
- Determining testing needs for different manure handling and storage systems
- Choosing on-farm tests for manure N content



On-farm quick tests determine manure N content within a few minutes.

Manure application plans often are based on average manure analyses for a particular manure handling and storage system. However, manure nutrient composition also is related to your specific management practices, including:

- Source and quality of feed
- Water added to manure
- Type and amount of bedding
- How long the manure is stored

Because these factors often vary during the year, manure nutrient content also varies.

The importance of nitrogen

Nitrogen (N) usually is the most important nutrient in a manure testing program. Farm management plans approved by your local conservation district, the Natural Resources Conservation Service, or the Oregon Department of Agriculture require an agronomic manure application rate. The agronomic rate usually is based on N. Agronomic rates supply appropriate amounts of plant-available N for crop growth without excessive loss of nitrate to groundwater.

Crops take up N from the soil in the ammonium or nitrate forms (plant-available N). Manure usually contains little or no nitrate as applied. Nitrogen in manure usually is present as ammonium and organic forms (amino acids, proteins, etc.). Manure ammonium-N is plant-available immediately after application. Soil microorganisms slowly convert manure organic N to plant-available forms after application.

Manure analytical methods determine total N and ammonium N. Organic N is not measured directly. It is calculated as the total N content minus the ammonium-N content.

You can use nitrogen analyses of manure for both long-term planning and short-term decision making. First, analyses collected over a period of years serve as a good data source for long-term farm plans (e.g., determining land area needs for manure utilization). Second, you can use analyses to guide daily management decisions (e.g., calculating an

application rate for a particular field). Simple, rapid on-farm testing procedures are well-suited for daily management decisions.

Effect of manure storage and handling on nitrogen content

How predictable is manure N content from your operation? The more variable the manure, the more samples you need to accurately characterize manure N content. Factors contributing to variability include:

Storage. Generally, the longer manure is stored, the higher the proportion of total N in the ammonium form, which is immediately available to plants. Organic N in stored manure is converted to ammonium-N by microbes; some of the ammonium-N then is lost as ammonia-N to the atmosphere.

Drying. Dried manure generally is low in ammonium-N; it is lost as ammonia during the drying process. Drying increases manure total N concentration (per unit volume).

Dilution. The more water added to manure, the lower its nutrient content. If you periodically add fresh water to a lagoon for summer irrigation, manure N content is reduced. Straw or other bedding materials usually are low in N and also reduce manure N concentration.

Tables 1 through 4 summarize the range in nutrient analyses for different manure-handling systems in the Pacific Northwest. We make the following observations:

Lagoon liquid pumped without agitation usually contains less than 5 lb N/1,000 gal; most of the N is in the ammonium form. Average total N content reported for two-cell Yakima Valley lagoons is 2.0 lb N/1,000 gal (Stevens and Prest, 1992, unpublished data). This is considerably lower than the average content reported for two-cell Willamette Valley lagoons, which is 4.4 lb N/1,000 gal (Table 1).

Agitated slurry from a lagoon or storage tank is highly variable; its N content varies with the total solids content of the slurry (Table 2).

Dry stack manure can have highly variable N contents because of variability in straw and moisture content (Table 3).

Separated manure solids from a mechanical separator are quite uniform in N content across a variety of separator and bedding types (Table 4).

Composted dry stack manure or composted separated solids are quite uniform in N content. Piles are mixed repeatedly during the composting process.

Table 1.—Nitrogen content of secondary lagoon liquid.^a

Dairy	Usual range ^b		
	Low	High	Average
	lb N/1,000 gal		
A	3.0	6.0	4.4
B	1.8	3.5	2.6
C	3.0	6.0	4.9
D	2.0	7.0	4.2
E	3.0	6.0	4.9
F	3.0	7.0	5.6
G	3.0	4.5	3.8
H	3.5	6.0	5.0
Average	2.8	5.8	4.4

^aSource: Gangwer, M., and M. Graham, 1994.

^b"Usual range" contains 80 percent of monthly measurements over a 2-year period (locations A-E), or a 1-year period (locations F-H). Nitrogen determined via an Agros meter. For these lagoons with less than 1 percent total solids, Agros nitrogen was approximately equal to total nitrogen.

Table 2.—Nutrient content of dairy slurries from agitated lagoons or agitated storage pits.^a

Total solids	Total N	Total P	Total K
%	lb/1,000 gal		
2	6–10	1.4–2.0	7–15
4	10–14	2.8–3.4	10–18
6	14–18	4.0–4.8	14–22
8	18–24	5.2–6.2	17–25

^aSource: Sullivan, et al., 1994. Based on 37 analyses (Whatcom County, WA). Average total N was 3.7 percent, average total P was 0.9 percent, and average total K was 4.4 percent on a dry weight basis.

Table 3.—Nutrient content of dry stack manure.^a

Nutrient	Analysis	
	Average	Standard deviation
	% (dry matter basis)	
Total N	1.3	0.30
Total P	0.81	0.19
Total K	1.86	0.51
	lb/wet ton (as-received basis) ^b	
Total N	8.6	1.6
Total P	4.0	0.8
Total K	13.1	2.8

^aSource: Stevens, R.G., and V.I. Prest, 1992, unpublished data. Analyses are an average of composite samples from 14 dry stack facilities in the Yakima Valley (WA).

^blb/wet ton based on an average total solids content of 35 percent (65 percent moisture). Standard deviation in total solids content was 8 percent.

Table 4.—Nutrient content of separated manure solids.

Nutrient	Analysis	
	Oregon ^a	Washington ^b
	% (dry matter basis)	
Total N	1.2 (0.28) ^c	1.5 (0.33)
Total P	0.21 (0.11)	0.26 (0.15)
Total K	0.46 (0.22)	0.51 (0.26)
C:N Ratio	33.1 (7.0)	25.6 (5.0)
	lb/wet ton (as-received basis) ^d	
Total N	4.6	5.6
Total P	0.8	1.0
Total K	1.7	1.9

^aSource: Gangwer, M., and M. Graham, 1995. Analyses are an average of 51 Willamette Valley (OR) facilities.

^bSource: Sullivan, D., and H. Bierlink, 1992, unpublished data. Analyses are an average of nine Whatcom County (WA) facilities.

^cValues in parentheses are standard deviations in dry matter nutrient analyses.

^dlb wet/ton based on an average total solids content of 19 percent (81 percent moisture). Standard deviation in total solids content was 4 percent.

The hydrometer is a useful quick test for agitated lagoon slurry or semi-solid manure that has been scraped and stored in a pit or tank. Such manure sources, with solids contents above 2 percent, usually contain a substantial portion of their N in the solid part of the manure.

The hydrometer works best for slurries containing from 2 to 6 percent total solids. It is not appropriate for estimating the nutrient content of separated solids or of solid manure with large amounts of bedding.

On-farm quick test: Hydrometer

Description: Floating glass apparatus with a weighted bottom.

Test procedure: Collect a representative sample of slurry in a 5-gallon bucket. Stir to suspend solids. Place the hydrometer in the bucket and read the result after 15 seconds. If the slurry is too thick for the hydrometer to float freely, mix the slurry with water, stir well, and take a hydrometer reading. For a 1:1 dilution (water:slurry), double the hydrometer reading to get the correct value for undiluted slurry.

How it works: Measures the density (specific gravity) of liquid manure.

Manure type where it works best: Slurries, 2 to 6 percent total solids.

Initial cost: \$30 to \$60. No additional cost per sample.

Nutrients estimated: Total solids, total N, and total P.

Accuracy: Fair. We developed the following regression equations for agitated manure slurries (Sullivan, et al., 1994):

$$\text{Total N (lb/1,000 gal)} = 3.7 + 2.14 \times (\text{percent total solids}), R^2 = 0.72$$

$$\text{Total P (lb/1,000 gal)} = 0.42 + 0.66 \times (\text{percent total solids}), R^2 = 0.84$$

These regression equations were based on 37 composite samples collected from dairies in Whatcom County, WA over a 4-month period. Our regression equations for the hydrometer are similar, but not identical, to those previously reported for dairy slurry from North Carolina (Chescheir, 1985).

If your hydrometer is calibrated in units of specific gravity, use this table to estimate total solids:

Specific Gravity	Total Solids (%)
1.011	2.0
1.020	4.0
1.028	6.0

Other comments: To use a hydrometer to estimate slurry nutrient content, you must have a calibration equation to relate slurry density to nutrient content. Calibration equations given in this publication are valid only for dairy manure. Hydrometers are available that read out in units of specific gravity, percent total solids, or percent total N. Measurement scales for hydrometers that read out in units other than specific gravity are based on manufacturers' regression equations.



The hydrometer measures slurry density and estimates total slurry N via a regression equation (see page 6). It also provides an estimate of slurry P content.

The Nova meter, which measures only ammonium-N, provides a helpful quick test for the N that is immediately plant-available. It is the quick test of choice for lagoon liquids, which contain most of their N in the ammonium form.

On-farm quick test: Nova meter or Agros meter

Description: Stainless steel or plastic chamber with a built-in pressure gauge. The Nova meter (plastic chamber) is a recent replacement for the Agros meter (stainless steel chamber). Both Nova and Agros meters use the same chemical process to estimate manure N.

Test procedure: Add manure to the main chamber using the scoop provided by the manufacturer. Add hypochlorite reagent to a separate reservoir inside the chamber. After the lid is secured, mix the hypochlorite and the manure inside the chamber following the manufacturer's instructions. Wait 2–5 minutes. Manure N content is given on the pressure gauge.

How it works: Hypochlorite oxidizes ammonium-N to form nitrogen gas (N_2) inside the chamber. The higher the manure ammonium-N, the more pressure is generated. The pressure gauge is calibrated by the manufacturer to read out in units of N.

Manure type where it works best: This quick test gives results very similar to a laboratory ammonium-N analysis. Use for manure where ammonium-N is a major proportion of total N. This is the best quick test for liquid manure with less than 2 percent solids.

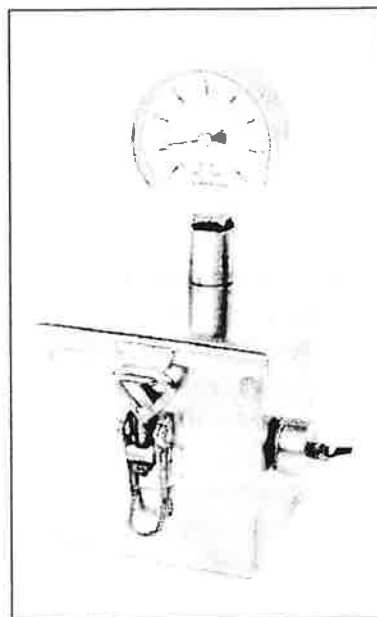
Cost: Initial cost is \$350 to \$500. Hypochlorite reagent is consumed with each test.

Nutrients estimated: Ammonium-N only.

Accuracy: Excellent (See Sullivan, et al., 1994; Chescheir, et al., 1985).

Caution: Hypochlorite reagent is hazardous to eyes and irritates the nose and skin. Protect yourself with safety glasses, gloves, and a dust mask. Perform the tests outdoors in a well-ventilated area. Hypochlorite also is corrosive. Rinse metal parts with water after each use. Don't dispose of excess reagent in the garbage; it is a strong oxidizer.

Other comments: On some Nova or Agros meters, the pressure gauge has units of $kg\ N/m^3$. To convert kg/m^3 to $lb/1,000\ gal$, multiply by 8.34.



Setting up a sampling program for your farm

Manure from different handling systems (dry stack, lagoon liquid, etc.) should be sampled and analyzed separately. The amount of time and money devoted to sampling manure from different sources should reflect its relative importance as a nutrient source and its potential variability. The more variability, the more sampling is required. Samples collected close to the time of application best reflect the nutrients applied to the field.

Let's take a look at how the general principles of manure sampling and testing apply to a specific dairy operation. For our example, let's consider a large dairy in western Washington or western Oregon with a flush barn-cleaning system, a mechanical solids separator, and a two-cell lagoon. Manure is generated from three sources: the separated solids, the secondary lagoon liquid, and periodic agitation of the primary and secondary lagoon for solids removal.

The suggested sampling plan is shown in Table 7 and is discussed below. To check the accuracy of the quick tests (Nova meter and hydrometer), we recommend splitting a composite sample once each year and analyzing it via both laboratory and quick test methods.

Secondary lagoon liquid. For this dairy operation, the most frequent manure application is in the form of secondary lagoon liquid. A yearly laboratory test is recommended to serve as a reliable record of the nutrient value of the secondary liquid (see

Table 5 for recommended analyses). The samples for laboratory analysis can be taken at almost any time, but are most useful if taken when the lagoon is at least half full.

Since the secondary lagoon liquid contains N primarily in the ammonium form, its N content can be estimated using a Nova meter. Testing with the Nova meter can be used throughout the application season to refine application rates. It is especially helpful in the summer when the operator mixes secondary lagoon effluent with fresh irrigation water.

Agitated lagoon slurry. Each spring, the operator agitates the lagoon to remove accumulated solids from the bottom. The slurry produced by agitation is much higher in N content because of the suspended solids. We recommend at least one laboratory analysis per year. A hydrometer can be used on a daily or weekly basis to measure changes in N content due to differing amounts of suspended solids.

Separated solids. The nutrient analysis of the separated solids is not expected to vary significantly from published values (Table 4). Furthermore, for the current growing season, the separated solids represent only a small risk of excess N application, because most of the N is present in organic compounds that are slow to release plant-available N. Therefore, using average analytical values for separated solids (Table 4) is acceptable. We do not recommend routine testing of separated solids for on-farm utilization.

Table 7.—Example of a yearly sampling plan utilizing both laboratory and on-farm quick test methods.^a

Manure applied as:	Application period	Suggested test frequency	
		Lab test	Quick test
Secondary lagoon liquid	April–Sept.	yearly	Nova—monthly
Separated solids	April–Sept.	none	none
Agitated lagoon slurry	April–May	yearly	Hydrometer—weekly

^aExample location: western Oregon/Washington. Two-cell lagoon storage with solids separator.

Calculating manure application rates

A manure analysis is only part of the information you need for site-specific estimates of appropriate N application rates (volume or weight per acre).

Other information needed includes:

- Crop N requirement
- Proportion of manure-N that will be plant-available during the growing season (less than 100 percent)
- Quantity of N supplied from other sources (e.g., decomposition of soil organic matter, fertilizer N)
- Crop N uptake efficiency—proportion of plant-available N removed by the crop (less than 100 percent)

We suggest you work with an agronomist in calculating site-specific application rates. You can get a rough idea of appropriate manure N application rates by assuming that crop N uptake is approximately equal to the needed manure N inputs. An example of this approach is found in OSU Extension publication EM 8585, *Manure Application Rates for Forage Production* (Hart, et al., 1996). It is a reasonable approach if manure is applied every year to the same fields.

Periodic soil testing also helps you apply manure at rates that match crop requirements.

Manure testing as part of whole-farm nutrient management

Manure testing is a more powerful tool when used together with other tools for nutrient management. Records of feed inputs, field-by-field manure application amounts and timing, fertilizer applications, and soil and plant tissue test results are some of the other components of whole-farm nutrient management. When data from these sources are used together, you can consider environmental as well as economic consequences when making long-range management decisions.

The references listed at the end of this publication can help you get started with whole-farm nutrient management. Together with manure analyses, these tools can help you adjust manure management to meet economic and water-quality goals.

Suppliers for quick tests

Both hydrometers and Nova meters may be available for short-term use from your local conservation district or NRCS office.

Hydrometers

Whatcom Conservation District, 6975 Hannegan Rd., Lynden, WA 98264; phone: 360-354-2035.

Various laboratory supply companies. Choose a hydrometer used for measuring the specific gravity of soil suspensions. We recommend a model that is equivalent to ASTM #151H specifications (measures specific gravity from 0.995 to 1.038 g/cm³).

Nova meters

Farm Home Offices, Inc. 1965 64th St., Box 840, Vinton, Iowa 52349; phone: 800-788-7218 (sells a version of the Nova meter called "On-the-farm manure nitrogen test kit").

Grass Roots Project Management, P.O. Box 136, Chilliwack, BC, Canada V2P 6H7; phone: 604-795-2350 (sells a version of the Nova meter called the "Nova MK2 meter").

For more information

Selected research publications

Chescheir, G.M., P.W. Westermann, and L.M. Safley. 1985. Rapid methods for determining nutrients in livestock manures. *Transactions of the ASAE* 28 (6): 1817-1824 (American Society of Agricultural Engineers, St. Joseph, MI).

Sullivan, D.M., H. Bierlink, and W. Matthews. 1994. Tools for getting more value out of dairy manure. pp. 55-65. In: *Proc. 26th Annual Dairy Producers Short Course*, Feb. 8-9, 1994, Clearbrook, BC, Canada. BC Ministry of Agriculture, Fisheries and Food, Chilliwack, BC (available from Dan Sullivan, Department of Crop and Soil Science, Oregon State University).

Manure analyses for Willamette Valley dairies

Available from:

M. Gangwer
Marion County Office
OSU Extension Service
3180 Center St. NE, Room 1361
Salem, OR 97301
Phone: 503-588-5301

Gangwer, M., and M. Graham. *Wastewater volume and nitrogen concentrations in Willamette Valley, Oregon dairy ponds*, SR 939 (Oregon State University, Corvallis, 1994). No charge.

Gangwer, M., and M. Graham. *Analysis of separated manure solids from selected manure separators in Willamette Valley, Oregon dairy facilities*, SR 945 (Oregon State University, Corvallis, 1995). No charge.

Extension directories of analytical laboratories

See ordering instructions on page 11.

Hart, J. *A list of analytical laboratories serving Oregon*, EM 8677 (Oregon State University, Corvallis, 1997). No charge.

Schreiber, A., and C.H. Daniels. *Analytical laboratories and consultants serving the Pacific Northwest*, EB 1578 (Washington State University Cooperative Extension, Pullman, 1994). \$1.50

Extension publications on whole-farm nutrient management

See ordering instructions on page 11.

Sullivan, D.M., C.G. Cogger, and A.I. Bary. *Date, rate, and place: The field book for dairy manure applicators*, EM/PNW 506 (Oregon State University Corvallis, 1997). \$5.50

Gardner, E.H., and J. Hart. *How to take a soil sample . . . and why*, EC 628 (Oregon State University, Corvallis, revised 1995). No charge.

Grusenmeyer, D., and B. Peterson. *Manure management guidelines for western Washington* (Washington State University Cooperative Extension, Whatcom County, 1995). Available from Whatcom County Office, 1000 N. Forest, Bellingham, WA 98225.

Hart, J., M. Gangwer, M. Graham, and E. Marx. *Dairy manure as a fertilizer source*, EM 8586 (Oregon State University, Corvallis, reprinted 1997). 75¢

Hart, J., E.S. Marx, and M. Gangwer. *Manure application rates for forage production*, EM 8585 (Oregon State University, Corvallis, reprinted 1997). \$1.00

Hermanson, R.E. *Manure sampling for nutrient analysis with worksheets for calculating fertilizer values*, EB 1819 (Washington State University, Pullman, 1996). \$1.00

Hermanson, R.E., A.C.S. Rao, W.L. Pan, K.F. Duncan, and M.A. Wright. *MNB: Manure nutrient balancer* (computer software for IBM-compatible computers) (Washington State University, Pullman, 1995). Order number MCP 0026. \$25.00

Marx, E.S., J. Hart, and R.G. Stevens. *Soil test interpretation guide*, EC 1478 (Oregon State University, Corvallis, reprinted 1997). \$1.50

Marx, E.S., N.W. Christensen, J. Hart, M. Gangwer, C.G. Cogger, and A.I. Bary. *The pre-sidedress soil nitrate test (PSNT) for western Oregon and western Washington*, EM 8650 (Oregon State University, Corvallis, reprinted 1997). 75¢

Moore, J., and M.J. Gamroth. *Calculating the fertilizer value of manure for livestock operations*, EC 1094 (Oregon State University, Corvallis, reprinted 1993). \$1.00

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Manure testing quick tips

A regular manure testing program will:

- Help you save money on fertilizer
- Assist in refining application rates to meet, but not exceed, crop needs
- Demonstrate your commitment to protecting surface and groundwater quality
- Establish the value of manure for off-farm marketing
- Serve as a reliable data source for long-term farm plans

Variability in manure analyses. The more variable the manure source, the more often you need to test it to characterize its nutrient content. This publication summarizes the variability observed for different manure handling systems in the Pacific Northwest. Use this information to budget your testing dollars.

Collecting samples for nutrient analysis. Collect a sample that represents the average composition of a manure source (lagoon, dry stack, etc.) to obtain accurate results.

Laboratory testing is the most reliable testing method. Find a lab that knows how to test manure and report results in a usable form. We recommend analysis for total N, ammonium-N, total phosphorus (P), total potassium (K), and total solids (moisture content). Ask the lab to report nutrient analyses on both an "as-received" and a "dry weight" basis.

Quick tests for nitrogen. Although laboratory tests are more accurate, quick tests provide information to guide daily management decisions. Two simple, rapid, on-site test procedures for N analysis are described in this publication (the hydrometer and the Nova meter). Verify quick test results with periodic laboratory analyses.

Calculating agronomic manure application rates. A manure analysis is only part of the information you'll need. An agronomist can help you calculate site-specific manure application rates to meet crop needs.

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\$2.00

DATE: July 19, 2006
 REPORT: S 7247
 GROWER: JENNIFER ZWICKE/ SCHOCH DAIRY
 ADDRESS: 24335 NW UNION RD; HILLSBORO, OR 97124
 SAMPLED: SAMPLE #1
 FIELD: SAMPLE #1
 CROP:

AGRI-CHECK, INC.
 Agricultural Testing Laboratory
 3223 Sixth St. - P.O. Box 1350
 Umatilla, OR 97882
 800.537.1129 * 541.922.4894



SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN										MOISTURE							
									NO3 #/A	NH4 #/A	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat.%	SMP Bufr.pH	Total %	Avail. inches	TKN %	C pi	
8336	0-6"	6.0	0.26	7.4	114	592	11.0	3.4	44	16	11.9	0.6	8.1	38	3.2	282			15.9		6.4					

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
 PHOSPHORUS: LBS PER ACRE P2O5
 POTASSIUM: LBS PER ACRE K2O
 SULFUR: LBS PER ACRE ACTUAL S
 BORON: LBS PER ACRE ACTUAL B
 ZINC: LBS PER ACRE ACTUAL Zn
 MAGNESIUM: LBS PER ACRE ACTUAL Mg
 OTHERS:

COMMENTS:

TOTALS: 44 16

YIELD GOAL/ACRE:

ACRES:
 PREVIOUS CROP:
 GYPSUM REQUIREMENT:
 LIME REQUIREMENT:
 DOLOMITE REQUIREMENT:
 TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

TOTAL INCHES:

SOIL TEXTURE ANALYSIS:

CLASS:
 % SAND:
 % SILT:
 % CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %		Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %
		N %	N ppm														

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Brn P and Acetate K extractions. Fertility recommendations may change after application of gypsum or

DATE: July 19, 2006
 REPORT: S7247
 GROWER: JENNIFER ZWICKE/ SCHOCH DAIRY
 ADDRESS: 24335 NW UNION RD, HILLSBORO, OR 97124
 SAMPLED: SAMPLE #2
 FIELD: SAMPLE #2
 CROP:

AGRI-CHECK, INC.
 Agricultural Testing Laboratory
 323 Sixth St. - P.O. Box 1350
 Umatilla, OR 97882
 800-537-1129 * 541-922-4894



SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN										MOISTURE						
									NO3 #/A	NH4 #/A	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Bu:ph	Total %	Avail. Inches	TKN %	
8337	0-6"	6.6	0.26	7.7	154	732	13.8	4.0	37	22	11.0	0.7	13.6	16	5.3	200			19.7		6.8				

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
 PHOSPHORUS: LBS PER ACRE P2O5
 POTASSIUM: LBS PER ACRE K2O
 SULFUR: LBS PER ACRE ACTUAL S
 BORON: LBS PER ACRE ACTUAL B
 ZINC: LBS PER ACRE ACTUAL Zn
 MAGNESIUM: LBS PER ACRE ACTUAL Mg
 OTHERS:

COMMENTS:

TOTALS: 37 22

YIELD GOAL/ACRE:

ACRES:
 PREVIOUS CROP:
 GYPSUM REQUIREMENT:
 LIME REQUIREMENT:
 DOLOMITTE REQUIREMENT:

TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES

PREPLANT:

SIDEDRESS:

TOTAL INCHES:

SOIL TEXTURE ANALYSIS:

CLASS:
 % SAND:
 % SILT:
 % CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD: DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moisture %
---------	---------------------	-----------	---------------	-----	-----	-----	------	------	-------	--------	--------	--------	--------	--------------	--------	------------

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Brw P and Acetate K extractions. Fertility recommendations may change after application of gypsum or

DATE: July 13, 2006
 REPORT: 37247
 GROWER: JENNIFER ZWICKE/ SCHOCH DAIRY
 ADDRESS: 24335 NW UNION RD, HILLSBORO, OR 97124
 SAMPLED: SAMPLE #3
 FIELD: SAMPLE #3
 CROP:

AGRI-CHECK, INC.
 Agricultural Testing Laboratory
 3223 Sixth St. - P.O. Box 1350
 Umatilla, OR 97882
 800-537-1129 * 541-922-4884



SOIL ANALYSIS REPORT

Lab No.	Depth Foot	pH	S.Salt mmhos	O.M. %	P ppm	K ppm	Ca meq	Mg meq	NITROGEN										MOISTURE					
									NO3 #/A	NH4 #/A	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	CEC meq	Na meq	Total Bases	Base Sat. %	SMP Bufl.pH	Total Avail. Inches	TKN %	
8338	0-6"	7.3	0.46	8.4	152	1141	15.6	4.9	46	23	16.6	1.1	17.2	14	11.6	89			23.4		7.1			

TOTAL BROADCAST FERTILITY NEEDS:

NITROGEN: LBS PER ACRE N
 PHOSPHORUS: LBS PER ACRE P205
 POTASSIUM: LBS PER ACRE K2O
 SULFUR: LBS PER ACRE ACTUAL S
 BORON: LBS PER ACRE ACTUAL B
 ZINC: LBS PER ACRE ACTUAL Zn
 MAGNESIUM: LBS PER ACRE ACTUAL Mg
 OTHERS:

COMMENTS:

TOTALS: 46 23
 YIELD GOAL/ACRE:
 ACRES:
 PREVIOUS CROP:
 GYPSUM REQUIREMENT:
 LIME REQUIREMENT:
 DOLOMITE REQUIREMENT:

TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES
 TONS PER ACRE 6-INCHES

PREPLANT:
 SIDEDRESS:

TOTAL INCHES:

SOIL TEXTURE ANALYSIS:

CLASS:
 % SAND:
 % SILT:
 % CLAY:

PLANT TISSUE ANALYSIS REPORT

Lab No.	FIELD DESCRIPTION:	Total N %	Nitrate N ppm	S %	P %	K %	Ca %	Mg %	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Chloride ppm	Na ppm	Moist %
---------	--------------------	-----------	---------------	-----	-----	-----	------	------	-------	--------	--------	--------	--------	--------------	--------	---------

NOTE: East of Cascades Bicarb P & K extraction/SMP=1/4 SMP Buffer pH; West of Cascades Weak Bray P and Acetate K extractions. Fertility recommendations may change after application of gypsum or

Oregon Department of Agriculture
ANIMAL WASTE MANAGEMENT PLAN

MINIMUM REQUIRED ELEMENTS

Producer name: Dave and Casey Schoch Facility / Operation Location: 24335 NW West Union Rd Hillsboro, OR 97124

This guidance document is intended as a tool for producers and their plan preparers. It lists all of the minimum required elements of an AWMP. This guidance document is also available on ODA's website at http://www.oregon.gov/ODA/NRD/cafo_front.shtml

AWMP Minimum Required Elements	Notes
1. Summary of CAFO Operation	
a) Contact name, address, phone number	C
b) Facility address	C
c) Type of operation	
(i) Number and size of animals by species, expansion?	C
d) Manure, litter and process waste system – provide a general narrative description of each	
(i) Collection – How is manure, litter and process waste removed from housing, confinement lots? How is clean water diverted from storage?	reception tank on facility map
(ii) Storage – Types and size of manure, litter and process waste storage tanks, ponds.	Size of solid storage facility
(iii) Transfer – How is manure, litter and process waste moved to storage, application areas?	C
(iv) Use – How is manure, litter and process waste treated (composted, separated, anaerobic digestion or storage, aeration)? How is manure, litter and process waste water used on crops? If export is utilized, describe that process.	C
2. Specific descriptions and calculations	
a) A description of production area and land application locations	
(i) Aerial photo or topographical map showing numbered field locations, production area facilities, clean water diversions, and surface water features.	C
(ii) Soil maps of all application fields, including those not owned, and map unit descriptions. Indicate areas with application limitations.	C
b) Manure, litter and process waste volumes	

xdouble check size of reception tank
 ECD's

AWMP Minimum Required Elements

Notes

(i) Manure (feces and urine), litter and process waste output that is collected and stored in this system.	C
(ii) Bedding added and collected.	C
(iii) Process and wash water collected, include footbath use when appropriate.	C
(iv) Silage and feed processing leachate.	C
c) Contaminated storm water	
(i) Direct rainfall into storage.	C
(ii) Slab or lot runoff collected.	C
(iii) Overflow from gutters or other diversions.	C
d) Nutrient content of manure, litter and process waste water	
(i) Content and volume of nutrients in manure, litter and process waste generated – can come from NRCS Animal Waste Field Handbook (chapter 4)), land grant university publications, or analyses of manure, litter and process waste. Actual test values are required of large CAFOs.	C
e) Farm nutrient balance	
(i) Show amount of nutrients (N, P, K) generated, lost in storage, lost during application, used by crops, and/or exported off the farm on an annual basis.	40 acres of farm?
(ii) Nutrient application must balance to most limiting nutrient as determined by NRCS Agronomy Technical Note #26 and the NRCS Phosphorus Index.	* contact Jennifer
(iii) Include all acres required to balance nutrients owned or leased by the operator.	?
f) Application schedule and limitations	
(i) Show scheduled applications of solids and liquids. Include date, amount and method of application to identified fields. Describe calibration of equipment used to apply manure, litter and process waste water.	C
(ii) Describe limitations to manure, litter and process waste applications. Indicate buffer areas and management to avoid saturated soils. Justify buffer width and management. If application to frozen soil is planned, include field descriptions, specific management/structural practices, monitoring and record keeping.	emergency app - 1000 ft from the - 19 B soil type - growing crop
(iii) Using agronomic rates, application limitations, and scheduled applications, calculate the minimum storage required for liquids and solids.	C

Apps after 8/31.
should be
seeds to perm
pasture or cover
crop

AWMP Minimum Required Elements

Notes

(iv) How is irrigation water managed relative to manure, litter and process waste water application? Include general timing and application rates of irrigation water. Irrigation water management must not allow leaching of soluble nutrients or runoff.	C
g) Animal mortality management	
(i) Describe how the farm handles mortalities. rendering	C
h) Operation and maintenance	
(i) Include operation and maintenance narrative for structural and mechanical components included in this plan.	C
3. Record keeping and reporting requirements	
a) Testing – Monitoring	
(i) Include the protocol for testing manure, litter and process waste.	C
(ii) Include the protocol for testing and measuring crop nutrient removals.	C
(iii) Include the protocol for soil testing to evaluate nutrient application and crop uptake.	C
b) Record keeping. Include the following:	
(i) Date and amount of manure, litter and process waste applied by field. Calculate N and P applied.	C
(ii) Manure, litter and process waste volume exported.	C
c) Reporting to Oregon Department of Agriculture	
(i) Any discharge within 24 hours.	C
(ii) Amount of manure, litter and process waste applied annually.	
(iii) Amount of manure, litter and process waste exported annually.	
4. Additional requirements for Large CAFOs	
a) Inspections	
(i) Check storm water diversions, runoff diversions, waste transport, storage structures, storage structure volume weekly.	Not applicable
(ii) Check water lines daily.	Not applicable
(iii) Check for application equipment leaks periodically.	Not applicable
b) Record keeping	
(i) Results of daily inspections.	Not applicable

planned app.
Field 1 - grazing; 2 & 3 liquid 4 = solids

$$\begin{array}{r} 28 \\ 3 \overline{) 85} \end{array}$$

AWMP Minimum Required Elements

Notes

(ii) Results of weekly inspections.	Not applicable
(iii) Results of periodic inspections.	Not applicable
(iv) Corrective actions taken, explain those not corrected.	Not applicable
(v) Expected crop yields if not in the plan.	Not applicable

T2N R2W section 10
Tracts 3375 & 3376

Plan (160) (30)

190 milking & dry

109 heifers (79) + calves (30) 58.7 acres owned

40.0 acres

299

Permit Summary

150 milking & dry
100 heifers
250

High soils P & K

15'1. sep solids 20x15x8 ps 42
reception tank 12x12x10 ps 5

separator

Field	1	2	3	4	Yield
	2.1	11.6	40.5	3.4	4
					4
					6
					3
					57.6

Irrigation - pipeline/handline - fields 2 & 3.

concrete slab
storage pond
#1 - 3.5 AF
#2 - 4.9 AF

solids are exported

concrete slab
11,458 (design volume)

solid stack facility 40x40x6
hay facility (as solids)
40x45x15

Plans - remove solids from #1 cell
- repair current separator
- more solid storage
- plastic liner for pond #1
planned irrigation for fields 2 & 3

Questions emailed Jenn. for 10/12/16

Page 4 - wastewater → flush alley → reception tank
(where is the tank on the picture)
in section 12, 15 sump = reception tank

Fields 1-4 all there on page 6, 40 acres of crop land

A. P Index - still medium

Page 58 differs from page 59 - why?

Section 4

CHECKED BY:

ANIMAL INVENTORY

GRAZING PERIOD

cr-

WEATHER STATION		HILLSBORO		▼	
Month	2511-24Hr	4.00	Lot Runoff Factors as a Percent of Monthly Precipitation		
	Monthly Average in Inches				
	Precipitation	Evaporation	Paved	Unpaved	
October	2.68	1.72	55%	15%	
November	6.03	0.76	55%	20%	
December	6.44	0.43	55%	20%	
January	5.76	0.48	55%	20%	
February	4.72	0.81	45%	20%	
March	3.93	1.57	45%	15%	
April	2.46	2.40	35%	15%	
May	1.90	3.75	35%	10%	
June	1.46	4.34	35%	10%	
July	0.61	5.42	30%	0%	
August	0.93	4.94	35%	10%	
September	1.61	3.37	45%	15%	
Annual	38.53	29.99			

Description of Runoff Area

[illegible]

--	--

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 Wastewater	160.0	2	1.00	320	42.8
Equipment Wash		2	50.00	100	13.4
Flushwater		2	0.09	0	0.0
Miscellaneous		2	0.00	0	0.0
Total>>>>>>>>>>>>>>>>				-420	56.1

1

Field Number	Acres	Crop	Condition	Yield Units	Target Yield	Nutrients Removed in Pounds per Acre		
						Nitrogen N	Phosphorous P ₂ O ₅	Potassium K ₂ O
1	2.1	Grass/Legume Hay/Pasture	▶ DHM	Ton	4.00	136	50	166
2	11.6	Hay/Pasture Mix 14% Protein	▶ DHM	Ton	4.00	179	49	137
3	40.5	Hay/Pasture Mix 14% Protein	▶ DHM	Ton	6.00	269	74	205
4	3.4	Oats Hay/Pasture	▶ DHM	Ton	3.00	78	70	54
			▶					
			▶					
			▶					
			▶					
			▶					
			▶					
			▶					
Off-Farm			▶					

Section 4

BEDDING VOLUME							
Type of Animal	Type of Bedding Facility	Bedding Material	Unit Weight Lbs/CF	Amount Lbs/Day/AU	Volume CF/Day/AU	Total Volume CF/Day	Total Weight Lbs/Day
MILKER (Holstein)	Free Stall	Sawdust	12.00	10.00	0.83	180	2,160
MILKER (Dry)	Free Stall	Paper Pulp	4.00	10.00	2.50	101	405
HEIFERS (12-24 Months)	Loose Housing	Paper Pulp	4.00	12.00	3.00	201	806
CALVES (1-12 Months)	Loose Housing	Loose Straw	2.50	60.00	24.00	180	504
							1,230
							1,110
							600
							3,476
							4,390
							4,810
							5,940
							6,170
							6,690
							7,010
							7,530
							7,950
							8,370
							8,790
							9,210
							9,630
							10,050
							10,470
							10,890
							11,310
							11,730
							12,150
							12,570
							12,990
							13,410
							13,830
							14,250
							14,670
							15,090
							15,510
							15,930
							16,350
							16,770
							17,190
							17,610
							18,030
							18,450
							18,870
							19,290
							19,710
							20,130
							20,550
							20,970
							21,390
							21,810
							22,230
							22,650
							23,070
							23,490
							23,910
							24,330
							24,750
							25,170
							25,590
							26,010
							26,430
							26,850
							27,270
							27,690
							28,110
							28,530
							28,950
							29,370
							29,790
							30,210
							30,630
							31,050

SOLIDS SEPARATION FACTOR									
Type of Animal	Type of Separator	Separation Factor %	Volume of Solids Separated CF/Day	Volume of Liquids CF/Day	Volume of Manure in Liquids CF/Day	Volung of Manure in Solids CF/Day	Accumulated Sludge in Storage CF/Day	Density of Separated Solids Lbs/CF.	Weight of Separated Solids Lbs/Day
MILKER (Holstein)	Static Inclined Screen with Drag Chain	▼ 15%	34	193	361	7	180	36	1,224
MILKER (DRY)	Static Inclined Screen with Drag Chain	▼ 15%	16	90	37	1	8	36	570
HEIFERS (12-24 Months)	Static Inclined Screen with Drag Chain	▼ 15%	32	179	59	1	22	36	1,138
CALVES (1-12 Months)	Dry Scrape System	▼ 100%	190	0	0	10	0	36	6,842
		▼							
		▼							
		▼							
		▼							
		▼							
		▼							
		▼							
		▼							
Total Solids>>			271	462	457	19	211		9,774

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

CLIENT: Dave and Casey Schoch
ASSISTED BY: Jennifer Zwickie

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM PRODUCTION

MONTHLY VOLUMES

Month	Runoff in Cubic Feet					Facility Water Use Cubic Feet		Manure		Bedding		Solids Separated		Solids in Liquids		Total Solids		Total Liquids	
	Roof Area Square Feet	Paved Slab Area Square Feet	Unpaved Lot Area Square Feet	Sludge Pit Surface Area, SF	Facility Water Use Cubic Feet			Solids Cubic Feet	Liquids Cubic Feet			Pounds	Cubic Feet	Pounds	Cubic Feet			Pounds	Cubic Feet
October	3,577	3,694	201	613	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,673	498,458	8,416	35,071	35,071		
November	804	8,311	603	823	1,684	2,110	19,881	20,544	118,445	8,416	302,991	14,308	515,673	498,458	8,416	40,320	40,320		
December	839	8,876	644	871	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,673	498,458	8,416	40,320	40,320		
January	768	7,938	576	832	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,673	498,458	8,416	40,320	40,320		
February	629	5,322	472	723	1,572	1,969	11,353	18,536	106,982	7,602	273,669	12,923	465,228	465,228	7,602	35,800	35,800		
March	524	4,432	295	668	1,741	2,180	12,570	20,544	118,445	8,416	302,991	14,308	515,673	498,458	8,416	36,124	36,124		
April	328	2,158	185	579	1,684	1,787	10,107	12,636	85,644	7,095	252,351	7,413	266,884	266,884	7,095	24,096	24,096		
May	253	1,666	95	55	1,741	1,803	11,109	11,718	81,972	6,866	247,166	6,597	237,504	237,504	6,866	21,343	21,343		
June	195	1,280	73	43	1,684	1,745	9,874	12,109	84,704	7,095	255,405	6,817	245,420	245,420	7,095	20,569	20,569		
July	81	459	0	0	1,741	1,803	12,109	12,109	84,704	7,095	255,405	6,817	245,420	245,420	7,095	21,042	21,042		
August	124	816	47	27	1,741	1,803	12,109	12,109	84,704	7,095	255,405	6,817	245,420	245,420	7,095	22,445	22,445		
September	215	1,815	121	542	1,684	1,745	9,874	11,718	81,972	6,866	247,166	6,597	237,504	237,504	6,866	22,445	22,445		
Annual	5,137	46,766	3,311	5,775	20,495	23,488	193,009	1,199,087	91,438	3,291,751	125,059	4,502,131	91,438	3,605,595	3,605,595				

DAILY NUTRIENT PRODUCTION

Type of Animal	Pounds/Day of Nutrients from LIQUIDS					Pounds/Day of Nutrients from SOLIDS					Pounds/Day of Nutrients from GRAZING				
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
MILK COW (Holstein)	128.52	50.56	71.19	22.68	8.92	12.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MILK COW (Dry)	11.36	5.52	7.05	2.00	0.97	1.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEIFERS (12-24 Months)	15.18	5.95	8.25	2.68	1.05	1.46	17.86	7.00	9.71	0.00	0.00	0.00	0.00	0.00	0.00
CALVES (1-12 Months)	0.00	0.00	0.00	3.15	0.93	0.99	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
	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	0.00	0.00	0.00	0.00	0.00	0.00

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

MONTHLY NUTRIENT PRODUCTION

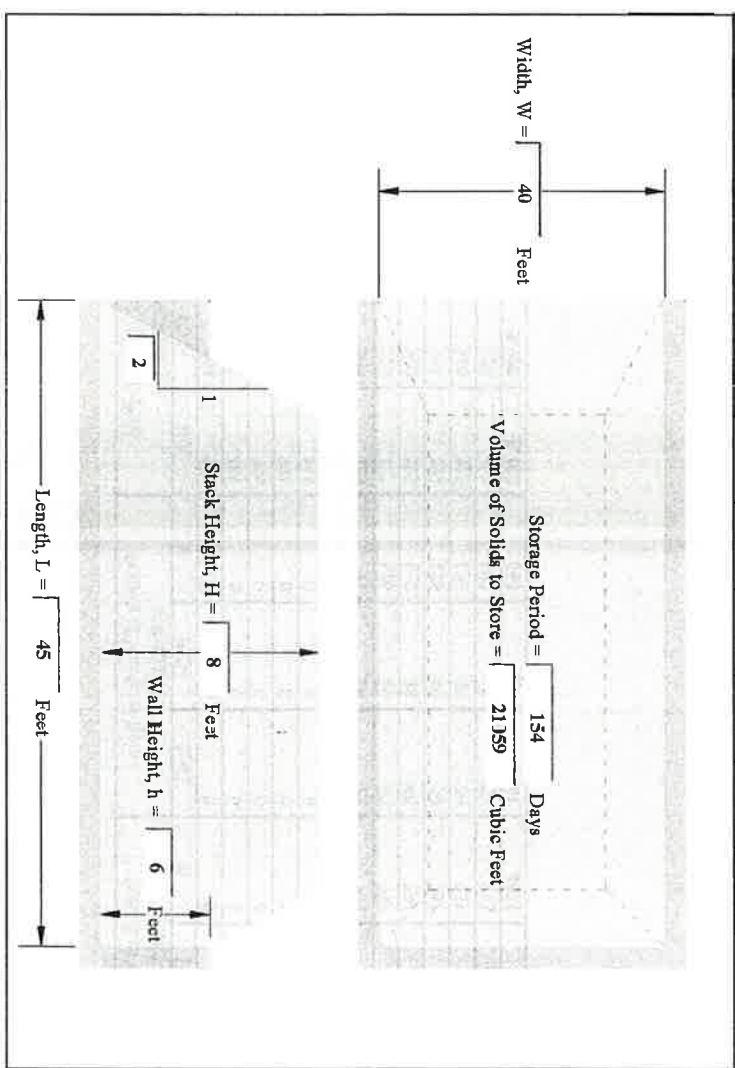
Month	Pounds of Nutrients from LIQUIDS			Pounds of Nutrients from SOLIDS			Pounds of Nutrients from GRAZING			Pounds of Nutrients going OFF-FARM			Total Pounds of Nutrients from ALL SOURCES		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
October	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
November	4,652	1,861	2,595	915	356	488	0	0	0	0	0	0	5,567	2,217	3,083
December	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
January	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
February	4,342	1,737	2,422	854	332	455	0	0	0	0	0	0	5,196	2,069	2,877
March	4,807	1,923	2,681	946	368	504	0	0	0	0	0	0	5,753	2,291	3,186
April	3,994	1,571	2,211	799	305	420	41	16	22	733	325	430	5,567	2,217	3,083
May	4,056	1,595	2,246	813	310	427	126	49	69	758	336	444	5,753	2,291	3,186
June	3,925	1,544	2,173	787	300	413	122	48	66	733	325	430	5,567	2,217	3,083
July	4,056	1,595	2,246	813	310	427	126	49	69	758	336	444	5,753	2,291	3,186
August	4,056	1,595	2,246	813	310	427	126	49	69	758	336	444	5,753	2,291	3,186
September	3,925	1,544	2,173	787	300	413	122	48	66	733	325	430	5,567	2,217	3,083
Annual	52,232	20,734	29,039	10,367	3,998	5,487	663	260	361	4473	1983	2620	67,736	26,975	37,507

MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

CLIENT: Dave and Casey Schoch
ASSISTED BY: Jennifer Zwickle
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=	154	October	31	592	1,825	4,208	54
Stacking Width, W in Feet=	40	November	30	573	1,572	4,072	161
Stacking Height, H in Feet=	8.00	December	31	592	1,825	4,208	172
Wall Height, h in Feet=	6.00	January	31	592	1,825	4,208	154
Stack Side Slope (X:1)=	2.00	February	28	535	1,067	3,801	126
Existing Storage, Cubic Feet=	9,898	March	31	592	1,825	4,208	79
Surface Area of Existing Storage, SF=	1,600	April	30	524	1,485	3,505	49
25 Year-24 Hour Storm Runoff, CF=	433	May	31	535	1,539	3,547	25
Volume Needed, Cubic Feet=	21,059	June	30	518	1,348	3,433	19
Design Volume, Cubic Feet=	11,458	July	31	535	1,539	3,547	0
Is Facility Covered? YES		August	31	535	1,539	3,547	12
		September	30	518	1,348	3,433	32
		Annual	365	6,641	84,796	45,719	883

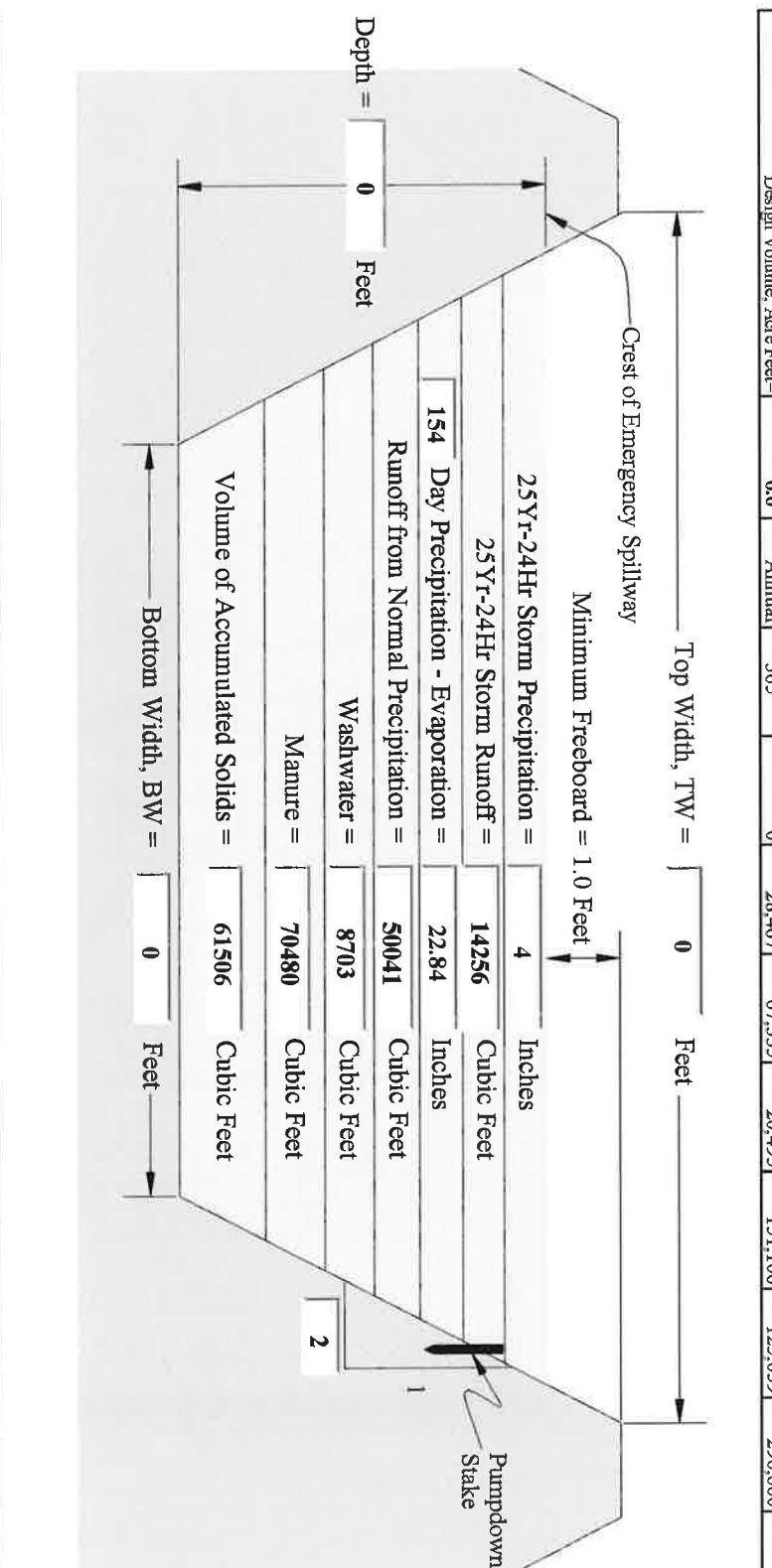


MANURE AND WASTEWATER HANDLING AND STORAGE FACILITIES

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	Solids CF	Waste to Store CF
Storage Period, Days=	154	October	31	0	3,200	5,087	1,741	14,158	14,308	30,206
Side Slope (X:1)=	2.00	November	30	0	17,567	11,637	1,684	13,701	13,846	29,232
Bottom Width, BW, Feet=	0	December	31	0	20,033	12,428	1,741	14,158	14,308	30,206
Bottom Length, BL, Feet=	0	January	31	0	17,600	11,116	1,741	14,158	14,308	30,206
Accumulated Solids Duration, Years=	1	February	28	0	13,033	7,926	1,572	12,788	12,923	27,283
Existing Storage, Acre Feet=	8.40	March	31	0	7,867	6,475	1,741	14,158	14,308	30,206
Surface Area of Existing Storage, SF=	40,000	April	30	0	200	3,437	1,684	11,370	7,413	20,468
Minimum Soil Liner Depth, Feet=	1.00	May	31	0	-6,167	2,594	1,741	11,471	6,817	20,029
25 Year-24 Hour Storm Runoff, CF=	14,256	June	30	0	-9,600	1,993	1,684	11,101	6,597	19,383
Top Width, TW, Feet=	0	July	31	0	-16,033	718	1,741	11,471	6,817	20,029
Top Length, TL, Feet=	0	August	31	0	-13,367	1,270	1,741	11,471	6,817	20,029
Volume Needed, Acre Feet=	8.3	September	30	0	-5,867	2,653	1,684	11,101	6,597	19,383
Design Volume, Acre Feet=	0.0	Annual	365	0	28,467	67,335	20,495	151,106	125,059	296,660



NUTRIENT MANAGEMENT

NUTRIENT MANAGEMENT

PHOSPHOROUS, P2O5

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

LIQUIDS										SOLIDS				GRAZING		
Field Number	Acres	Crop	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	Percent to be Applied	Pounds of Nutrients to be Applied	Acres Needed for Utilization of Nutrients		
1	2.1	Grass/Legume Hay/Pasture	0%	0	0	0%	0	0	61%	159	0	0	0			
2	11.6	Hay/Pasture Mix 14% Protein	4%	653	13	0%	0	0	0%	0	0	0	0			
3	40.5	Hay/Pasture Mix 14% Protein	18%	3,359	45	0%	0	3	0%	0	0	0	0			
4	3.4	Oats Hay/Pasture	0%	0	0	6%	216									
Off-Farm			79%	14,649	58	94%	3,382	3	39%	101						
TOTALS-	57.65		100%	18,661		100%	3,598		100%	260			3			

[illegible]

NUTRIENT MANAGEMENT

Section 6

Nutrient Utilization Worksheet

CLIENT: Dave and Casey Schoch
ASSISTED BY: Jennifer Zwicke

CHECKED BY:

ANIMAL WASTE MANAGEMENT SYSTEM UTILIZATION

NUTRIENTS AVAILABLE AFTER STORAGE

Nutrient Source	Type of Operation	Pounds of Nutrients Available			Percent Nutrients Retained			Pounds of Nutrients Retained After Storage		
		N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids	Storage Pond (<50%) Dilution	52,232	20,734	29,039	53%	90%	90%	27,588	18,661	26,135
Solids	Solids Storage Facility (Roofed)	10,357	3,998	5,487	75%	90%	90%	7,775	3,598	4,939
Grazing	NONE	663	260	361	100%	100%	100%	663	260	361

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 ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids	Sprinkling	27,588	18,661	26,135	75%	100%	100%	20,691	18,661	26,135
Solids	Broadcast (Incorporated 7 or more days after application)	7,775	3,598	4,939	70%	100%	100%	5,443	3,598	4,939
Grazing	Grazing	663	260	361	85%	100%	100%	564	260	361

NUTRIENTS AVAILABLE AFTER DENITRIFICATION

Nutrient Source	Location	Pounds of Nutrients Available			Percent Nutrients Retained After Denitrification			Pounds of Nutrients Retained After Denitrification		
		N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Liquids	Between Coastal and Cascade Mountains	20,691	18,661	26,135	87%	100%	100%	18,001	18,661	26,135
Solids	Moderately Well Drained	5,443	3,598	4,939	87%	100%	100%	4,735	3,598	4,939
Grazing	Moderately Well Drained Somewhat Poorly Drained	564	260	361	83%	100%	100%	468	260	361

**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 #

63616

Name or Business Name

Dave and Casey Schoch

Facility Location Address

24335 NW West Union Road

City

Hillsboro

Zip Code

97124

County

Washington

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.

250 animals based on a herd composition of 150 milking and dry cows and 100 heifers.

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.

299 animals based on a herd composition 190 milking and dry cows 79 heifers and 30 calves.

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.



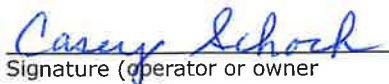
Signature (operator or owner)

11-15-06

Date

Dave Schoch

Print Name



Signature (operator or owner)

11-15-06

Date

Casey Schoch

Print Name

RECEIVED

NOV 21 2006 June 2005

**NATURAL RESOURCES
DIVISION**

<p align="center">Definition of Legally Authorized Representative:</p> <p align="center">See 40 CFR 122.22 for more detail. Please also provide the information requested in brackets []</p> <p>◆ Corporation — President, secretary, treasurer, vice-president, or any person who performs principal business functions; or a manager of one or more facilities employing more than 250 persons or having gross annual sales or expenditures exceeding \$25 million that is authorized in accordance to corporate procedure to sign such documents</p> <p>◆ Partnership — General partner <i>[list of general partners, their addresses, and telephone numbers]</i></p> <p>◆ Sole Proprietorship — Owner(s) <i>[each owner must sign the application]</i></p> <p>◆ City, County, State, Federal, or other Public Facility — Principal executive officer or ranking elected official</p> <p>◆ Limited Liability Company — Member <i>[articles of organization]</i></p> <p>◆ Trusts — Acting trustee <i>[list of trustees, their addresses, and telephone numbers]</i></p>

SEND THIS FORM TO:

**Oregon Department of Agriculture
Natural Resources Division
635 Capitol Street NE
Salem, Oregon 97301-2532**

ANIMAL INCREASE REQUEST INSTRUCTIONS

A. GENERAL INFORMATION:

1. Enter the legal name.
2. Enter the common name of the facility or operation, if different than the legal name.
3. Enter the facility's physical address (physical location), including city, state, zip code and telephone number.

B. CIRCLE THE APPROPRIATE LIVESTOCK TYPE OF YOUR OPERATION.

- C. Self-explanatory
D. Self-explanatory
E. Describe your proposed animal increase by herd composition or class
F. Self-explanatory
G. Signature

CAFO Designation by Size Threshold (used for items D and F)

Animal sector	Large Federal CAFO	Medium Federal CAFO	State CAFO
Beef feedlot or Cow/calf pairs, heifer replacement facility	1,000 or more	300-999	Less than 300
Mature dairy cattle	700 or more	200-699	Less than 200
Swine (weighing over 55 pounds)	2,500 or more	750-2,499	Less than 750
Swine (weighing less than 55 pounds)	10,000 or more	3,000-9,999	Less than 3,000
Horses or other Equine	500 or more	150-499	Less than 150
Sheep or lambs	10,000 or more	3,000-9,999	Less than 3,000
Poultry laying hens or broilers (liquid manure handling system)	30,000 or more	9,000-29,999	Less than 9,000
Chicken other than laying hens (other than a liquid manure handling system)	125,000 or more	37,000-124,999	Less than 37,000
Laying hens (other than a liquid manure handling system)	82,000 or more	25,000-81,999	Less than 25,000



Oregon

Theodore R. Kulongoski, Governor

Celebrating 75 years!

Department of Agriculture

635 Capitol Street NE
Salem, OR 97301-2532

July 5, 2006



Schoch Dairy LLC
Dave and Casey Schoch
24335 NW West Union Road
Hillsboro, Oregon 97124

RE: Animal Waste Management Plan (AWMP) extension request; MA# 63616

Dear Mr. and Mrs. Schoch:

On June 26, 2006, the Oregon Department of Agriculture received your letter requesting an extension to complete the AWMP. Currently the AWMP is due July 1, 2006; however, you have requested an additional three months to complete the plan. Your proposed due date for the AWMP completion is October 1, 2006.

Extension approved

After careful review of your request, the department has decided to grant this extension. Your AWMP is now due **October 1, 2006**.

Should you have any questions with this matter, please feel free to contact your local Livestock Water Quality Specialist, Kathryn Higgs, at 503-986-4780.

Good luck with the development of your AWMP.

Sincerely,

William Matthews, CAFO Program Manager
Natural Resources Division
PH: 503-986-4792
FX: 503-986-4730

cc: Kathryn Higgs, Area II LWQS

WM/kh/cd



Schoch Dairy LLC

24335 NW West Union Road
Hillsboro OR 97124

503-647-2638
503-647-9461

Schoch4@juno.com

FAX TRANSMITTAL FORM

To: Dept. of Agriculture
Name: Wym Matthews
CC: Kathryn Higgs
Phone: 503-986-4780
Fax: 503-986-4730

From: Dave & Casey Schoch
Date Sent: 06-21-06

Number of Pages: 1

Message:

To whom it may concern:
(Wym Matthews)

We are writing to you regarding our AWMP. We have currently hired Jennifer Zwicke to create our updated AWMP. We ran up against some obstacles regarding our recycled paper pulp bedding and are trying to decide on the best equipment or possible improvements to our current system for separating manure. We would like to file for a three month extension of our AWMP in order to finish this project correctly.

Thank you for your consideration.

Dave and Casey Schoch
Schoch Dairy LLC

RECEIVED
JUN 26 2006
NATURAL RESOURCES
DIVISION

MA# 63616
Status: Approved
Date: 6/26/06

Entered: 6/26/06 KH

United States Soil 1080 S. W. Baseline
Department of Conservation Building B Suite B-2
Agriculture Service Hillsboro. OR 97123-3823

May 3, 1993

Mr. Dave Wilkinson
Oregon Department of Agriculture
Natural Resource Division
635 Capitol Street NE
Salem, Oregon 97310

Dear Dave:

I am writing this letter to ask for a letter to construct for the following CAFO operations for which planning has been completed in Washington County:

Hans Schoch Dairy, Hillsboro, Oregon
Tom Taylor Dairy, Cornelius, Oregon
Ernest Rieben, Swine Operation, Banks, Oregon

We are anticipating start of construction on all of these projects about June 1, 1993.

If you have questions about a particular animal waste / CAFO plan please give me a call at 648-3014.



ROBERT K. APP
District Conservationist

cc: Hans Schoch
Ernest Rieben
Tom Taylor

RECEIVED

MAY 5 1993

**NATURAL RESOURCES
DIVISION**

April 30, 1993

Hans Schoch
24327 NW West Union Road
HILLSBORO OR 97124

RE: POLLUTION PLAN REVIEW NUMBER: 9232

Regarding OAR 340-52-045(3), the Department of Environmental Quality has, through a Memorandum of Agreement, authorized the Oregon Department of Agriculture (ODA) to review for approval or rejection, plans and specifications for Confined Animal Feeding Operation (CAFO) wastewater pollution control facilities.

We hereby approve these CAFO animal waste disposal facilities and certify they have been designed in accordance with the Oregon Animal Waste Installation Guidebook. Modifications or additions to these facilities must be approved by ODA prior to construction.

PROJECT DESCRIPTION

A 272 head Holstein dairy consisting of 140 milkers, 12 dry cows, 60 heifers, and 60 calves.

COMPONENT DESCRIPTION

A 4.9 ac. ft. waste storage pond added as a second cell to the existing pond.



David Wilkinson
CAFO Project Coordinator
Natural Resources Division
(503) 378-3810
FAX (503) 378-2590

Enclosures

cc: Washington Soil and Water Conservation District
Rene Dulay, DEQ
Bruce Wilson, SCS

Barbara Roberts
Governor



635 Capitol Street NE
Salem, OR 97310-0110

SECTION III

OPERATION, INSPECTION and MAINTENANCE PLAN FOR THE HANS SCHOCH DAIRY

Waste management components and appurtenances will be managed as follows:

Existing R/C Reception Pits

Operation: Two existing reception pits will continue to serve for collection and short-term storage of manure and contaminated waste from the dairy barns and holding lots. These pits house agitator and pump elements to transfer the manure slurry to the solids separator.

Maintenance: The tanks will be pumped out and inspected prior to any new construction start. Thereafter, both tanks will be pumped out every five years to allow for inspection and removal of rocks, wire, and accumulated debris. Damage to the facilities will be corrected when found. Any inlet slots, pump/agitator ports, or access ladders will be kept safely grated, covered, or protected at all times; any entry into either pit will be done on a tether, after ventilation or with a respirator (or both), and with one person on the outside at all times.

Waste Transfer & Irrigation Pipelines

Operations: These surface and or underground pipelines will convey the pond water to crop fields for use as irrigation and nutrient supply.

Maintenance: Pipelines will be flushed with clean water regularly to prevent clogging. Pipelines will be inspected periodically. Any leaks or broken sections will be repaired.

Waste Holding Pond (Two-cell)

Operation: The pond will receive the liquid fraction from the solids separator. This fraction will be held for application to crop fields on a schedule consistent with the waste utilization part of this plan. Before the first manure is introduced, the receiving cell will be filled one-quarter full with fresh water. At spring and fall pump-down, sufficient water will be left or added to support the alley-flush system; however, it is imperative that the pond be as empty as possible before the rainy season begins (about October 20th).

Maintenance: The waste storage pond will be inspected annually. Accumulated solids and sludge will be removed periodically to prevent build up from limiting the capacity of the pond. Livestock will not be permitted in the pond or on its banks. Undesirable vegetative growth will be controlled by spraying or cutting. Rodents will be controlled. Eroded areas will be filled and re-seeded or repaired with riprap. Embankment leaks will be repaired. Safety features such as signs and fences will be kept in good repair.

Manure Solids Stacking Facility

Operation: The covered, reinforced concrete structure will serve to store separated solids until they are hauled away to the Oregon Roses Nursery facility.

Maintenance: These facilities will be inspected annually. Any deteriorated or broken slab and wall elements will be replaced or repaired.

Gutters and Downspouts

Operation: Eve gutters, downspouts and outlet pipes (diversions) have been installed to divert rainwater from roofed areas of the facility. New construction will be equipped in a similar manner.

Maintenance: Eve gutters and downspouts will be inspected annually. They will be kept free of all foreign material. Broken elements will be repaired or replaced. Gutters, will be maintained in a free flowing condition; weeds and sediment will be removed from outlets and rodent guards will be kept in good repair.

Pumps and Agitators

Pumps will be operated and maintained according to the manufacturers manuals and recommendations. Liquid manure will be drained from pumps during freezing weather. Pumps will be inspected regularly for debris wrapped around the impeller.

Agitators will be maintained in accordance with the manual and recommendations of the manufacturer. All plumbing will be inspected annually, and broken lines will be repaired or replaced. Loose connections will be tightened.

Separator

Operation: The solids separator will receive manure slurry from the reception pits and, by mechanical means, separate out the coarser vegetative material in the slurry. The solid component will be directed to the stack slab area, the liquid component will be directed into the first cell of the waste holding pond.

Maintenance: The separator unit will be maintained in accordance with the manufacturers manual. In addition, it is recommended that provision be made to flush the unit with fresh water on a regular schedule; the fresh water flush will help prevent the buildup of caked materials. The separator, stand, and appurtenances will also be inspected regularly and proper repairs made in a timely manner.

Curbs, Walls, Slabs and Flush Tanks

Operation: Water control structures such as curbs, speed bumps and walls will be installed and operated to convey manure and contaminated water into reception pits or storage facilities. Manure will be prevented from overtopping curbs or walls at any time.

Maintenance: Concrete curbs, walls and slabs will be inspected periodically. Broken elements will be repaired or replaced.

Drop Inlets/Underground Outlets

Inlets, junction boxes and outlets will be inspected annually. Debris and sediment will be removed as often as necessary to maintain a free flowing condition. Damaged grates and pipes will be repaired or replaced. Rodent guards and receiver structures will be repaired as necessary.

Fences

Maintenance: 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 will be replaced.

Safety

Waste collection and management facilities will be kept in a state of good repair and safe operating condition at all times. Entry into pits, ponds or tanks will be governed as follows:

- 1) Do not go into a confined space used to store waste products.

If entry cannot be avoided:

- 2) Ventilate the facility before and during occupancy and/or use a self-contained breathing apparatus.
- 3) The party entering the facility will do so on a tether or lead and will be tended by a person outside the facility at all times.

When inspecting or working on machinery, power connection will be broken. Blocks to prevent roll or rotation will be used if possible.

OPERATOR AGREEMENT

I have read, I understand and I concur with the principles set forth in this Animal Waste Management Plan and the Operation and Maintenance Plan for the facilities. I intend to install and/or maintain the facilities described in the waste management plan and scheduled in the Conservation Plan of Operations.

Signature <u>Hans Schach</u>	<u>8/20/92</u>
Operator	Date
<u>Dave Schach</u>	<u>8/20/92</u>
Co-Operator	Date
_____	_____
Co-Operator	Date
_____	_____
Co-Operator	Date

This plan has been prepared by:

<u>Ed R. Evans</u>	<u>8-14-92</u>
Preparers Signature	Date

Plan reviewed and approved by:

<u>Robert H. Gyp</u>	<u>8-26-92</u>
Soil Conservation Service	Date
District Conservationist	

Compliance with this plan will be evaluated annually by the Conservation District working in conjunction with the District Conservationist and his staff.

<u>Tom Ouyck</u>	<u>8-26-92</u>
Washington County Soil &	Date
Water Conservation District	

This Job Class II Waste Management System Plan is approved by:

<u>Ed R. Evans</u>	<u>8-14-92</u>
Approval Signature	Date

SECTION I

ANIMAL WASTE MANAGEMENT SYSTEM PLAN

FOR THE

HANS SCHOCH DAIRY

Name of Landowner/Operator: Hans Schoch

Street Address: 24327 NW West Union Road

City: Hillsboro, Oregon Zip: 97124

Phone Number: 647-5578

Assisted by: Edd Evans

Date: August 13, 1992

RECEIVED

NOV 20 1992

**NATURAL RESOURCES
DIVISION**

General Description of Operation

The Hans Schoch Dairy currently consists of 272 animals that includes 140 lactating Holstein animals, 12 dry animals, 60 heifers and 60 calves.

The main problems with the current waste management system are:

1. Liquor from cannery corn waste used for feed drains from bunker to tile line. Waste holding pond is too high to catch flow by gravity.
2. Waste holding pond is too small, must be pumped three times/year (once in winter).

The proposed waste management system for the Hans Schoch Dairy consists of an existing alley flush facility with one existing reception pit. A second cell will be added to the existing waste holding pond for liquids and contaminated rainwater. The system is designed to provide 180 days storage for manure products and contaminated water from the Confined Animal Feeding Operation. The storage volume required for this period is estimated to be 234,860 cubic feet. Of this 21,416 cubic feet will be stored in the solid stack facility and 213,444 cubic feet will be stored in the waste holding pond.

The Hans Schoch Dairy Waste Management System has been designed to manage waste generated at the dairy in a manner that prevents or minimizes degradation of air, soil, and water resources and protects the public health and safety. The system has been planned to preclude discharge of pollutants to surface or ground water; and to recycle waste through soil and plants to the fullest extent practicable.

The application area consists of 30 acres of oats for grain and 65 acres of wheat. The oats are producing 50 bushels per acre, and the wheat is producing 100 bushels per acre. Mr. Schoch is currently farming a planned crop rotation schedule.

At full herd expansion, full utilization of available N, P and K can be accomplished on the 65 acres of available crop production.

It is not anticipated that any manure applications will be necessary during the rainy season. If such applications become necessary, they will be made on field numbers 2 & 3. All applications will be made as evenly over the field as possible and will be accomplished when weather forecasts predict a minimum of three days with less than 0.1 inches of precipitation. To minimize soil sealing and maximize bacterial die-off, four field applications with intervals of at least three weeks between each will be scheduled. It is estimated that the manure will provide plant nutrient values of 15,159 pounds of nitrogen, 32,886 pounds of phosphorous, and 31,980 pounds of potassium each year.

The drainage classification of soils on this farm range from moderately well drained, to poorly drained. The soils, ranked by extent in area, are Helvetia silt loam, Huberly silt loam, and Verboort silty clay loam. Each of these soils is subject to perched water tables in the profile during the November-May rainfall period. See the attached soil interpretation sheets for more information about soils in the application area.

An unnamed tributary of McKay creek flows immediately adjacent to the dairy facility and receives any liquids lost from the facility.

Mr. Schoch would like to upgrade his current waste handling facility and reduce the possibility of pollutants entering surface and ground water sources by developing a waste management system plan and installing the following practices to supplement the practices all ready on site:

SCS	
Practice	
Standard	Description
312	Waste Management System
313	Waste Storage Structure-
	*Concrete Tanks
	*Solid Waste Stacking Facility
328	Conservation Cropping Sequence
362	Diversion
382	*Fencing
411	Grasses and Legumes in rotation
425	Waste Storage Pond
449	Irrigation Water Management
472	*Livestock Exclusion
510	Pasture and hayland management
533	*Pumping Plant for Water Control
558	*Roof Runoff Management
587	Structure for Water Control-
	*Curbing
	*Separator
	*Transfer Pipes
590	Nutrient Management
633	Waste Utilization

*Components are installed and functioning properly.

Hans Schoch, as operator of the Hans Schoch Dairy, is responsible for the operation and maintenance of the waste management system. The system was planned and designed by the Soil Conservation Service, and the effort is based on the best available technical knowledge. One must recognize that if the system is to operate as intended, it must be inspected periodically and repair or replacement of defective parts done as expeditiously as possible. Please refer to SECTION III for specific operation and maintenance guidelines.

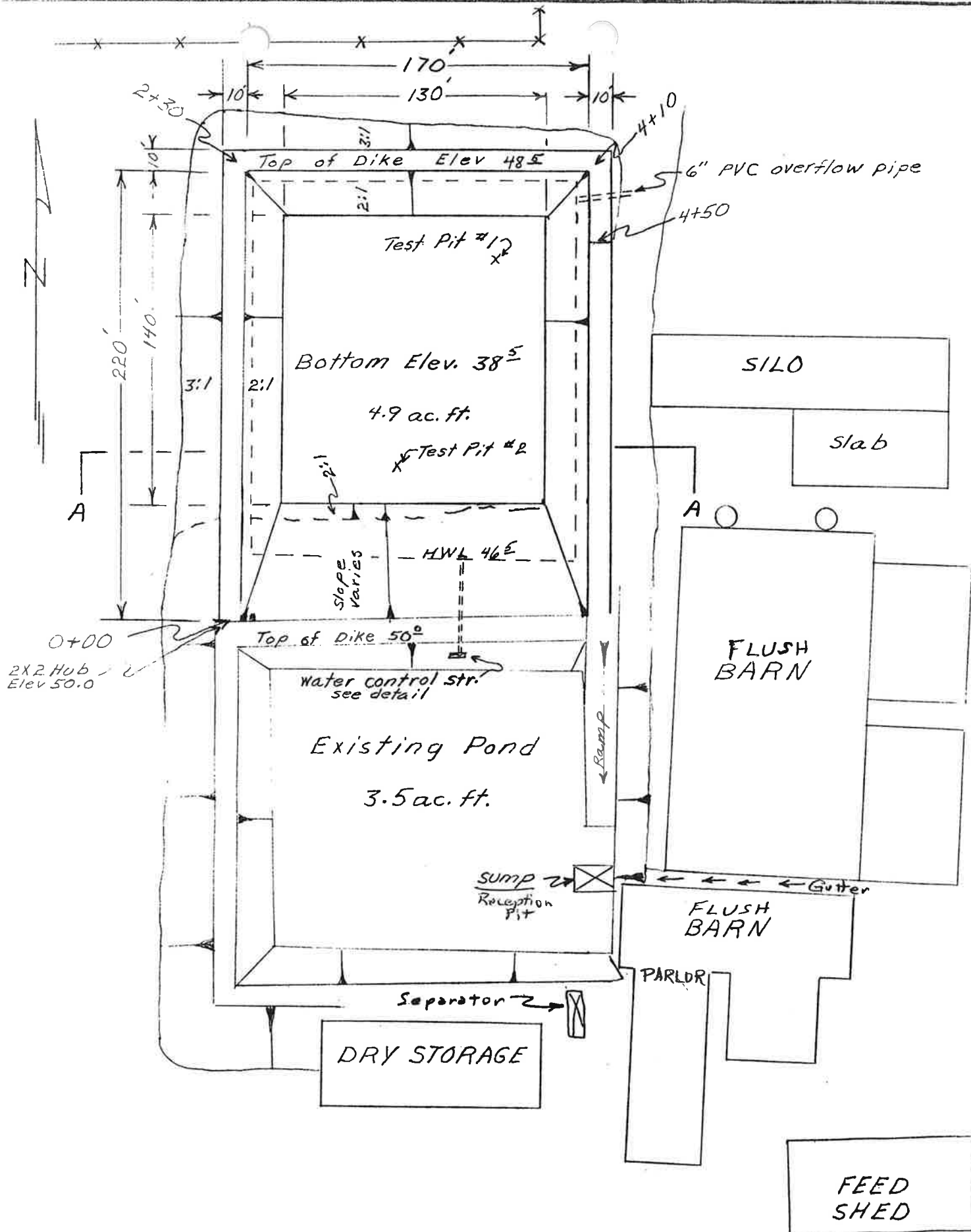
A Confined Animal Feeding Operation (CAFO) permit administered by the Oregon Department of Agriculture to the Hans Schoch Dairy will be kept in good standing by complying with all permit provisions. The permit will be based on this plan but may or may not have the same requirements. This plan provides guidelines for the wise use of the soil, air, water, plant and animal resources for the Dairy. Changes in the waste management system and/or number of livestock by 25 head or 10 percent, whichever is greater, will require a revision of this plan.

SECTION II

CONSERVATION PLAN OF OPERATIONS

FOR THE

HANS SCHOCH DAIRY



PLAN
 50 0 50
 scale in feet

ANIMAL WASTE COMPUTATION WORKSHEET FOR HANS SCHOCK

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
Assisted by- EDD EVANS Date- 12-03-1
SCS Animal Waste Management System, (PS 312) Job Approval Class- III

INVENTORY DATA FOR HANS SCHOCK DAIRY OPERATION

=====

NUMBER OF ANIMALS, AVERAGE WEIGHT AND STORAGE PERIODS

REF: Oregon Animal Waste Installation Guidebook(OAWIG) Pages 137-140

=====

DESCRIPTION	NUMBER	WEIGHT LBS	DAYS CONFINED	DAYS GRAZED	DAYS STORAGE LIQUIDS SOL
MILKER HOLSTEIN	140	1400	365	0	180
MILKER (DRY)	12	1200	365	0	180
HEIFERS	60	750	365	0	180
CALVES	60	250	365	0	180
		0	0		
0		0			

===== **CLIMATIC AND HYDROLOGIC DATA** REF: OAWIG Pages 151-158 & 181- =====

CLIMATIC STATION- HILLSBORO

Month	Average Monthly Precipitation	in Inches Evaporation	% Lot Runoff Concrete	Factors Unpaved
JAN	6.18	0.45	55	20
FEB	4.49	0.76	45	20
MAR	3.91	1.47	45	15
APR	2.06	2.24	35	15
MAY	1.67	3.54	35	10
JUN	1.47	4.05	35	10
JUL	0.48	5.06	30	0
AUG	0.91	4.62	35	10
SEP	1.48	3.15	45	15
OCT	2.99	1.60	55	15
NOV	5.69	0.71	55	20
DEC	6.58	0.40	55	20
25YR-24HR STORM RAINFALL- 4 Inches				

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
Assisted by- EDD EVANS

Date- 12-03-01

INVENTORY DATA CONTINUED FOR HANS SCHOCK DAIRY OPERATION

BEDDING AND SEPARATOR FACTORS

REF: OAWIG Pages 144-

TYPE OF BEDDING- WOOD SHAVINGS
DAILY BEDDING FACTOR- 0.26 CF/DAY/1000#

TYPE OF FEED- High Fiber Ration (Silage & Considerable Bedding)
SEPARATOR FACTOR- 0.75 CF/DAY/1000#

Does feed seepage enter liquid storage facility (Y/N)-? Y

VOLUME OF WASH WATER

REF: OAWIG Page

DESCRIPTION	RANGE	SELECTED GAL/DAY	CF
Cow Preparation-			
Manual.....	(3-7Gal or 0.5-1CF /Cow-Day)	.5	0.
Automatic- Stall Wash...	(5-15Gal or 1-2CF /Cow-Day)		
Sprinkler Wash.....	(25-40Gal or 3-5.5CF /Cow-Day)		
Total Daily Volume = 140 Cows X Total Selected Amount=		70	9
Bulk Tank- Automatic.....	(60-110Gal or 8-15CF /Wash)		
Manual.....	(30-50Gal or 4-7CF /Wash)		
Miscellaneous Equipment.....	(25-35Gal or 10-20CF /Wash)		
Pipelines.....	(75-150Gal or 10-20CF /Wash)		
Milkhouse and Parlor.....	(300-700Gal or 40-90CF /Wash)	280	37.
Holding Area.....	(500-1200Gal or 70-160CF /Wash)		
Total Daily Volume= 2 Washes X Total Selected Amount=		560	74

RAINFALL RUNOFF AREA CONTRIBUTING TO STORAGE

DESCRIPTION	AREA IN SQUARE F
Roof.....	
Concrete Slab, Scraped Daily, (Y/N)- N	6900
Unsurfaced Lot.....	
Total-	6,900 SF

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
 Assisted by- EDD EVANS

Date- 12-03-1

INVENTORY DATA CONTINUED FOR HANS SCHOCK DAIRY OPERATION

DESCRIPTION OF WASTE MANAGEMENT SYSTEM

REF: OAWIG Pages 199-

LIQUID SYSTEM-

Storage>>>> Two Cell Waste Holding Pond				Nutrients Utili	
Application>>>> Sprinkling					
Soils>>>> Moderately well drained					
-----Crops-----	Units	Yield	Acres	N	P2O
Oats, Straw	(Ton)	2	30	12.8	3.0
Oats, Grain	(Bu)	50	30	1.9	0.3
Wheat, Grain Soft White	(Bu)	100	65	1.0	0.2
Wheat, Straw	(Ton)	3	65	10.2	1.2

SOLIDS SYSTEM-

Storage>>>> Open lot				Nutrients Utili	
Application>>>> Broadcast					
Soils>>>> Moderately well drained					
-----Crops-----	Units	Yield	Acres	N	P2O
Oats, Straw	(Ton)	2	30	12.8	3.0
Oats, Grain	(Bu)	50	30	1.9	0.3
Wheat, Grain Soft White	(Bu)	100	65	1.0	0.2
Wheat, Straw	(Ton)	3	65	10.2	1.2

GRAZING SYSTEM-

Storage>>>> None (grazing)				Nutrients Utili	
Application>>>> Grazing					
Soils>>>> Moderately well drained					
-----Crops-----	Units	Yield	Acres	N	P2O
Oats, Straw	(Ton)	2	3	12.8	3.0
Oats, Grain	(Bu)	50		1.9	0.3
Wheat, Grain Soft White	(Bu)	100		1.0	0.2
Wheat, Straw	(Ton)	3		10.2	1.2

Date- 12-03-

REF: OAWIG Pages 137-

DESCRIPTION	CF/D/1000# MANURE	NITROGEN	LB/DAY/1000# PHOSPHOROUS	POTASS
MILKER HOLSTEIN	1.30	0.45	0.07	0.2
MILKER (DRY)	1.10	0.36	0.05	0.2
HEIFERS	1.30	0.31	0.04	0.2
CALVES	1.30	0.31	0.04	0.2
	0.00	0.00	0.00	0.0
	0.00	0.00	0.00	0.0
0	0.00	0.00	0.00	0.0

DAILY SOLIDS PRODUCED

	DESCRIPTION	1000LB ANIMAL UNITS	PERCENT MANURE SOLIDS	MANURE SOLIDS	CUBIC FEET/DAY BEDDING	SEPAR. SOLID
MILKER HOLSTEIN		196	13	0.00	25.48	147
MILKER (DRY)		14	0	0.00	1.87	10
HEIFERS		45	0	0.00	5.85	36
CALVES		15	0	0.00	1.95	12
O		0	0	0.00	0.00	0
TOTALS>>>>>>>>>>>>>>		270		0.00	35.15	202

	Length of Facility=	66 ft.
	Width of Facility=	40 ft.
Wall	Height of Facility=	6 ft.
Total Stacking	Height of Facility=	12 ft.
	Side Slopes of Stack=	2 : 1
Is the Facility Covered, (Y/N)?		N
Volume	of Solids to Store=	21,416 CF
	Volume of Facility=	21,744 CF

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
Assisted by- EDD EVANS

Date- 12-03-1

LIQUID STORAGE VOLUMES FOR HANS SCHOCK DAIRY OPERATION

RAINFALL RUNOFF ENTERING LIQUID STORAGE FACILITY

Month	Inches Rain	SF Roof	RUNOFF IN CUBIC FEET		37,701SF Storage Surface	Monthly Totals
			6900SF Concrete Slab	* 2640SF Unsurfaced Lot		
JAN	6.18	0	1,954	272	19,416	21,660
FEB	4.49	0	1,162	198	14,106	15,466
MAR	3.91	0	1,012	129	12,284	13,425
APR	2.06	0	415	68	6,472	6,955
MAY	1.67	0	336	37	5,247	5,620
JUN	1.47	0	296	32	4,618	4,947
JUL	0.48	0	83	0	1,508	1,591
AUG	0.91	0	183	20	2,859	3,062
SEP	1.48	0	383	49	4,650	5,082
OCT	2.99	0	946	99	9,394	10,438
NOV	5.69	0	1,799	250	17,877	19,926
DEC	6.58	0	2,081	290	20,673	23,043

* - Unsurfaced lot area includes surface area of solid stacking facility

TOTAL MONTHLY INFLOWS ENTERING LIQUID STORAGE FACILITY

Month	CUBIC FEET					Totals
	Surface Runoff	Evaporation	Seepage	Wash Water	Manure	
JAN	21,642	-1,414	1,246	2,612	10,808	34,894
FEB	15,466	-2,388	1,126	2,359	9,762	26,325
MAR	13,425	-4,618	1,246	2,612	10,808	23,473
APR	6,955	-7,038	1,206	2,527	10,459	14,110
MAY	5,620	-11,122	1,246	2,612	10,808	9,164
JUN	4,947	-12,724	1,206	2,527	10,459	6,415
JUL	1,591	-15,897	1,246	2,612	10,808	3,260
AUG	3,062	-14,515	1,246	2,612	10,808	3,213
SEP	5,082	-9,897	1,206	2,527	10,459	9,377
OCT	10,438	-5,027	1,246	2,612	10,808	20,077
NOV	19,926	-2,231	1,206	2,527	10,459	31,887
DEC	23,043	-1,257	1,246	2,612	10,808	36,492

Total Liquids Entering Liquid Storage Facility Based on 180 Day Storage
 4.00 Inch 25YR-24HR Storm Rainfall= 12,567 CF or 0.3 AF
 180 Day Precipitation - Evaporation= 76,816 CF or 1.8 AF
 Lot Runoff= 10,171 CF or 0.2 AF
 Seepage= 7,237 CF or 0.2 AF
 Washwater= 15,164 CF or 0.3 AF
 Manure= 62,755 CF or 1.4 AF
 25Yr-24Hr Rainfall Runoff= 0 CF or 0.0 AF
 3 Year Sludge Accumulated= 32,586 CF or 0.7 AF
 Existing Storage= 0 CF or 0.0 AF

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
 Assisted by- EDD EVANS

Date- 12-03-

LIQUID STORAGE VOLUMES FOR HANS SCHOCK DAIRY OPERATION

DESCRIPTION OF LIQUIDS STORAGE FACILITY

Type of Liquid Storage Facility is - Two Cell Waste Holding Pond

	CELL #1	CELL #2
Inside Top Width=	69 ft.	160 ft.
Inside Top Length=	129 ft.	180 ft.
Bottom Width=	20 ft.	100 ft.
Bottom Length=	80 ft.	120 ft.
Slope Ratio=	2.5 : 1	2.5 :
Pond Depth=	8 ft.	10.1 ft.
Freeboard Not Included in Pond Depth=	2.0 ft.	2.0 ft.
Volume of Liquids to Store=	0.7 AF	4.2 AF
Volume of Facility=	0.8 AF	4.3 AF

NUTRIENT CALCULATIONS FOR HANS SCHOCK DAIRY OPERATION

NUTRIENT PRODUCTION

DAILY-

Type	Nutrients in Pounds		
	Nitrogen	Phosphorous	Potassium
Liquids	87	13	55
Solids	25	3	14
Grazing	0	0	0

ANNUAL-

Type	Nutrients in Pounds		
	Nitrogen	Phosphorous	Potassium
Liquids	31,882	39,645	35,861
Solids	8,992	1,229	5,013
Grazing	0	0	0

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
Assisted by- EDD EVANS

Date- 12-03-1

NUTRIENT CALCULATIONS FOR HANS SCHOCK DAIRY OPERATION

NUTRIENT ACCOUNTING FOR LIQUIDS

Loss Category	Nitrogen Remaining Percent	Nitrogen Remaining Pounds	Phosphorous Remaining Percent	Phosphorous Remaining Pounds	Potassium Remaining Percent	Potassium Remaining Pounds
Storage	70	22,317	90	35,680	90	32,2
Application	75	16,738	100	35,680	100	32,2
Denitrification	80	13,390	100	35,680	100	32,2
Recalcitrant	90	12,051	90	32,112	90	29,0

NUTRIENT ACCOUNTING FOR SOLIDS

Loss Category	Nitrogen Remaining Percent	Nitrogen Remaining Pounds	Phosphorous Remaining Percent	Phosphorous Remaining Pounds	Potassium Remaining Percent	Potassium Remaining Pounds
Storage	60	5,395	70	861	65	3,0
Application	80	4,316	100	861	100	3,2
Denitrification	80	3,453		61	100	3,0
Recalcitrant	90	3,1		74	90	2,9

NUTRIENT ACCOUNTING FOR GRAZING

Loss Category	Nitrogen Remaining Percent	Nitrogen Remaining Pounds	Phosphorous Remaining Percent	Phosphorous Remaining Pounds	Potassium Remaining Percent	Potassium Remaining Pounds
Storage	100	0	100	0	100	0
Application	85	0	100	0	100	0
Denitrification	80	0	100	0	100	0
Recalcitrant	90	0	90	0	90	0

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
 Assisted by- EDD EVANS

Date- 12-03-

NUTRIENT CALCULATIONS FOR HANS SCHOCK DAIRY OPERATION

NUTRIENT UTILIZATION		N-Nitrogen	P-Phosphorous	K-Potassium
TARGET YIELDS AND DEPTH OF WASTE APPLICATION BASED ON NITROGEN-				
Crop	Average Target Yield	Acres		Allowable > Unifor Annual Application
	Tons/Acre	Liquids	Solids	Inches/Acre
Oats, Straw	2.0	30	30	0.13> 0.16 0.20>
Oats, Grain	50.0	30	30	0.47> 0.16 0.73>
Wheat, Grain Soft White	100.0	65	65	0.49> 0.16 0.77>
Wheat, Straw	3.0	65	65	0.15> 0.16 0.24>

ANNUAL NUTRIENTS APPLIED AND UTILIZED-

Crop	Nutrients Applied lb/Ac			Nutrients Util lb/Ac	
	N	P	K	N	P
Oats, Straw	38.0	82.4	80.2	25.6	6.0
Oats, Grain	39.9	86.5	84.2	95.0	15.0
Wheat, Grain Soft White	39.9	86.5	84.2	100.0	20.0
Wheat, Straw	39.9	86.5	84.2	30.6	3.6

NUTRIENT BALANCE-

Crop	lb/Ac		
	N	P	K
Oats, Straw	12.4	76.4	16.2
Oats, Grain	-55.1	71.5	59.2
Wheat, Grain Soft White	-60.1	66.5	24.2
Wheat, Straw	9.3	82.9	41.6

Note: If available nutrients are positive, then there is excessive nutrient application based on the acreage available.

If available nutrients are negative, then additional nutrients may be needed to sustain crop yields.

Location- T.1N.;R.2W.;S.10 WEST UNION RD.
 Assisted by- EDD EVANS

Date- 12-03-1

NUTRIENT CALCULATIONS FOR HANS SCHOCK DAIRY OPERATION

NUTRIENT UTILIZATION CONTINUED

NUTRIENTS REMAINING-

	Nutrients in Pounds		
	Nitrogen	Phosphorous	Potassium
Liquids-	-56	29,948	19,708
Solids-	-8,999	-1,390	-6,406
Grazing-	-77	-18	-192

EXTRA ACRES NEEDED FOR UTILIZATION BASED ON NITROGEN APPLICATION-

Crop	% to be Applied		/ Acres Required	
	Liquids	Solids	Grazing	
Oats, Straw	16 /	0	16 /	-56 /
Oats, Grain	16 /	0	16 /	-15 /
Wheat, Grain Soft White	34 /	0	34 /	-31 /
Wheat, Straw	34 /	-1	34 /	-100 /

NUTRIENT APPLICATION CALENDAR-

N - Application Not Recommended
 Y - Application Recommended

MONTH>>>> ---JAN--- --FEB-- ---MAR--- ---APR---
 WEEK>>>> 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
 APPLY>>>> N N N N N N N N N N N N Y Y Y Y Y Y

MONTH>>>> ---MAY--- ---JUN--- ---JUL--- ---AUG---
 WEEK>>>> 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
 APPLY>>>> Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y

MONTH>>>> ---SEP--- ---OCT--- ---NOV--- ---DEC---
 WEEK>>>> 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
 APPLY>>>> Y Y Y Y Y Y Y N N N N N N N N N N

(Hay - Straw)

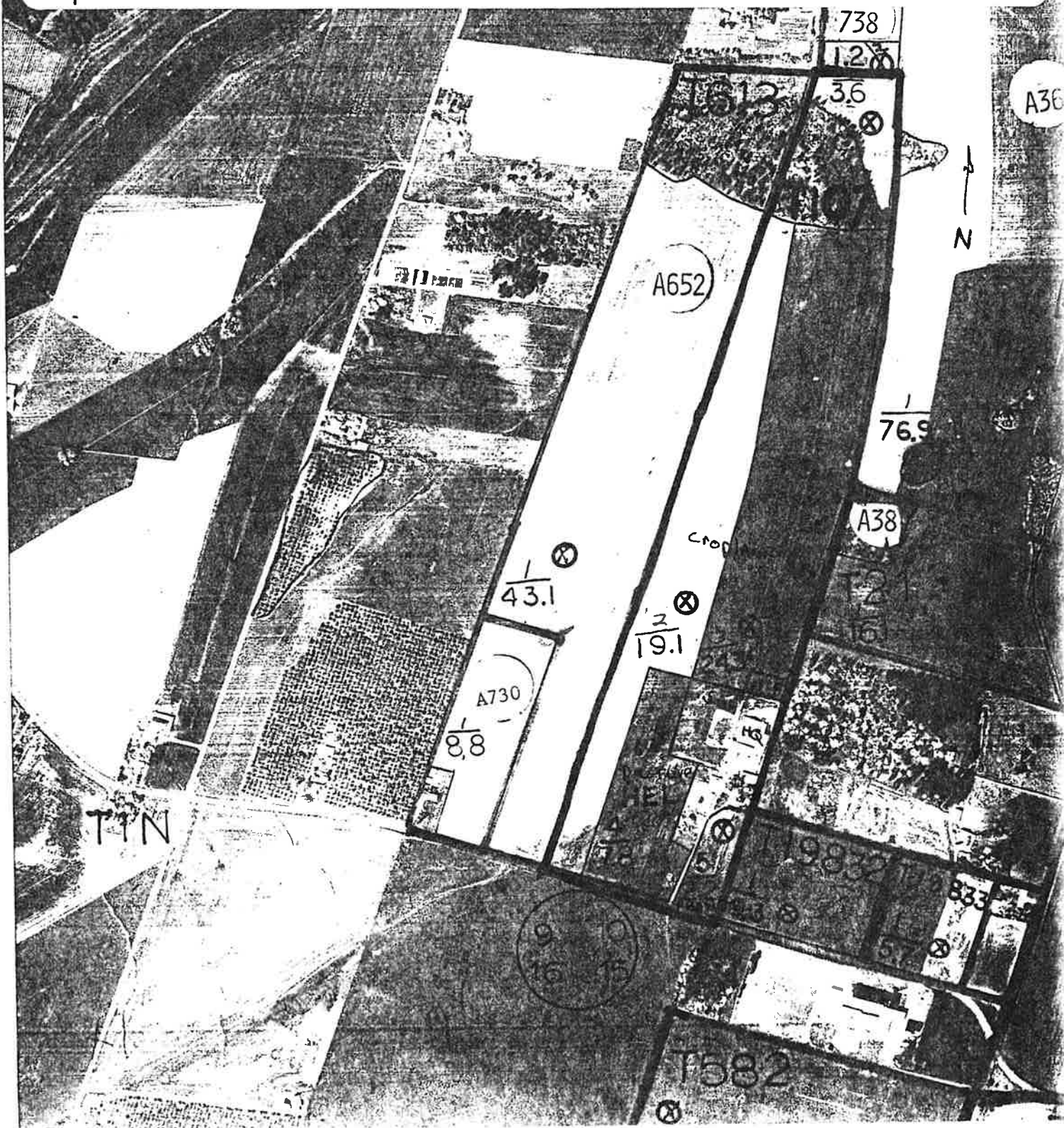
$$\begin{aligned} \text{Oats} \quad 7 \text{ lb N/ton} @ 2 \text{ t/a} &\stackrel{?}{=} 50 \text{ b/a} \times 1.9 \text{ lb N/b} \\ &\stackrel{?}{=} 95 \text{ lb N/a} \end{aligned}$$

$$\begin{aligned} \text{Wheat} \quad &\stackrel{\text{Hay - straw}}{(20.5 - 10.2)} \times 3 \text{ t/a} \stackrel{?}{=} 100 \text{ b/a} \times 1 \text{ lb N/b} \\ &30.9 \text{ lb N/a} \stackrel{?}{=} 100 \text{ lb N/a} \end{aligned}$$

Todd - 4-28-93 - Difference in N utilization by straw + grain compared to hay is due to longer growing season for a grain crop. He feels calculating N uptake for grain + straw on same acreage is correct.

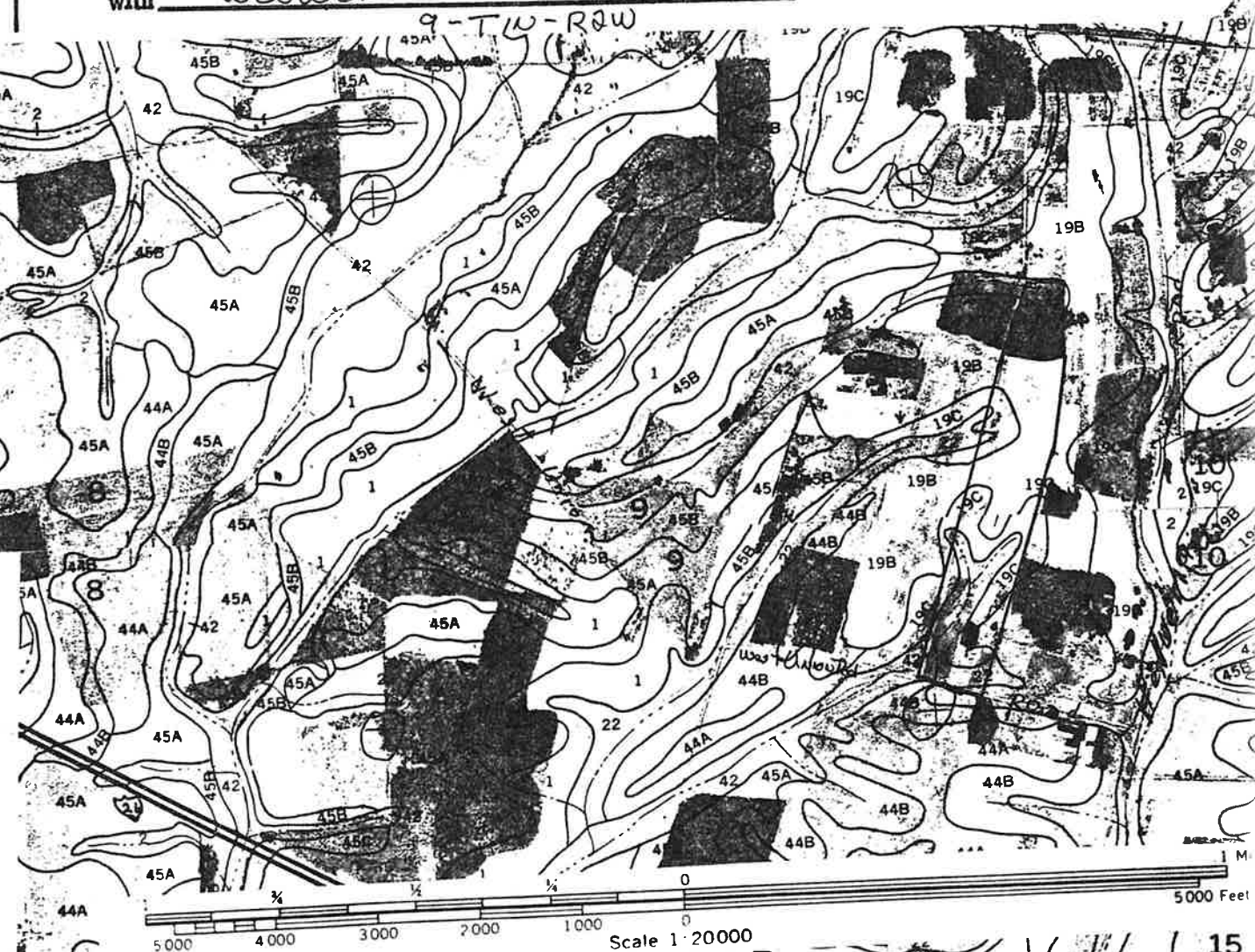
CONSERVATION PLAN MAP

Owner HANS SCHOCH Operator HANS SCHOCH
County WASHINGTON State OREGON Date 8/17/92
Approximate acres 60 Approximate scale 1" = 660'
Cooperating with WASHINGTON COUNTY SOIL + WATER Conservation District
Plan identification 9-TN-RZW Photo number _____
Assisted by HILLSBORO FIELD OFFICE USDA Soil Conservation Service



**U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE**

Owner _____ Operator HAUG School
County WASHINGTON State OR
Soil survey sheet(s) or code nos. 25 & 21 Approximate scale 1:20,000
Prepared by U. S. Department of Agriculture, Soil Conservation Service cooperating
with WCSWCD Conservation District



19 Helvetia Silt Loam
22 Huberly Silt Loam
42 Verboort Silty Clay Loam

SOIL LEGEND

Arabic numerals in the symbols indicate the map units. The capital letters A, B, C, D, E, F, or G following the numeral or numerals indicate the slope class. Some symbols without slope class letters are for nearly level soils.

SYMBOL	NAME	SYMBOL	NAME
1	Aloha silt loam	27	Labish mucky clay
2	Amity silt loam	28B	Laurelwood silt loam, 3 to 7 percent slopes
3E	Astoria silt loam, 5 to 30 percent slopes	28C	Laurelwood silt loam, 7 to 12 percent slopes
3F	Astoria silt loam, 30 to 60 percent slopes	28D	Laurelwood silt loam, 12 to 20 percent slopes
		28E	Laurelwood silt loam, 20 to 30 percent slopes
4B	Briedwell silt loam, 0 to 7 percent slopes	29E	Laurelwood silt loam, 3 to 30 percent slopes*
5B	Briedwell stony silt loam, 0 to 7 percent slopes	29F	Laurelwood silt loam, 30 to 60 percent slopes
5C	Briedwell stony silt loam, 7 to 12 percent slopes		
5D	Briedwell stony silt loam, 12 to 20 percent slopes	30	McBee silty clay loam
		31B	Melbourne silty clay loam, 2 to 7 percent slopes
6B	Carlton silt loam, 0 to 7 percent slopes	31C	Melbourne silty clay loam, 7 to 12 percent slopes
6C	Carlton silt loam, 7 to 12 percent slopes	31D	Melbourne silty clay loam, 12 to 20 percent slopes
7B	Cascade silt loam, 3 to 7 percent slopes	31E	Melbourne silty clay loam, 20 to 30 percent slopes
7C	Cascade silt loam, 7 to 12 percent slopes	31F	Melbourne silty clay loam, 30 to 60 percent slopes
7D	Cascade silt loam, 12 to 20 percent slopes	32C	Melby silt loam, 3 to 12 percent slopes
7E	Cascade silt loam, 20 to 30 percent slopes	32D	Melby silt loam, 12 to 20 percent slopes
7F	Cascade silt loam, 30 to 60 percent slopes	32E	Melby silt loam, 20 to 30 percent slopes
8C	Chehalis silty clay loam, 3 to 12 percent slopes	33E	Melby silt loam, 2 to 30 percent slopes*
9	Chehalis silty clay loam, occasional overflow	33F	Melby silt loam, 30 to 60 percent slopes
10	Chehalis silt loam, occasional overflow	33G	Melby silt loam, 60 to 90 percent slopes
11B	Cornelius and Kinton silt loams, 2 to 7 percent slopes		
11C	Cornelius and Kinton silt loams, 7 to 12 percent slopes	34C	Olyic silt loam, 5 to 12 percent slopes
11D	Cornelius and Kinton silt loams, 12 to 20 percent slopes	34D	Olyic silt loam, 12 to 20 percent slopes
11E	Cornelius and Kinton silt loams, 20 to 30 percent slopes	34E	Olyic silt loam, 20 to 30 percent slopes
11F	Cornelius and Kinton silt loams, 30 to 60 percent slopes	35E	Olyic silt loam, 5 to 30 percent slopes*
12A	Cornelius Variant silt loam, 0 to 3 percent slopes	35F	Olyic silt loam, 30 to 60 percent slopes
12B	Cornelius Variant silt loam, 3 to 7 percent slopes	35G	Olyic silt loam, 60 to 90 percent slopes
12C	Cornelius Variant silt loam, 7 to 12 percent slopes		
13	Cove silty clay loam	36C	Pervina silty clay loam, 7 to 12 percent slopes
14	Cove clay	36D	Pervina silty clay loam, 12 to 20 percent slopes
		36E	Pervina silty clay loam, 20 to 30 percent slopes
15	Dayton silt loam	36F	Pervina silty clay loam, 30 to 60 percent slopes
16C	Deiena silt loam, 3 to 12 percent slopes		
		37A	Quatama loam, 0 to 3 percent slopes
17B	Goble silt loam, 2 to 7 percent slopes	37B	Quatama loam, 3 to 7 percent slopes
17C	Goble silt loam, 7 to 12 percent slopes	37C	Quatama loam, 7 to 12 percent slopes
17D	Goble silt loam, 12 to 20 percent slopes	37D	Quatama loam, 12 to 20 percent slopes
17E	Goble silt loam, 20 to 30 percent slopes		
18E	Goble silt loam, 2 to 30 percent slopes*	38B	Saum silt loam, 2 to 7 percent slopes
18F	Goble silt loam, 30 to 60 percent slopes	38C	Saum silt loam, 7 to 12 percent slopes
		38D	Saum silt loam, 12 to 20 percent slopes
19B	Helvetia silt loam, 2 to 7 percent slopes	38E	Saum silt loam, 20 to 30 percent slopes
19C	Helvetia silt loam, 7 to 12 percent slopes	38F	Saum silt loam, 30 to 60 percent slopes
19D	Helvetia silt loam, 12 to 20 percent slopes		
19E	Helvetia silt loam, 20 to 30 percent slopes	39E	Tolke silt loam, 5 to 30 percent slopes
20E	Hembre silt loam, 3 to 30 percent slopes	39F	Tolke silt loam, 30 to 60 percent slopes
20F	Hembre silt loam, 30 to 60 percent slopes		
20G	Hembre silt loam, 60 to 90 percent slopes	40	Udfluvents, nearly level
21A	Hillsboro loam, 0 to 3 percent slopes	41	Urban Land
21B	Hillsboro loam, 3 to 7 percent slopes		
21C	Hillsboro loam, 7 to 12 percent slopes	42	Verboort silty clay loam
21D	Hillsboro loam, 12 to 20 percent slopes		
22	Huberly silt loam	43	Wapato silty clay loam
		44A	Willamette silt loam, 0 to 3 percent slopes
23B	Jory silty clay loam, 2 to 7 percent slopes	44B	Willamette silt loam, 3 to 7 percent slopes
23C	Jory silty clay loam, 7 to 12 percent slopes	44C	Willamette silt loam, 7 to 12 percent slopes
23D	Jory silty clay loam, 12 to 20 percent slopes	44D	Willamette silt loam, 12 to 20 percent slopes
23E	Jory silty clay loam, 20 to 30 percent slopes	45A	Woodburn silt loam, 0 to 3 percent slopes
23F	Jory silty clay loam, 30 to 60 percent slopes	45B	Woodburn silt loam, 3 to 7 percent slopes
		45C	Woodburn silt loam, 7 to 12 percent slopes
24G	Kilchis-Klickitat complex, 60 to 90 percent slopes	45D	Woodburn silt loam, 12 to 20 percent slopes
25E	Klickitat stony loam, 3 to 30 percent slopes		
25F	Klickitat stony loam, 30 to 60 percent slopes	46F	Xerochrepts and Haploxerolls, very steep
25G	Klickitat stony loam, 60 to 90 percent slopes	47D	Xerochrepts-Rock outcrop complex
26	Knappe silt loam		

*Broadly defined unit

U.S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service

CONSERVATION PLAN
SCHEDULE OF OPERATIONS

[illegible]

U.S. DEPARTMENT OF AGRICULTURE
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CONSERVATION PLAN
SCHEDULE OF OPERATIONS

1. NAME Schoch, Hans		2. COUNTY Washington	3. STATE Oregon	4. CONTRACT OR AGREEMENT NO. 15. TOTAL ACRES UNDER CONTRACT 43												
ITEM NO.	PLANNED CONSERVATION TREATMENT (Record of Decisions)	ESTIMATED AMOUNT (UNITS)	COST BASIS \$	C-S: RT %	COMPLETION SCHEDULE AND ESTIMATED COST-SHARE BY YEAR (For Noncost-Share Items Show Units)											REF. NO.
					1993	1994	1995	1996	1997	1998	1999	2000	2001	2002		
	land and storage will be observed. It will be fenced to provide safety and control livestock access to the edge of the water. Inspections will be made annually or more frequently if necessary. Repairs will be performed as needed.															
21	Excavation	5500, Cy.	\$1.00 AM; 75; \$4125													
22	Compacted Fill	3500, Cy.	\$1.25 AM; 75; \$3281.25													
23	R/C Weir Box	1.2 Cy.	\$225.00 AM; 75; \$202.50													
24	Pipe Drop	24, Ft.	\$6.00 AM; 75; \$108													
	LANDUSE Cropland															
3	2, 3; Waste Utilization-633 Animal waste will be hauled from the storage facility and spread onto identified and approved land disposal areas. Specifications for rates of application etc. will be provided prior to installation.	43.4 Ac.	N/C	N/C; 43.4Ac.												
un1	2, 3; Conservation Cropping Sequence -328 Soil fertility will be maintained by soil testing on a regular basis. Crop residues will be returned to the soil to improve soil	43.4 Ac.	N/C	N/C; 43.4Ac.												

U.S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service

CONSERVATION PLAN SCHEDULE OF OPERATIONS

[illegible]

CONSERVATION PLAN
SCHEDULE OF OPERATIONS

U.S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 522a). The authorities for requesting the information to be supplied on this form are: 16 U.S.C. 590a-(f) (Soil and Water Conservation); 16 U.S.C. 590n(b) (Agriculture Conservation); 16 U.S.C. 590p(b) (Great Plains); 30 U.S.C. 1236 et seq. (Rural Abandoned Mine Reclamation); 33 U.S.C. 1268 et seq. (Rural Clean Water); The Food Security Act of 1985, Public Law 99-198; and the regulations promulgated thereunder.

NOTE--> The information requested is necessary for the development and implementation of a conservation, reclamation or water quality plan as the basis for satisfying program eligibility and compliance requirements, and for providing technical assistance and/or cost-sharing under the previously mentioned authorities. Furnishing this information is voluntary; however, failure to furnish correct, complete information will result in the withholding or withdrawal of such technical or financial assistance. The information may be furnished to other USDA agencies, the Internal Revenue Service, the Department of Justice, or other State or Federal law enforcement agencies, or in response to orders of a court, magistrate, or administrative tribunal.

1. NAME Schuch, Hans	2. COUNTY Washington	3. STATE Oregon	4. CONTRACT OR AGREEMENT NO. 15. TOTAL ACRES UNDER CONTRACT 43
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[illegible]

NOTES: A. All items numbered in column 6 must be carried out as a part of this contract to prevent violation.
B. When established, the conservation practices listed in column 8 must be maintained by the participant at no cost to the government.
C. Enter total cost per unit in column 10 unless the method of cost-share is flat rate. When flat rate, enter the amount per unit to be paid to the participant.
D. All cost share rates in column 11 are based on average cost with the following exceptions:
AA = Actual costs not to exceed average cost.
FR = Flat rate.
NC = Non cost-shared.
AM = Actual cost not to exceed a specified maximum.
E. Modifications will be referenced by number in column 17.
F. By signing, the participant acknowledges receipt of this conservation plan including the SCS-LTP-011 and SCS-LTP-11B and agrees to comply with the terms and conditions hereof.

8. CERTIFICATION OF PARTICIPANTS
SIGNATURE Ann Schach DATE 8/28/82 SIGNATURE _____ DATE _____

9. REVIEWING OFFICIALS SIGNATURES
DISTRICT CONSERVATIONIST-TECHNICAL ADEQUACY CERTIFICATION
DATE 8/24/82 SIGNATURE Tom Dwyer DATE 8--

APPROVED BY (Signature of Conservation District Representative)