

Larry Gulick Dairy

Nutrient Management Plan

March 17, 2001

Nutrient Management Plan Prepared For:

Larry Gulick
329 S 300 E
Jerome ID 83338

Certified Planner: Darwin Vander Stelt

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Facility Information Sheet

Facility	Larry Gulick Dairy		
Operator Information	Larry Gulick		(208) 536-5622
	329 S 300 E		
	Jerome ID 83338		
Legal Description	T9S R17E sect 4		
County	Jerome		
Soil Conservation District	Northside SCD		
Watershed Basin	Upper Snake		
Hydrologic Unit Code #	17040212- 070		
Stream Segment	Clear Lakes Bridge to Cedar Draw (5174)		
GPS	N42° 40.51' W114° 27.76'		

	Nitrogen (lbs)	% of Total Produced	Phosphorus (lbs)	% of Total Produced	Potassium (lbs)	% of Total Produced
Nutrients Exported	19,157	72%	8,523	72%	35,480	73%
Animal Nutrients Applied	7,366	28%	3,263	28%	13,374	27%
Commercial Nutrients Applied						

Limiting Resource:	Comb GW> 5'	Vulnerability:	Medium
Plan Designed to		1.5x Crop Uptak	
AU on the facility	531		
Total Acres Available for Nutrients			
Owned by the Facility	57.1		
Animal Equivalent Units per Acre		2.6	

Action Required	Compliance Date	Completion Date
Containment Upgrade Required:		
Irrigation Mechanical Upgrade Required:	10/01/01	
Irrigation Management Upgrade Required:		
Water Quality Related Practice Required:		

Certified Planner: _____ Date _____
 Darwin Vander Stelt (# 212)

Operator: _____ Date _____
 Larry Gulick

Producer Summary

Facility Summary

The Larry Gulick Dairy is an existing dairy facility located in Jerome, Idaho at 329 S 300 E, and is operated by Larry Gulick.

The purpose of this nutrient management plan is to inform the producer and others of the value of animal waste and to certify that nutrients are utilized in an appropriate way which will not adversely impact surface or groundwater.

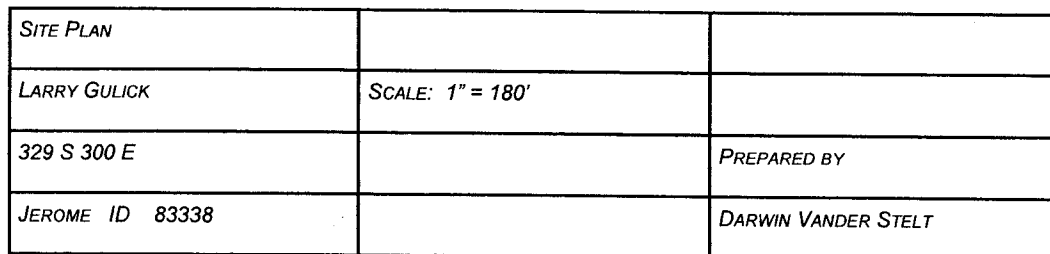
The Larry Gulick Dairy milks 250 Holstein cows and also maintains 40 mature dry cows. The animals are housed in open corrals which are bedded with straw. Manure and straw bedding is scraped and piled in the corrals or in storage areas until it can be hauled away. The dairy owns 57 acres of irrigated cropland. The crop rotation is corn and alfalfa in rotation.

Resource Concerns

The Larry Gulick Dairy is located in the hydrologic unit code 17040212- 070 in the Upper Snake watershed basin, within the Clear Lakes Bridge to Cedar Draw (5174) stream segment. The Clear Lakes Bridge to Cedar Draw (5174) stream segment is water quality limited. The pollutants of concern are sediment and temperature. The facility is found at N42° 40.51' W114° 27.76' using GPS co-ordinates.

The default resource concern on the Larry Gulick Dairy is a combination of surface runoff and groundwater quality, though depth to groundwater is greater than 5' on all the property. The dairy uses a center pivot for irrigation of field 1 and for the distribution of effluent on that field, and run-off is unlikely (on field 1) in a normal rainfall year. Gravity irrigation is used on fields 2,3, and 4, and run-off of tailwater into tributaries of the Snake River are likely. In addition, excessive land applications of animal waste will also elevate soil potassium and salt concentrations which will reduce crop yields.

Facility Site Plan



Waste Storage and Handling Requirements

- Store, handle and mix nutrient products away from wells and other water sources. Keep manure and livestock wastes at least 100 ft away from wells to prevent problems with direct run-in.
- Install hardware and software improvements to the pivot so that effluent may be distributed in field one without contamination of the irrigation lateral or the groundwater via the rock outcrop. This is a requirement of the plan and is to be completed by 10/01/01.

Nutrient Management Plan Requirements

- Liquid wastes will be applied as appropriate to all fields through the irrigation system. Total acreage currently available for land application of liquid wastes is 36 acres. While the plan requires only a total of 8 acres for land disposal of liquid wastes, the availability of additional acreage allows for greater flexibility in meeting the requirements of the crop rotation. Liquid waste should be applied to growing crops, at appropriate times, until the lagoon is empty.
- The lagoon will be emptied during the growing season, starting with the first irrigation and ending with the last irrigation with no effluent application through the winter season, except that effluent may be applied to growing winter crops provided there is no run-off. **Effluent must not be applied to bare ground before 1-Mar without consulting the Idaho Department of Agriculture.**
- Irrigation times should be adjusted so that each field receives uniform coverage with nutrients. The lagoon should never be full in the fall.
- Apply liquid waste at a rate that is consistent with the infiltration rate and available water holding capacity of the soil. Avoid applying liquids at a rate that will bring the soil to its maximum available water holding capacity. This will prevent run-off and groundwater contamination.
- Solid wastes will be applied in the spring or fall, at agronomic rates (after accounting for planned liquid waste applications), to land going into a non-legume crop. Land applied manure will be incorporated through plowing or disking as soon as possible after spreading. **Seventy-five Percent** the solid waste will be exported off of the facility.
- For each field, keep a record of the date, time, and rate of manure or chemical fertilizer applications.
- Manure application rates developed in appendix D are based on 1.5x Crop Uptake and are approximately as follows. This table is only a rough indicator of the application rates and must be adjusted after spring soil samples are available and budgets for each field can be prepared:

Application Schedule Field 2,3,4		Nutrients provided in current year by this application				
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001						
2002						
2003						
2004						
2005	2,3,4		3878	291	137	607
Application Schedule Field 1						
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001	1	100%		66	17	69
2002	1	100%		25	5	20
2003	1	100%		3	1	2
2004	1	100%				
2005	1	100%	1512	168	64	277

- Annual Spring soil tests must be taken to ascertain the nitrogen and potassium requirements of each crop.

Facility Testing Requirements

- Regulatory soil samples will be required from each field every three years. These samples must be taken from the 0- 12" zone for surface runoff fields, and from 18-24" for groundwater concern fields. The samples will be reviewed for phosphorus level and compared with previous test data. These tests will indicate compliance with the nutrient management plan and the adequacy of the plan. Regulatory soil testing will be conducted every three years starting in 2001.

Storage and Handling Plan Recommendations

- Weed control along the top and inside surface of the lagoon will help control plugging problems associated with pumping lagoon water through sprinklers.
- Apply liquid wastes during daylight hours so that set times can be adjusted and run-off avoided.

A list of recommended practices relating to the storage and handling of manure is as follows: (from "BEST MANAGEMENT PRACTICES for Nutrient Management in the State Of Idaho")

ODOR CONTROL

- Maintain a distance from the facility to any occupied residence. When considering where to place corrals, lagoon, etc., one should take into consideration the prevailing wind direction and frequency, land topography, number of animal units, the size of structure (i.e. lagoon, etc.), and manure management practices in relationship to nearby residences.
- General housekeeping around the facility, such as gathering feed spillage around feed bunks, proper carcass disposal, and keeping manure accumulation to a minimum will assist in reducing odor.
- Using inoculants (bacteria, etc.) in lagoons can reduce the amount of solid manure in the lagoon and reduce odor.
- Manure storage management - cleaning solids, settling basins, and channels on a regular basis can have a significant effect on odor.

- Through the use of aeration devices, the intensity of odor coming off of a lagoon structure can be significantly reduced. Some typical aeration devices that are being used are windmill aerators, aeration pumps, and recirculatory systems where water is pumped from the bottom of the lagoon and injected onto the surface of the lagoon.
- Creating windbreaks through the use of structural and natural barriers around the facility can reduce the degree and distance of odor dispersal. Using a windbreak along the prevailing wind side of a lagoon can increase the velocity of the wind crossing the surface of the lagoon and decrease the odor through dilution.
- Artificial or biocovers are an excellent method of reducing containment system odors. These methods can also be used in conjunction with methane harvesting systems.

WASTE HANDLING

- Store, handle and mix nutrient products away from wells and other water sources.
- Keep manure and livestock wastes at least 100 ft away from wells to prevent problems with direct run-in.
- Berm corrals to prevent run-off of manure from the facility.
- Contain manure storage areas to prevent run-off and direct seepage to groundwater from occurring.
- When composting manure, try to maintain temperatures between 130 to 160°F through turning of windrows and the addition of moisture to achieve maximum composting capabilities.
- Continual inspection and maintenance of waste handling facilities and equipment will prevent unwarranted waste discharges into surface water and groundwater.

Nutrient Management Plan Recommendations

- Set realistic crop yield goals in order to provide an accurate account of the plant nutrient needs.
- Weigh crops so that accurate yield data can be acquired.
- Test hay, silage, manure, and lagoon water for concentrations of N, P, and K. Use this data to fine-tune the actual crop uptakes.
- Apply fertilizer to cool season crops in the spring rather than the previous fall. This will prevent fertilizer leaching through the soil profile and provide the crop with the necessary levels of nutrients.
- Use split or multiple fertilizer applications in order to provide the crop with a propellant treatment and the needed nutrient levels throughout the growing season till the point of major nutrient uptake.

A list of recommended practices relating to nutrient management and spreading manure is as follows: (from *"BEST MANAGEMENT PRACTICES for Nutrient Management in the State of Idaho"*)

WASTE APPLICATION

- Check with local city and county officials for applicable regulations on zoning, health, building codes, setback distances, etc.
- Calibrate the manure spreader and apply only as much manure as the nutrient requirements of the crop. Incorporate the manure as soon as possible after application, to prevent runoff and conserve nitrogen.
- Test the soil in each field for N, P, K, and other nutrient levels, pH, and cation exchange capacity. Follow a soil testing routine recommended by the Cooperative Extension Service or by a crop consultant or fertilizer dealer.

- On each field, keep a record of manure and chemical fertilizer applications, crop information, and soil and manure test results.
- Create buffer zones or filter strips around environmentally sensitive areas, such as rock outcroppings, surface waters, etc., to prevent surface water and groundwater contamination.
- To prevent excessive P and K buildup, rotate manure applications to other fields, or decrease applications to meet the most limiting nutrient requirement (generally P) and then supplement with commercial fertilizer.
- Be cautious applying waste to areas of high soil permeability with high leaching potential and areas of low soil permeability (>50% clay) since they do not provide sufficient infiltration.
- Refrain from manure application near residences, roadways, etc. to decrease risk of incidental contamination and odor problems.
- Apply liquid waste at a rate that is consistent with the infiltration rate and available water holding capacity of the soil. Avoid applying liquids at a rate that will bring the soil to its maximum available water holding capacity. This will prevent run-off and groundwater contamination.
- Manure application to frozen ground should be limited to fields with slopes less than 6%. These minimal slopes will be less likely to have a major run-off due to a storm event.
- If manure is applied in a 10-yr. floodplain area, it should be incorporated within 72 hrs of application.
- In the spring or fall, apply manure with the greatest N content; in the summer, apply that with the least N content.
- Haul the highest nutrient content manure to the farthest fields. Apply the lowest nutrient content manure to the closest fields. Irrigate with runoff water and lagoon water.
- Apply the highest nutrient manure to corn silage, vegetable root crops, or other crops with high nutrient demands.
- Apply the highest nutrient manure to legumes only if you have no better use for the N, for legumes can produce their own N if none is provided.
- To avoid N leaching to ground water, limit N applications on sandy soils, and avoid soils with high water tables.

NITROGEN MANAGEMENT

- When applying manure in the fall and winter, it is recommended that it not be applied when soil temperatures are greater than 50° F. At lower temperatures, the conversion of ammonium-N to nitrate-N is significantly reduced.
- Nitrification inhibitors in liquid-manure injection systems can decrease N losses in coarse-textured soils all year long, in all soils during fall and summer, and in fine or medium textured soils with high water tables during winter and spring.
- Apply N so that it is available during peak plant demand.
- To minimize nitrate leaching, apply manure to sandy soil shortly before planting time, and apply small amounts N frequently instead of a large amount at one time. Do not fall-apply on sandy soil without first completing a hydraulic loading analysis.

PHOSPHORUS MANAGEMENT

- In areas of surface water or run-off concern, berm field boundaries to prevent phosphorus from leaving the field through erosion and run-off.
- Irrigate fields efficiently to meet crop needs and the available water holding capacity of the soil. This will prevent phosphorus run-off from occurring caused by over irrigation.
- Install and maintain properly designed buffer/filter strips to prevent phosphorus runoff and erosion.
- The use of PAM is a management practice to prevent sediment attached phosphorus runoff and erosion.

Irrigation Management Plan Recommendation

- Irrigate fields efficiently to meet crop needs and the available water holding capacity of the soil. This will prevent the movement of nitrogen through the soil profile to groundwater caused by over irrigation.
- A soil moisture-monitoring device should be utilized to help determine irrigation scheduling to meet crop demands.
- The following schedule suggests maximum irrigation frequencies for the soil types, crops, and irrigation systems on the farm:

	Days between	No. hours/	in .
Field	Irrigation	rot./ set	water
2,3,4	8	12	5.6
1	2	48	0.75

Analysis of Nutrient Management Practices

Facility Description

The Larry Gulick Dairy is an existing dairy facility located in Jerome, Idaho at 329 S 300 E, and is operated by Larry Gulick.

The purpose of this nutrient management plan is to inform the producer and others of the value of animal waste and to certify that nutrients are utilized in an appropriate way which will not adversely impact surface or groundwater.

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Waste Storage and Handling

Solid waste and bedding deposited in the corrals are piled and stored in the corrals. Approximately 15% of the total manure produced is deposited in the milking parlor and holding pen. It is estimated that 200 tons of straw are used yearly for bedding purposes. Manure will be transported from the corrals and from the storage basin in spreader trucks and applied to owned or rented cropland.

Manure deposited in the milking parlor flows into a concrete, two cell separation device, and from there into a settling basin. Solids are allowed to settle out and liquids flow by gravity into the lagoons. All runoff is contained in the lagoons or in a run-off containment basin located near the low corner of the large corral (see site plan). Lagoon sizing is based on owner estimates of water use. It is estimated that 1790 gallons per day are used for cow prep and clean up. The required storage for 180 days is 69,285 cubic feet. **The lagoons and run-off basin together hold a total 202,884 cu. ft.,** which is more than adequate for 180 days storage. The calculations for the required 180-day storage for liquid wastes are found in Appendix C.

Table 1 shows the total quantity of nutrients produced on the facility.

Table 1. Nutrients Produced					
Description	Volume cu.ft	N lbs/yr	P lbs/yr	K lbs/yr	Ton@40#/cf) Gallons
Lagoon	95,832	1,087	469	1,744	718,742
Solid Waste	255,974	25,437	11,317	47,111	5,119
Total Nutrients Produced	351,806	26,523	11,787	48,854	
Deduct: Nutrients exported	192,781	19,157	8,523	35,480	
Total Nutrients for Land Application		7,366	3,263	13,374	

See Appendix A

Percentage of N, P, and K to be exported:	72%
Percentage of solid waste to be exported:	75%

Raw data used to calculate the information illustrated in Table 1 is found in Appendix A. The actual tonnage of material to be applied or exported is dependent upon the degree of decomposition of the solid material, moisture levels and other factors. The producer is required to keep records, both of tonnage applied, and tonnage exported, to verify that an appropriate percentage of solid manure is exported.

A particular concern is the presence of an irrigation lateral running under the path of the pivot in field 1, and also of a large rock outcrop NW of the center of the pivot. When using the pivot for applying effluent, there is a danger of surface water contamination if effluent is sprayed on the irrigation lateral (running water), and a risk of groundwater contamination if effluent is sprayed on the rock outcrop. The owner has agreed to install an electronic switching system on the pivot which will turn off nozzles as they pass over the lateral or the rock outcrop. This is to be completed by 10/01/01.

A list of recommended practices relating to the storage and handling of manure is as follows: (from "BEST MANAGEMENT PRACTICES for Nutrient Management in the State Of Idaho")

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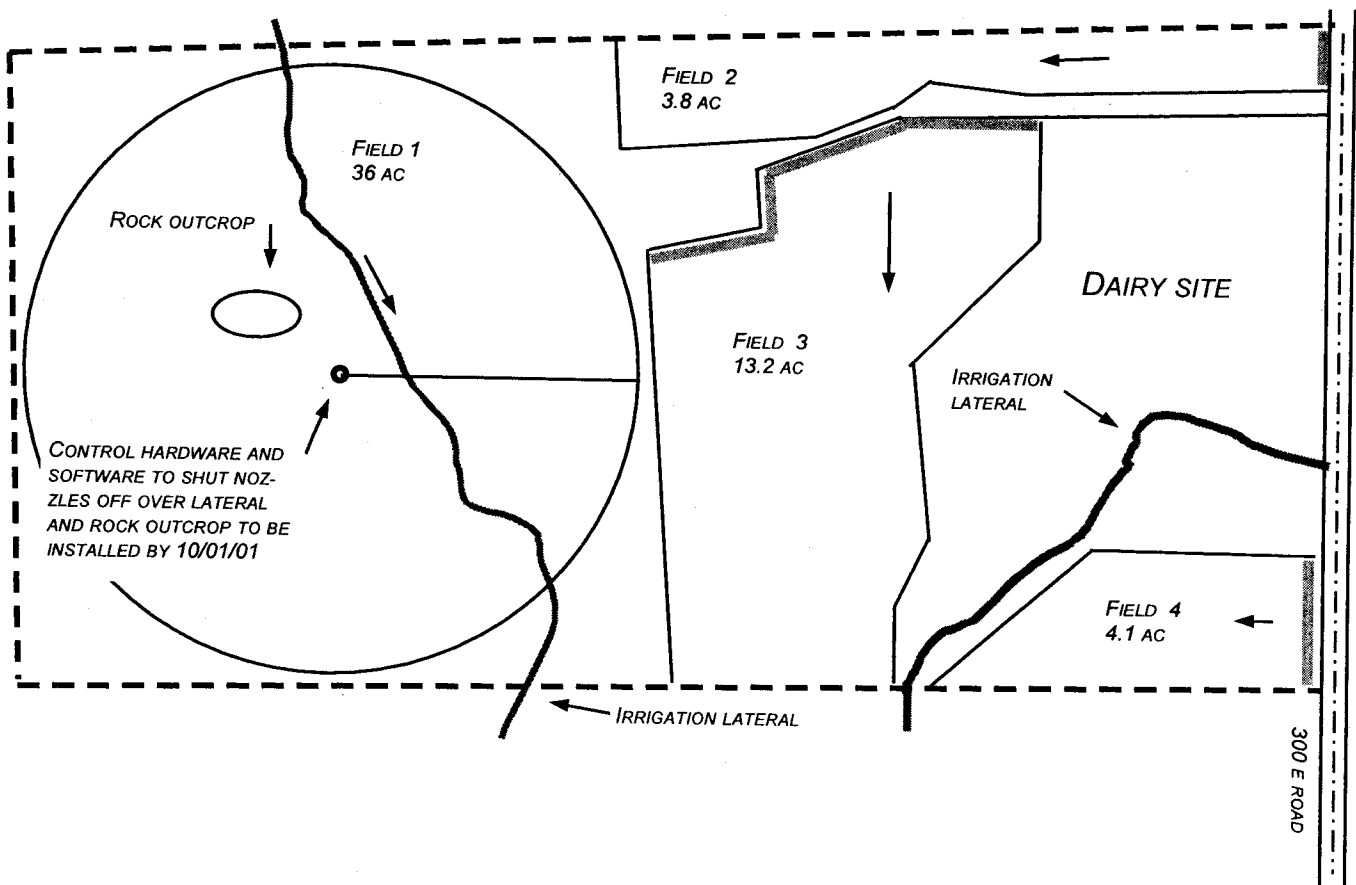
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- General housekeeping around the facility, such as gathering feed spillage around feed bunks, proper carcass disposal, and keeping manure accumulation to a minimum will assist in reducing odor.
- Using inoculants (bacteria, etc.) in lagoons can reduce the amount of solid manure in the lagoon and reduce odor.
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WASTE HANDLING

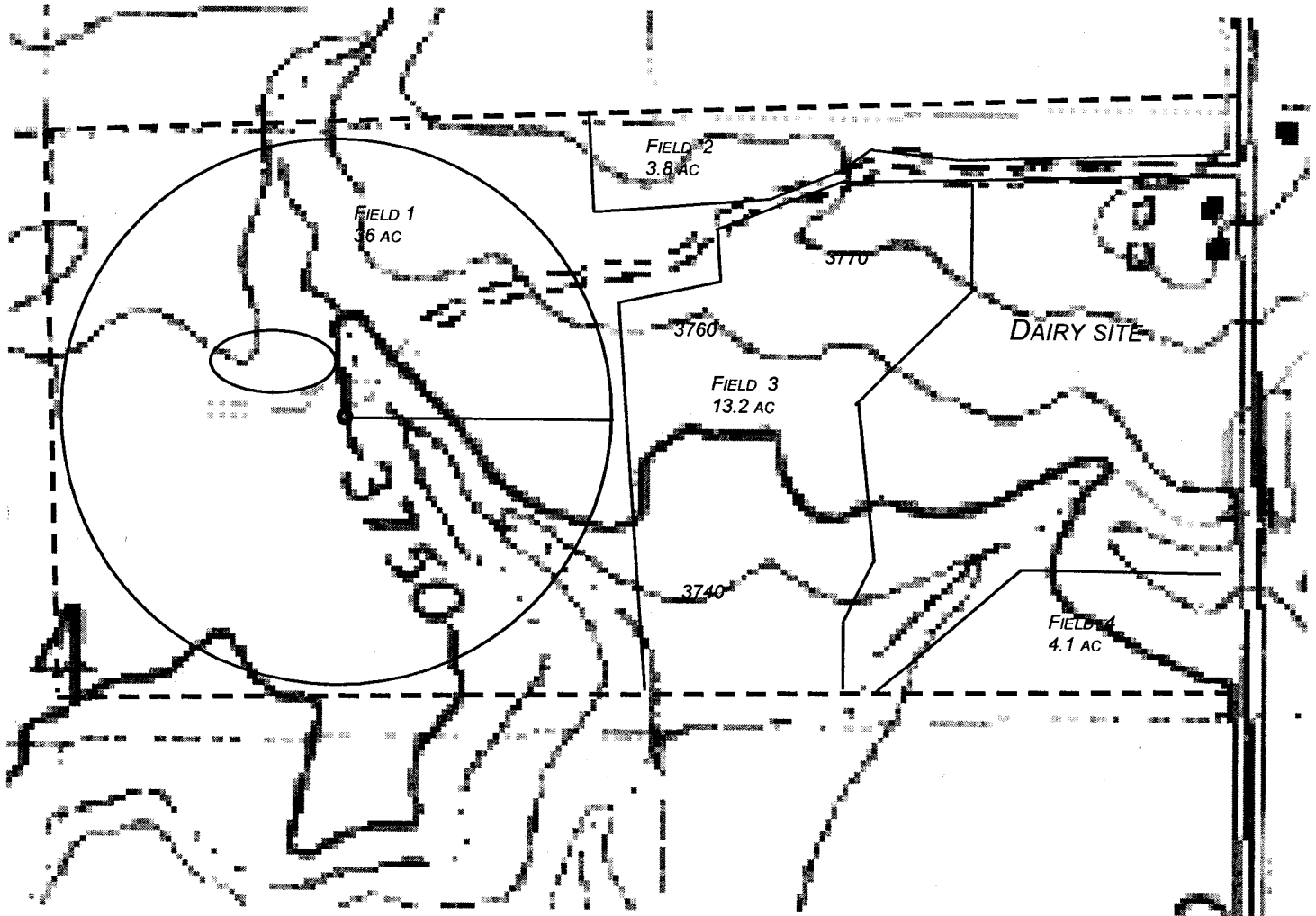
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- Keep manure and livestock wastes at least 100 ft away from wells to prevent problems with direct run-in.
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- Contain manure storage areas to prevent run-off and direct seepage to groundwater from occurring.
- When composting manure, try to maintain temperatures between 130 to 160°F through turning of windrows and the addition of moisture to achieve maximum composting capabilities.
- Continual inspection and maintenance of waste handling facilities and equipment will prevent unwarranted waste discharges into surface water and groundwater.

Land Application Site Plan



FIELD APPLICATION MAP		SEE TOPO MAP NEXT PAGE FOR SLOPES
LARRY GULICK	SCALE: 1" = 385'	
329 S 300 E		PREPARED BY
JEROME ID 83338		DARWIN VANDER STELT





FIELD APPLICATION MAP		
LARRY GULICK	SCALE: 1" = 385'	
329 S 300 E		PREPARED BY
JEROME ID 83338		DARWIN VANDER STELT

Nutrient Management System

The dairy has a total of 57 acres of irrigated cropland for disposal of solid and liquid wastes.

Table 2 contains an inventory of the cropland:

Field	Acres	2001 Crop	Yield	Yr. in Rotation	Resource Concern
1	36	Alfalfa Hay	6	6	Groundwater>5'
2	3.8	Alfalfa Hay	6	6	Surface Runoff
3	13.2	Alfalfa Hay	6	6	Surface Runoff
4	4.1	Alfalfa Hay	6	6	Surface Runoff

Application of all the lagoon effluent is the first priority, with applications of solid manure in amounts dependent upon the specific crop. This necessitates budgeting varying amounts of liquid and solid waste depending on acres available for emptying the lagoon. Because there is not a great surplus of land available to spread effluent, care must be exercised to leave room in the "nutrient bank" for next year's effluent. Testing of actual quantities of phosphorous in the manure and lagoon water is recommended, and regular soil testing is required.

The operator intends to grow corn and alfalfa in rotation. However, it should be understood that the farmer is not bound to any particular crop selection by this plan. Nevertheless, it is required that annual nutrient budgets be prepared which take into account the manure application history, the crop production history, and the nutrient requirements for the current crop for each field.

Table 3. Recommended Crop Rotation, Nutrient Uptake, and Fertilization							
Rotation 1		Years in Rotation	Yield (tons/acre)	N (U of I) lbs/acre	P (uptake) lbs/acre	P (1.5 x CU) lbs/acre	K(U of I) lbs/acre
Corn Silage		5	28	240.0	49.0	74	199
Alfalfa Hay		4	6	229.5	24.5	37	202
Totals		9			38	57	

The crop rotations, yields, and fertilization rates are shown in Table 3:

The rates of fertilization indicated for nitrogen and potassium are the highest possible under the University of Idaho Guidelines. They are not necessarily appropriate for any particular crop or field. It is a requirement of this plan that soil test values will be used to determine a recommendation for nitrogen and potassium based on the University of Idaho Fertilizer Guides.

Soil samples have not been taken but are a requirement of this plan. When the tests are taken, the results may be recorded in the chart below.

Table 4. Soil Test Data										
Field	Date	Depth	N	P (ppm)	K	pH	% OM	CEC	Org	Salts
1		18-24								
2		0-12								
3		0-12								
4		0-12								

Table 5 illustrates the nutrients supplied by the liquids and solids when applied at rates for phosphorous. It must be understood that the University of Idaho Guidelines make recommendations based on soil test, crop, and expected yield, so that **these average rates of application are not appropriate for any particular field or crop. They are used to provide a crude indicator of the nutrient balance for this farm.**

Table 5. Nutrient Applied to Cropland (using P application rates)			Total Lbs./acre available each year		
			0		
			0		
			N	P	K
Rotation 1	Crop	cu.ft./ac	lb/acre	lb/acre	lb/acre
Solids	Field 2,3,4				
Year	Prev nut. credit		60		
1	Corn Silage	3878	291	137	607
2	Corn Silage	0	96	14	57
3	Corn Silage	3878	270	146	642
4	Corn Silage	0	96	14	57
5	Corn Silage	3878	270	146	642
6	Alfalfa Hay		96	14	57
7	Alfalfa Hay		39	9	36
8	Alfalfa Hay				
9	Alfalfa Hay				
Field 1 (L&S)	Prev nut. credit		60		
Yr 1 liquid	Corn Silage	2637	0	0	0
Yr 1 solid		1512	168	64	277
2 liquid	Corn Silage	2637	0	0	0
2 solid		0	63	17	67
3 liquid	Corn Silage	2637	0	0	0
3 solid		1512	134	69	298
4 liquid	Corn Silage	2637	0	0	0
4 solid			66	17	69
5 liquid	Corn Silage	2637	0	0	0
5 solid		1512	134	69	298
6 liquid	Alfalfa Hay	2637	0	0	0
6 solid			66	17	69
7 liquid	Alfalfa Hay	2637			
7 solid			25	5	20
8 liquid	Alfalfa Hay	2637			
8 solid			3	1	2
9 liquid	Alfalfa Hay	2637			
9 solid					

As shown in Table 5, waste application at this level to meet crop phosphorus demands may supply enough nitrogen for this rotation. In general, where manure is applied at phosphorus uptake levels, non-legume crops will need more nitrogen, and legume crops will need more potassium. The application rates suggested in this plan are useful as general guidelines; however, mineralization plays an important role in the availability of nitrogen and potassium. Mineralization is dependent upon temperature, precipitation, nutrient content of the manure, as well as other factors. **Because these factors cannot be managed, mineralization can and will vary considerably from one year to the next. Therefore, due to the mobility and variability in the availability of nitrogen and potassium, a spring soil test is imperative to determine the exact nutrient needs of the crop.** This is especially true when using a nutrient budget approach to optimize nutrient applications.

Mineralization rates used to develop Table 5 are as follows:

General mineralization rates for nitrogen, phosphorus, and potassium for the PNW

Nutrient and location			Percent mineralized (years after application)		
			1st Year	2nd Year	3rd Year
Nitrogen					
West of Cascades			60%	20%	15%
East of Cascades, irrigated			60%	25%	10%
East of Cascades, dryland			45%	20%	15%
Phosphorus					
West of Cascades			76%	10%	6%
East of Cascades			80%	8%	5%
Potassium					
West of Cascades			80%	8%	5%
East of Cascades			85%	8%	5%

Source: How to Calculate Manure Application Rates In the Pacific Northwest, PNW0239, University of Idaho, Oregon State University, or Washington State University

Table 6 shows the total acres that should be utilized to land apply the liquid and solid waste from 531 AU's onto the current cropland rotation:

Table 6. Acres Needed for Land Application	
1.5x Crop Uptake	
Liquids	8
Solids	198

The Larry Gulick Dairy has 57 acres in cropland rotation, 36 of which are currently available for disposal of liquid wastes. Where fields may receive both liquid and solid waste, care must be taken to leave room in the nutrient budget for future liquid manure applications. While it is possible and acceptable to apply all the phosphorous required for 5 years in the first year, if that is done through the application of solid waste, there will be no place to go with liquid manure in the subsequent years. Manure and liquid waste should be applied according to the following schedule:

Application Schedule Field 2,3,4		Nutrients provided in current year by this application				
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001						
2002						
2003						
2004						
2005	2,3,4		3878	291	137	607
Application Schedule Field 1						
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001	1	100%		66	17	69
2002	1	100%		25	5	20
2003	1	100%		3	1	2
2004	1	100%				
2005	1	100%	1512	168	64	277

Notice that because the operator farms all the fields the same way, and because alfalfa was planted this year, it is anticipated that no manure will be spread other than liquid until 2005. In 2005, 2007, and 2009, the dairy can use 53% of the total solids available.

In spreading the lagoon water, care should be used to distribute the applications throughout the season. Applications of lagoon water should be alternated with irrigation water or mixed with irrigation water to avoid burning crops.

Hydraulic Balance

Liquid waste may be applied to a growing crop through the irrigation system at any time of the year, **provided there is no run-off**. When applying liquid wastes to bare ground, there is an additional concern that nutrients will be leached into the ground water. Consequently, it is important to determine the date before which application to bare ground poses an unacceptable risk of groundwater contamination. The calculations which develop this date are found in Appendix F. The calculations are summarized in a chart which follows. Assuming that applications will be made in increments of .5 inches, 1-Mar is the earliest date applications may be made.

Amount of application		0.5 inch	
1/2AWHC (in)	2.6		
Semi-monthly precip			
Jerome	inches		Storage available
4/1-4/15	0.43		2.12
3/15-3/30	0.665		1.455
3/1-3/15	0.665		0.79
2/14-2/28	0.63		0.16
2/1-2/14	0.63		-0.47
1/15-1/30	0.73		-1.2
1/1-1/15	0.73		-1.93
First Date to store(inch)		0.5	1-Mar

A list of recommended practices relating to nutrient management and spreading manure is as follows: (from "BEST MANAGEMENT PRACTICES for Nutrient Management in the State of Idaho")

WASTE APPLICATION

- Check with local city and county officials for applicable regulations on zoning, health, building codes, setback distances, etc.
- Calibrate the manure spreader and apply only as much manure as the nutrient requirements of the crop. Incorporate the manure as soon as possible after application, to prevent runoff and conserve nitrogen.
- Test the soil in each field for N, P, K, and other nutrient levels, pH, and cation exchange capacity. Follow a soil testing routine recommended by the Cooperative Extension Service or by a crop consultant or fertilizer dealer.
- On each field, keep a record of manure and chemical fertilizer applications, crop information, and soil and manure test results.
- Create buffer zones or filter strips around environmentally sensitive areas, such as rock outcroppings, surface waters, etc., to prevent surface water and groundwater contamination.
- To prevent excessive P and K buildup, rotate manure applications to other fields, or decrease applications to meet the most limiting nutrient requirement (generally P) and then supplement with commercial fertilizer.
- Be cautious applying waste to areas of high soil permeability with high leaching potential and areas of low soil permeability (>50% clay) since they do not provide sufficient infiltration.
- Refrain from manure application near residences, roadways, etc. to decrease risk of incidental contamination and odor problems.
- Apply liquid waste at a rate that is consistent with the infiltration rate and available water holding capacity of the soil. Avoid applying liquids at a rate that will bring the soil to its maximum available water holding capacity. This will prevent run-off and groundwater contamination.
- Manure application to frozen ground should be limited to fields with slopes less than 6%. These minimal slopes will be less likely to have a major run-off due to a storm event.
- If manure is applied in a 10-yr. floodplain area, it should be incorporated within 72 hrs of application.
- In the spring or fall, apply manure with the greatest N content; in the summer, apply that with the least N content.
- Haul the highest nutrient content manure to the farthest fields. Apply the lowest nutrient content manure to the closest fields. Irrigate with runoff water and lagoon water.
- Apply the highest nutrient manure to corn silage, vegetable root crops, or other crops with high nutrient demands.
- Apply the highest nutrient manure to legumes only if you have no better use for the N, for legumes can produce their own N if none is provided.
- To avoid N leaching to ground water, limit N applications on sandy soils, and avoid soils with high water tables.

NITROGEN MANAGEMENT

- When applying manure in the fall and winter, it is recommended that it not be applied when soil temperatures are greater than 50° F. At lower temperatures, the conversion of ammonium-N to nitrate-N is significantly reduced.
- Nitrification inhibitors in liquid-manure injection systems can decrease N losses in coarse-textured soils all year long, in all soils during fall and summer, and in fine or medium textured soils with high water tables during winter and spring.
- Apply N so that it is available during peak plant demand.
- To minimize nitrate leaching, apply manure to sandy soil shortly before planting time, and apply small amounts N frequently instead of a large amount at one time. Do not fall-apply on sandy soil without first completing a hydraulic loading analysis.

PHOSPHORUS MANAGEMENT

- In areas of surface water or run-off concern, berm field boundaries to prevent phosphorus from leaving the field through erosion and run-off.
- Irrigate fields efficiently to meet crop needs and the available water holding capacity of the soil. This will prevent phosphorus run-off from occurring caused by over Irrigation.
- Install and maintain properly designed buffer/filter strips to prevent phosphorus runoff and erosion.
- The use of PAM is a management practice to prevent sediment attached phosphorus runoff and erosion.

Crop Information

The following crop information was taken from the University of Idaho Crop Fertilization Guide. Some of the charts have been expanded to demonstrate quantities of manure, which are required to replace chemical fertilizers.

Irrigated Field Corn for Silage or Grain

The following fertilizer guidelines are based on relationships established between University of Idaho soil tests and crop yield response. The fertilizer rates suggested are designed to produce the yields shown if other factors are not limiting production. The rates will be accurate for your field provided (1) the soil sample are properly taken and represent the area to be fertilized; (2) the crop history information supplied is complete and accurate; (3) the yield goal is realistic; and (4) good crop management practices are used.

Nitrogen (N)

Adequate N is necessary for maximum economic production of irrigated field corn used for silage or grain. Fertilizer N represents by far the largest share of the fertilizer costs for field corn in Idaho. The amount of N required depends on many factors that influence total corn production and quality. These factors include length of growing season, corn hybrid, previous crop, past fertilizer use, soil type, leaching hazard and previous manuring. Estimates of both the N available to corn during the season and the yield potential of the crop should be considered when determining N fertilizer rates. may be justified if the effective rooting depth extends below 2 feet.

Potential Yield -- Fertilizer N rates should reflect the corn yield growers can reasonably expect under their soil and management conditions. The historic yield obtained in a specific field or area provides a fair approximation of yield potential given a grower's traditional crop management. projected changes in crop management designed to appreciably alter production may require upward or downward adjustment of yield potential.

Fertilizer N Requirement -- The fertilizer N requirements for field corn silage or grain based on soil test N and potential yield are shown in Tables 1 and 2. The N requirements for grain are 10 to 15 pounds per acre higher than those for silage. Grain yield is more susceptible to N shortages than silage yield. The fertilizer N requirements are based solely on soil test N and yield potential and do not reflect differences among soils in their organic N release rates.

The recommended fertilizer N rates do not account for N cycling as influenced by previous crops. Add 20 pounds N per acre for each ton of straw or stover plowed under to a maximum of 50 pounds per acre. Straw yields are normally 3 to 4 tons per acre and are not always related to grain yields. Winter wheat generally produces more straw than spring wheat or barley. Fertilizer N rates should be reduced 60 pounds per acre when corn follows alfalfa.

Table 1. Recommended fertilizer N rates (lb/acre) for field corn harvested for silage as affected by yield level and soil test N.

Soil Test N (ppm)*	Silage yields (tons/acre)				
	20	25	30	35	40
	lb N/acre				
0	210	230	250	270	295
10	170	190	210	230	255
20	130	150	170	190	215
30	90	110	130	150	175
40	50	70	90	110	135
50	10	30	50	70	95
60	0	0	10	30	55
70	0	0	0	0	15

*Soil test N values summed for the 0 to 12 and 12 to 24 inch depths

Table 2. Recommended fertilizer N rates (lb/acre) for field corn harvested for grain as affected by yield level and soil test N.

Soil Test N (ppm)*	Grain yields (bu/acre)						
	100	125	150	175	200	225	250
	-----lb N/acre-----						
0	215	235	255	280	300	320	340
10	175	195	215	240	260	280	300
20	135	155	175	200	220	240	260
30	95	115	135	160	180	200	220
40	55	75	95	120	140	160	180
50	15	35	55	80	100	120	140
60	0	0	15	40	60	80	100
70	0	0	0	0	20	40	60

*Soil test N values summed for the 0 to 12 and 12 to 24 inch depths

Timing N Applications -- Coarse textured soils, including sandy loams, loamy soils and sands, may lose N from leaching. For these soils, sidedress a portion of the N at the time of the last cultivation. Sprinkler irrigation of corn under center pivots provides increased flexibility for providing N during the season. With sprinklers N can be injected into the system and applied with the water. On silt loam soils, split applications of N have not proven more effective as long as preplant N is adequately incorporated.

High N rates (approaching 300 pounds per acre) broadcast and incorporated before planting may reduce early season corn growth. If high N rates are needed, split applications should be considered.

Phosphorus (P)

Adequate P is necessary for maximum production of field corn. The soil test for P is based on samples collected from the first foot of soil. The soil is extracted with sodium bicarbonate.

Table 3. Fertilizer P rates (lb/acre) based on soil test P and lime content

Soil Test P (ppm)*	Phosphate fertilizer Lime Content			Elemental P (from manure) Lime Content		
	5	10	15	5	10	15
	-----lb P ₂ O ₅ /acre-----			-----lb P/acre-----		
0	180	240	300	79	106	132
5	100	160	220	44	70	97
10	20	80	140	9	35	62
15	0	0	60	0	0	26
20	0	0	0	0	0	0

Economic response to fertilizer P is more likely with cooler soil temperatures and soils with high lime content, particularly when planting long season hybrids. Fertilizer p rates based on soil test P and soil lime contents are given in Table 3. Phosphorus is an immobile nutrient that does not move appreciably from where it is placed. It should be mixed into the seedbed or banded within easy reach of the seedling roots before or during the planting operation.

Potassium (K)

Field corn requires adequate K for optimum growth. Soil test K can be useful in determining the need for K fertilizers. The soil sample is taken from the first foot of soil and extracted with sodium bicarbonate. Fertilizer K rates based on soil test K are given in Table 4. Sulfur (S)

**Table 4. Fertilizer K rates (lb/acre)
based on soil test K**

Soil Test P (ppm)*	Fertilizer K (K ₂ O) -----lb K ₂ O/acre-----	Elemental K (from manure) -----lb K/acre-----
0	240	199
50	160	133
100	80	66
150	0	0

The major corn-growing regions of Idaho should not experience shortages of S. Areas with S deficiencies include some irrigated areas where both the soil and irrigation water are low in S. Snake River water is known to have high S concentrations. Coarse-textured soils including sandy loams, loamy sands and sands would be more susceptible to S deficiencies than silt loam soils. Where the need for S is evident, use 30 pounds per acre of sulfate-sulfur (SO₄S).

Irrigated Alfalfa

The following fertilizer guidelines are based on relationships established between University of Idaho soil tests and crop yield response. The fertilizer rates suggested are based on research results and are designed to produce above-average yields if other factors are not limiting production. Thus, the fertilizer guide assumes use of good crop management practices.

The suggested fertilizer rates will be accurate for your field provided (1) the soil samples represent the area to be fertilized and (2) the crop history information supplied is complete and accurate.

Nitrogen

Nitrogen (N) fertilizer is generally not needed for alfalfa since a healthy alfalfa stand is capable of fixing adequate levels of N. Responses to applied N usually indicate the alfalfa stand is not effectively nodulated due to lack of proper seed inoculation at planting or that the stand is aging.

Soils containing 20 to 30 pounds (4 to 7.5 ppm) of nitrate-nitrogen ($\text{NO}_3\text{-N}$) in the top 12 inches have sufficient N to establish a stand of alfalfa seeded alone. Adding fertilizer N at establishment reduces nodule number and nodule activity.

Establishing alfalfa with a companion crop is not recommended because the alfalfa stand typically is reduced by the excessive competition from the companion plantings. When growers plant alfalfa with a companion crop, both crops compete for the N. Under these conditions, N rates of 30 to 40 pounds per acre are suggested to establish alfalfa stands.

Phosphorus

Alfalfa responds well to applied phosphorus (P). The need for P fertilization can be determined by a soil test. phosphorus materials should be broadcast and incorporated into the seedbed before planting.

For best results, P fertilizers should be applied on established stands in the fall. Rates of P relative to soil test levels are given in Table I. The recommended application should be sufficient for 2 years of production.

Table 1. Phosphorus Fertilizer rates based on a soil test

Soil Test P	Phosphate fertilizer	Elemental P (from manure)
(ppm)*	lb P_2O_5 /acre	lbs P per acre
0	160	70
3	120	53
7	60	26
>10	0	0

P test by NaHCO_3 Extraction

Potassium

Alfalfa has a high potassium (K) requirement. Recommended K fertilization levels are determined by soil test (Table 2). Broadcast and incorporate K at establishment or apply in the fall or early spring on established stands.

Table 2. Potassium Fertilizer needs based on a soil test

Soil Test P	Potassium fertilizer	Elemental K (from manure)
(ppm)*	lb K_2O /acre	lbs K per acre
0	240	199
56	160	133
112	80	66
150	0	0

K test by NaHCO_3 Extraction

Sulfur

Mountain valleys and foothill areas that receive higher amounts of precipitation and/or that are irrigated with low sulfur-containing water are likely areas for sulfur (S) deficiency. Areas irrigated with water from the Snake River or any water containing the sulfate (SO₄) form of sulfur should have an adequate amount of S.

Alfalfa and other legumes require more S than grasses. Plant tissue testing is an excellent tool for detecting S-deficient alfalfa. Samples should be analyzed for total N and total S. These values are used to calculate the nitrogen/sulfur ratio, which should be less than 15. When the ratio is greater than 15, an S deficiency is suspected.

Soils testing less than 8 ppm SO₄-S for 0- to 12-inch soil depth should receive 40 pounds S per acre. This rate of application should provide adequate sulfur for 2 years of production. Many southern Idaho soils contain accumulated S below the 12-inch depth. Although the 0- to 12-inch soil zone may be low in S (8 ppm), the soil below 12 inches may supply enough S for alfalfa production. Thus, testing the soil at both 0- to 12 and 12- to 24-inch depths is advised for a good S recommendation.

Fertilizer S sources include gypsum (CaSO₄) and elemental sulfur. S is also included in some N, P and K fertilizer materials. Elemental S must be biologically converted to the SO₄ form to be used by the plant. The rate of conversion depends on soil temperature, soil water content and particle size of the elemental S applied. To correct an S deficiency the year of application, use a fertilizer containing SO₄ as the readily available S source. Elemental S can be used to provide long term S release.

Micronutrients

Zinc (Zn) deficiencies on alfalfa have not been observed in Idaho. Crops such as beans, corn, potatoes and onions would normally exhibit Zn deficiency before alfalfa. Zinc applied to any of those crops would have sufficient residual for alfalfa.

Boron

Alfalfa is sensitive to low soil boron (B). B deficiencies have been observed in southern Idaho, but they are not widespread. B deficiencies normally occur on acidic soils (pH less than 7.0) and droughty (gravelly and sandy) soils. If the soil tests less than 0.25 ppm B, apply 1 to 3 pounds per acre of B. Do not use higher rates because B in excessive amounts is toxic to plants.

Nutrient Budgeting

The following section will be utilized in conjunction with the Nutrient Budget worksheets, which are available in Appendix E to help determine fertilization rates.

The top half of the sheet is used to determine crop requirements for N, P, and K. Because this plan is based on rates of phosphorus, phosphorus recommendations from the University of Idaho fertilizer guides 4 used.

Line 1- Crop nutrient (N and K) requirements can be determined from spring soil testing and the University of Idaho Crop Fertilization Guides. Use the back side of the sheet to calculate these. For additional information on how to soil test, see University of Idaho Bulletin 704 - Soil Sampling. (Appendix H)

Line 2- Credit N and K from irrigation water if either exceeds 5 ppm

Line 3 - Using the U of I Fertilizer Guide, credit nitrogen from previous legume crop.

Line 4 - Total each column to arrive at nutrients required by the crop.

Line 5 - Nutrients provided by solid waste. Use appendix D for the specific field and crop.

Line 6- Nutrients provided by liquid waste. Use appendix D for the specific field and crop.

Line 7 - Subtotal the nutrients provided by animal waste (line 5 + line 6)

Line 8 - Units of each nutrient in excess or deficit. Excess phosphorus is expected in the first 4 years of the rotation.

Line 9 - Nutrients to be provided by chemical fertilizer.

This budgeting approach will help the producer to determine the amount of commercial fertilizer that should be applied to the cropland.

A list of recommended practices relating to Nutrient Budgeting is as follows: (from "*BEST MANAGEMENT PRACTICES for Nutrient Management in the State of Idaho*")

NITROGEN MANAGEMENT

- Set realistic crop yield goals in order to provide an accurate account of the plant nitrogen needs.
- Soil Sampling - Take representative samples of the field 34 weeks before planting. When taken at the rooting depth of the crop, these samples provide an accurate account of the plant available nitrogen already existing in the soil profile.
- Nitrogen Credits for Legumes and Manure - Crediting nitrogen supplied by legumes and manure can substantially reduce over application of nitrogen and reduce fertilizer application rates.

PHOSPHORUS MANAGEMENT

- Set realistic crop yield goals in order to provide an accurate account of plant phosphorus needs.
- Soil Sampling - Take representative samples of the field 34 weeks before planting. When taken at the rooting depth of the crop, these samples provide an accurate account of the plant available phosphorus already existing in the soil profile.

Irrigation System

A summary of the soil types and textures found on the farm, and the water holding capacity of these soils is summarized in Table 7:

Field	texture	AWHC in./in.	Soil Depth (in)	Irrig. System	Runoff?	Drained?	WT?
1	Barrymore silt loam	0.20	26	Pivot	N	N	N
2	Barrymore silt loam	0.20	26	Gravity	Y	N	N
3	Barrymore silt loam	0.20	26	Gravity	Y	N	N
4	Barrymore silt loam	0.20	26	Gravity	Y	N	N

*AWHC = Average water holding capacity in inches of water per inch of soil

** Water Table

Source: Soil survey of Jerome Area

The crops grown on these fields use water at the following rates:

Crop	Table ET* mm/day	Yield Adj. %	Peak ET* in/day	oot Dept in	M.A.D**
Corn silage	7.1	100%	0.28	3	50%
Alfalfa Hay	6.91	100%	0.27	4	55%

* Evapotranspiration rate (Allen & Brockway, Jerome data)

** Management Allowable Depletion (% of available soil water which may be depleted without yield or quality losses. (Introduction to Irrigation System Planning and Management, table 2.3))

Appendix F suggests times and application rates for irrigation of each field. The flows and times listed for each field are based on owner estimates. The following chart summarizes the set times and application rates:

	Days between	No. hours/	in .
Field	Irrigation	rot./ set	water
2,3,4	8	12	5.6
1	2	48	0.75

The frequencies and set times in the chart are for periods of maximum evapotranspiration (i. e. oats in June or corn in July.) Frequencies may be reduced during cooler periods or when crop is immature. Efforts should be made to keep water in the root zone of growing crops. Too frequent irrigation will result in loss of water below the root zone, and flushing of nitrates and salts into the groundwater aquifer. If the irrigation rate exceeds the permeability of the soil, there will be runoff.

A list of recommended practices relating to irrigation is as follows: (from "BEST MANAGEMENT PRACTICES for Nutrient Management in the State of Idaho"):

IRRIGATION SYSTEM MANAGEMENT

- Evaluate the irrigation system based on the available water holding capacity of the soil, crop growth stage, evapotranspiration, rainfall, and previous irrigation in order to determine the timing and amount of irrigation water to be applied.
- Irrigation systems should be operated so that they meet the crop needs, but apply less than the amount needed to saturate the soil profile.
- Irrigate fields efficiently to meet crop needs and the available water holding capacity of the soil. This will prevent the movement of nitrogen through the soil profile to groundwater caused by over irrigation.
- Utilize a soil moisture-monitoring device to help determine irrigation scheduling to meet crop demands.

Appendixes

Appendix A - Nutrients Produced

Herd Profile

1	Total Cows	290
	Milking Cows	250
	Average weight /cow	1400
	Number of 1000 lb animal units	350
	Daily manure weight/1000lb animal (NRCS Handbook, Table 4-5) (Lb.)	80
	Daily manure volume/1000 lbs (cu.ft./day) (Table 4-5) (cu.ft./day)	1.30
2	Total Milk Cow Manure volume (cu.ft./day)	455
	Total Milk Cow Manure weight (Lbs./day)	28,000

% Dry cows 14%
 Number of Dry Cows 40

	Number of 1000 lb animal units	56
	Daily manure weight/1000lb animal (NRCS Handbook, Table 4-5) (Lb.)	82
	Daily manure volume/1000 lbs (cu.ft./day) (Table 4-5) (cu.ft./day)	1.3
3	Total Dry Cow Manure volume (cu.ft./day)	73
	Total Dry Cow Manure weight (Lbs./day)	4,581

Heifers:

0

Expected and actual numbers:

	Age % of Herd	Expected Number	Actual Number	Actual Avg. Weight	Calculated Mass (lbs)
	16-24 mo.	0.38 110	100	1250	125000
	13-15 mo.	0.12 35	0	800	0
	9-12 mo.	0.17 49	0	600	0
	5-8 mo	0.17 49	0	350	0
	3-4 mo	0.08 23	0	250	0
	0-2 mo	0.08 23	0	125	0
	Total heifers	290	100	Total Mass	125000

Total no. of 1000 lb animal units	125
Daily manure weight/1000lb animal (NRCS Handbook, Table 4-5) (Lb.)	85
Daily manure volume/1000 lbs (cu.ft./day) (Table 4-5) (cu.ft./day)	1.30
Total Heifer Manure volume (cu.ft./day)	163
Total Heifer Manure weight (Lbs./day)	10,625

Total volume in cu.ft./day from all animals in herd	690
Total weight in Lb./day from all animals in herd	43,206

Prepared by:
 Darwin Vander Stelt 3/17/01

Appendix A Animal Nutrients

Total Nutrients Excreted:

Source: NRCS Agricultural Waste Handbook, Table 4-5

Animals		1000# AU	Lbs. per day			Lbs. per year		
			N	P	K	N	P	K
Milk Cow	250	350	0.45	0.07	0.26	57,488	8,943	33,215
Dry cows	40	56	0.36	0.05	0.23	7,340	1,019	4,689
Heifers	100	125	0.31	0.04	0.24	14,144	1,825	10,950
Total Lbs. nutrients excreted annually						78,971	11,787	48,854

Manure nutrients are handled as either solid waste or liquid waste.

% of Milk cows handled as liquid (lagoon) 15%
less separator solids 65%
% Dry Cows handled as liquid 0%
less separator solids 65%
% Heifers handled as liquid 0%
less separator solids 65%
Total nutrients into lagoon
N retained in storage 50%
N retained after application 75%
N retained after denitrification 96%
Total N, P, K in Lagoon water

Lbs. Per Yr			Cubic ft Solids/yr	Authority
N	P	K		
8,623	1,341	4,982	24,911	(NRCS 11-5) (NRCS 11-6) (NRCS 11-8)
(5,605)	(872)	(3,238)	(16,192)	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
3,018	469	1,744	8,719	
1,087	469	1,744		

% Milk Cows handled as Solid waste 85%
Add Separator solids
% Dry Cows handled as solid Waste 100%
add Separator Solids
% Heifers Handled as Solid waste 100%
add Separator Solids
Total nutrients in Solids
N retained in storage 65%
N retained after application 60%
N retained after denitrification 96%
Tons of straw used 200
deduct: 15 Lb N/ton
Total N, P, K in Solid Waste

Lbs. Per Yr			Cubic ft Solids/yr	Authority
N	P	K		
48,864	7,601	28,233	141,164	(NRCS 11-5) (NRCS 11-6) (NRCS 11-8)
5,605	872	3,238	16,192	
7,340	1,019	4,689	26,506	
-	-	-	-	
14,144	1,825	10,950	59,313	
-	-	-	-	
75,953	11,317	47,111	243,174	
-3000				
25,437	11,317	47,111	243,174	

Total N, P, K for land application

26,523	11,787	48,854
--------	--------	--------

Concentration of nutrients in Solid waste and Lagoon Water:

Solid waste volume:

Total 1000 Lb. Animal Units

Cu. Ft. Waste /day/AU

Daily cu.ft.

Annual Cu.ft

deduct solids into lagoon (appendix c)

1.3

531
690
251,893
8,719

NRCS Table 4-5

3%

Annual Cu.ft

243,174

Add Straw (compacted to 64 cu.ft./ton)

12,800

Total Solid Waste Volume	255,974
Liquid Waste Volume (from Appendix C)	95,832

Type	Total Volume (Cu. Ft.)		Lbs. Nutrients/cu.ft.		
			N	P	K
Solid Waste	255,974		0.10	0.04	0.18
Lagoon Water	95,832		0.0113	0.0049	0.0182

Appendix B - Third Party Waste Agreements

Name	Address	Phone	Acres Farmed
Jake Traughber		324-7189	800

Appendix C - Sizing Output for 180 Liquid Storage

APPENDIX C LAGOON STORAGE VOLUME WORKSHEET

Manure into lagoon: %
Milk Cows 15% Parlor and holding pen, feed alleys
Dry Cows 0% Feed Alleys, dry cows only
Heifers 0%

Separator efficiency 65%

6 Manure into lagoon in cu.ft./day 24

Wash Pen:

7 Number of sprinklers in holding pen 0

8 Sprinkler output in gallons per minute (gpm) 3

(@50 psi 9/64 = 4.04; 5/32 = 4.98;
11/64 -- 6.01; 3/16 - 7.18)

9 Minutes per day sprinklers are used: 56

No. of Strings 8

Minutes/String 3.5

Number of milkings per day 2

10 Days run per year 300

11 Total wash pen water in Gals/day (Lines 7 X 8 X 9 X (line10/365)

Milkhouse and parlor:

	gals/optn.	x's/day	Gals/day
Bulk Tank	80	0.5	40
Pipeline	50	6	300
Backflush	0.5	0	0
Cleanup	600	2	1200
Cow Prep	0.5	2	250
Plate Cooler (ignore if recycled)			

12 Total Milkhouse and parlor in Gals/day : 1790

13 Total Milking Center Water in Gals/day 1,790 653,350

14 Total Milking Center water in cu.ft./day 239

Days storage required 180

15 Total storage required for Manure and barnwater (Cu.ft) 47,260

Total volume of liquid waste produced per year 95,832

Runoff Calculations :

Area1 length in ft	300	upper corral
Area1 width in ft	300	
Area 2 length in ft	400	lower corral
Area 2 width in ft	400	
Runoff area in Sq. ft. and acres	250,000	5.74

Precipitation in 25 yr 24hr storm from map (inches) 1.8

Runoff /1000 sq.ft. from Table 6 (Cu.ft) 82.5

16 Cu. ft. of storage required by 25 yr/24hr. storm 20,625

Precipitation from 1 in 5 yr winter from Table 7 (in) 83 Jerome

Runoff /1000 sq.ft. from Table 7 (Cu.ft) 5.6

17 Cu. ft. of storage required by 1 in 5 yr winter precipitation 1,400

18 Total Storage required (cu. ft.) 69,285

Lagoon 1

All water in lagoon (process and runoff):

No. of Cells	1
Slope	1 :1
Depth (ft) (add 1' freeboard)	8
Width of lagoon at top (ft)	50
Width of lagoon at bottom(ft)	34
Avg Width	42
Length at top	187
Length at bottom	171
Avg. Length	179
Actual Capacity in Cu. Ft.	60,144

Rise over run

Lagoon 2

No. of Cells	1	
Slope	1 : 1	
Depth (ft) (add 1' freeboard)	6	
Width of lagoon at top (ft)	270	
Width of lagoon at bottom(ft)	258	
Avg Width		264
Length at top	77	
Length at bottom	65	
Avg. Length		71
Actual Capacity in Cu. Ft.	112,464	

Basin 3 (Run-off)

No. of Cells	1	
Slope	1 : 1	
Depth (ft) (add 1' freeboard)	6	
Width of lagoon at top (ft)	35	
Width of lagoon at bottom(ft)	23	
Avg Width		29
Length at top	180	
Length at bottom	168	
Avg. Length		174
Actual Capacity in Cu. Ft.	30,276	

Lagoon 4

No. of Cells	0	
Slope	0.5 : 1	
Depth (ft) (add 1' freeboard)	8	
Width of lagoon at top (ft)	125	
Width of lagoon at bottom(ft)	113	
Avg Width		119
Length at top	84	1/2 base x's height
Length at bottom	72	
Avg. Length		78
Actual Capacity in Cu. Ft.	-	

Total storage
 Reserve

202,884
 133,599 Cu. Ft

Appendix D - Crop Rotation Balance

General mineralization rates for nitrogen, phosphorus, and potassium for the PNW

Nutrient and location			Percent mineralized (years after application)		
			1st Year	2nd Year	3rd Year
Nitrogen					
West of Cascades			60%	20%	15%
East of Cascades, irrigated			60%	25%	10%
East of Cascades, dryland			45%	20%	15%
Phosphorus					
West of Cascades			76%	10%	6%
East of Cascades			80%	8%	5%
Potassium					
West of Cascades			80%	8%	5%
East of Cascades			85%	8%	5%

Source: How to Calculate Manure Application Rates In the Pacific Northwest, PNW0239, University of Idaho, Oregon State University, or Washington State University

Fertilizer Value Conversion Chart

1 lb. P₂O₅ = 0.44 lb. P

1 lb. K₂O = 0.83 lb. K

To convert to elemental form:

Multiply P₂O₅ by 0.44 = elemental P

Multiply K₂O by 0.83 = elemental K

To convert to fertilizer form:

Multiply P by 2.29 = P₂O₅

Multiply K by 1.21 = K₂O

References for Further Reading

- x Calculating the Fertilizer Value of Manure from Livestock Operations, EC1094, Oregon State University
- x Dairy Manure as a Fertilizer Source, EM8586 Oregon State University
- x How to Calculate Manure Application Rates in the Pacific Northwest, PNW0239, University of Idaho, Oregon State University, or Washington State University

- x Manure Application Rates for Forage Production, EM8585, Oregon State University

Appendix E - Nutrient Budget Worksheets

CALCULATIONS FOR DETERMINING N, P, & K FOR ITEM 1 OF THIS WORKSHEET

This worksheet will vary somewhat depending upon the procedure outlined in the fertilizer guide for the crop being evaluated. Refer to the crop specific fertilizer guide for the proper procedure.

Determine Total N Needed: Crop Being Evaluated _____ Field Number _____

Yield goal X N required¹ per unit yield = Total N needed

Yield Goal _____ X N required/unit yield _____ = Total N required _____

¹ Note: The current UI Fertilizer Guide may adjust N requirement for precipitation.

2. Residues from previous crop removed: Yes / No. If No, determine N needed to decompose residue from previous crop (_____) lbs. N per ton of residue (from guide), up to 50 lbs. Generally, 1 ton of residue is produced per 20 bu. of grain. If residues are incorporated, calculate N needed to decompose residue as shown below.

[(yield _____ / 20)] X N value from the Guide (_____) = _____ Do not exceed more than 50 lbs. Use: _____

Total N required: Line 1 + Line 2: _____ Enter in A. below.

B. Determine Mineralized N: _____ % organic matter. Determine from appropriate table. Enter in B below.

C. Determine total ppm N, P, and K from soil test results.

Depth	ppm NO ₃ -N	ppm NH ₄ -N	Total ppm N	ppm P	ppm K
0 - 12 in.					
12 - 24 in.					
_____al ppm					

Does total ppm P exceed threshold for any concern? Y / N

From the appropriate Fertilizer Guide, use the ppm of N, P, or K to determine crop needs and enter below for N to determine total N needs. Enter total P and K in Item 1, Pg. 1 or this worksheet.

N: Total ppm N _____ X 4 (OR FROM FERTILIZER GUIDE) = Total soil test N: _____ Enter in C below.

Summary Total N Required For The Crop

A. Total N required: _____

B. Minus mineralized N _____

C. Minus soil test N (lbs/ac) _____

D. Equals N fertilizer required (lbs/ac) _____

ENTER IN ITEM 1, Pg. 1

SOLVE FOR P AND K

P: Total ppm P _____¹ Total P OR P₂O₅ from the Guide _____ Convert P₂O₅ to P and enter in Item 1, Pg. 1

Total ppm K _____¹ Total K OR K₂O from the Guide _____¹ Convert K₂O to K enter in Item 1, Pg. 1.

¹ Caution: Some fertilizer guides express phosphate or potassium requirements as P or K and some as P₂O₅ or K₂O. Soil test values are generally expressed as P or K. Convert soil test values as necessary.

P X 2.29 = P₂O₅

P₂O₅ X .44 = P

K X 1.20 = K₂O

K₂O X 0.83 = K

NUTRIENT BUDGET

Producer: _____ Date: _____

anned Crop Rotation: _____

Crop Evaluated on this worksheet: _____ Field Number _____ Worksheet _____ of _____

Fertilizer Guide Used: _____ Date of Guide: _____

	N lb/ac	P lb/ac	K lb/ac
1. CROP NUTRIENT REQUIREMENTS - COMPLETE Pg. 2 of this worksheet.			
2. N AND K FROM IRRIGATION WATER IF > 5 ppm			
3. LEGUME CREDITS FROM PREVIOUS CROP Use only if accounted for in the fertilizer guide. Soil Extraction Method:			
4. TOTAL POUNDS OF NUTRIENT NEEDED. (Line 1 - Line 2- Line 3)			
NUTRIENTS FROM SOLID WASTE			
From calculation or IDWMP lb/ac total available nutrients from solids are: Total = solids + grazing deposition (if applicable)			
6. NUTRIENTS FROM LIQUID WASTE From calculations or IDWMP lb/ac total available nutrients from liquids are:			
7. TOTAL NUTRIENTS AVAILABLE FROM ANIMAL WASTE. (Line 5 + Line 6)			
8. UNITS OF NUTRIENTS NEEDED OR IN EXCESS			
Line (4) - Lines (7) = _____ If line 8 is a positive, additional nutrients are required. If line 8 is negative, nutrients are in excess. Reallocate the sources of nutrients available from lines 5 & 6.			
9. NUTRIENTS FROM COMMERCIAL FERTILIZER			

Evaluation Prepared by: _____ Date: _____

Comments: _____

CALCULATIONS FOR DETERMINING N, P, & K FOR ITEM 1 OF THIS WORKSHEET

This worksheet will vary somewhat depending upon the procedure outlined in the fertilizer guide for the crop being evaluated. Refer to the crop specific fertilizer guide for the proper procedure.

1. Determine Total N Needed: Crop Being Evaluated _____ Field Number _____

Yield goal X N required¹ per unit yield = Total N needed

Yield Goal _____ X N required/unit yield _____ = Total N required _____

¹ Note: The current UI Fertilizer Guide may adjust N requirement for precipitation.

2. Residues from previous crop removed: Yes / No. If No, determine N needed to decompose residue from previous crop (_____): _____ lbs. N per ton of residue (from guide), up to 50 lbs. Generally, 1 ton of residue is produced per 20 bu. of grain. If residues are incorporated, calculate N needed to decompose residue as shown below.

[(yield _____ / 20)] X N value from the Guide (_____) = _____ Do not exceed more than 50 lbs. Use: _____

Total N required: Line 1 + Line 2: _____ Enter in A. below.

B. Determine Mineralized N: _____ % organic matter. Determine from appropriate table. Enter in B below.

C. Determine total ppm N, P, and K from soil test results.

Depth	ppm NO ₃ -N	ppm NH ₄ -N	Total ppm N		ppm P		ppm K
0 - 12 in.							
12 - 24 in.							
all ppm							

Does total ppm P exceed threshold for any concern? Y / N

From the appropriate Fertilizer Guide, use the ppm of N, P, or K to determine crop needs and enter below for N to determine total N needs. Enter total P and K in Item 1, Pg. 1 or this worksheet.

N: Total ppm N _____ X 4 (OR FROM FERTILIZER GUIDE) = Total soil test N: _____ Enter in C below.

Summary Total N Required For The Crop

A. Total N required: _____

B. Minus mineralized N - _____

C. Minus soil test N (lbs/ac) - _____

D. Equals N fertilizer required (lbs/ac) _____ ENTER IN ITEM 1, Pg. 1

SOLVE FOR P AND K

P: Total ppm P _____¹ Total P OR P₂O₅ from the Guide _____. Convert P₂O₅ to P and enter in Item 1, Pg. 1

Total ppm K _____¹ Total K OR K₂O from the Guide _____.¹ Convert K₂O to K enter in Item 1, Pg. 1.

¹ Caution: Some fertilizer guides express phosphate or potassium requirements as P or K and some as P₂O₅ or K₂O. Soil values are generally expressed as P or K. Convert soil test values as necessary.

P X 2.29 = P₂O₅ P₂O₅ X .44 = P K X 1.20 = K₂O K₂O X 0.83 = K

NUTRIENT BUDGET

Producer: _____ Date: _____

anned Crop Rotation: _____

Crop Evaluated on this worksheet: _____ Field Number _____ Worksheet ____ of ____

Fertilizer Guide Used: _____ Date of Guide: _____

	N lb/ac	P lb/ac	K lb/ac
1. CROP NUTRIENT REQUIREMENTS - COMPLETE Pg. 2 of this worksheet.			
2. N AND K FROM IRRIGATION WATER IF > 5 ppm			
3. LEGUME CREDITS FROM PREVIOUS CROP Use only if accounted for in the fertilizer guide. Soil Extraction Method:			
4. TOTAL POUNDS OF NUTRIENT NEEDED. (Line 1 - Line 2 - Line 3)			
5. NUTRIENTS FROM SOLID WASTE From calculation or IDWMP lb/ac total available nutrients from solids are: Total = solids + grazing deposition (if applicable)			
6. NUTRIENTS FROM LIQUID WASTE From calculations or IDWMP lb/ac total available nutrients from liquids are:			
7. TOTAL NUTRIENTS AVAILABLE FROM ANIMAL WASTE. (Line 5 + Line 6)			
8. UNITS OF NUTRIENTS NEEDED OR IN EXCESS Line (4) - Lines (7) = _____ If line 8 is a positive, additional nutrients are required. If line 8 is negative, nutrients are in excess. Reallocate the sources of nutrients available from lines 5 & 6.			
9. NUTRIENTS FROM COMMERCIAL FERTILIZER			

Evaluation Prepared by: _____ Date: _____

Comments: _____

Appendix F - Irrigation Calculations

Field No: 1

No. Acres 36.0
Soil Type & code nos: Barrymore silt loam
Crop: Corn Silage
Rooting Depth(in): 26

Available water capacity (AWC):

depth	inches	AWC (in/in)
0-8	8	0.2
8-16	8	0.2
16-26	10	0.19
Total	26	AWC

Source: Soil Survey, Jerome County Area,

Max. ET for crop (Allen and Brockway, Jerome):

mm/day 7.1 in/day 0.28

Management Allowable Depletion (MAD):

Irrigation Method Pivot

Irrigation efficiency

50%

75%

Theoretical frequency to irrigate:

available water (in) 2.55

days until depleted 9.1

Days between irrigation 2

Water to apply each irrigation (in): 0.75

Application Rate in inches /hr 0.02

Flow calculations

System flow (Gal/Min) 254.0

Pivot length (ft) 707

Portion of Circle 100%

Gal water applied to field 730,573

Set time (hrs)/ rotation 47.9

Miner's
inches

28

0.00

Permeability

depth	inches	Perm* (in/hr)
0-8	8	6
8-16	8	6
16-26	10	
0	0	
Total	26	3.69

Source: Soil Survey, Jerome County Area,

*max. permeability in inches of travel per

** uptake in inches of water/hr

Permeability Class

Moderate

Recommendations:

(Hottest week in July, Corn)

Set Time: 48 hrs/rotation

F Gravity

Field No: 2

No. Acres 3.8
Soil Type & code nos: Barrymore silt loam
Crop: Corn Silage
Rooting Depth(in): 26 bedrock @26"

Available water capacity (AWC):

depth	inches	AWC (in/in)	in/in
0-8	8	0.2	0.062
8-16	8	0.2	0.062
16-26	10	0.19	0.073
			0.000
Total	26	AWC	0.20

Max. ET for crop (Allen and Brockway, Jerome):

mm/day 7.1 in/day 0.28

Source: Soil Survey, Jerome County Area,

Management Allowable Depletion (MAD): 50%

Irrigation Method Gravity

Irrigation efficiency 40%

Theoretical frequency to irrigate:

available water (in) 2.55

days until depleted 9.1

Days between irrigation 8

Water to apply each irrigation (in): 5.59

Application Rate in inches /hr 0.47

Flow calculations Miner's inches 11

System flow (Gal/Min) 100

Row length (ft) 660

Row width (in) 30

Gal water applied/row 5,765

Flow rate per tube (gal/min) 8.01

Set time (hrs) 12

No. tubes 12

No. sets 8.0

Size tubes 1.00

(offsett 4 9.00)

Permeability			Maximum
depth	inches	Perm* (in/hr)	Rate**
0-8	8	2	0.40
8-16	8	2	0.40
16-26	10	2	0.38
			0.00
Total	26	2.00	

Source: Soil Survey, Jerome County Area,

*max. permeability in inches of travel per hour

** uptake in inches of water/hr

Permeability Class

Moderate

6.00 inch head

Recommendations:

(Hottest week in July, Corn)

Set Time: 8 hrs

12 - 1" tubes w/ 6" head = 9 gpm

Flow Rate : 11 inches

For Hottest week in July.

This soil has moderate permeability, and is at risk for run-off if set times are too long, or flows too fast.

Table 5.1. Soil intake family designations USDA soil textural classes
(Source: USDA-NRSC Idaho Irrigation Guide. 1977).

Intake Family	Soil Textural Classes
0.3	Heavy clays, silty clay (more than 60% clay)
0.5	Clays, silt loam (lake deposits), sandy clay
1	Silty clay loam, clay loam, sandy clay loam, silt loam (alluvial deposits)
1.5	Silt loam (wind deposits), loam, very fine sandy loam
2	Sandy loam, fine sandy loam, gravelly loam
3	Very fine sand, loamy sands, gravelly sandy loam
4	Sand

Soil Intake Family Adjustment Factors

Basic Factors

Texture

Fine-textured soils generally have slower intake rates than coarse-textured soils.

Structure

The arrangement of soil particles (structure) affects intake as follows:

- Single grain or granular structure - most rapid intake
- Blocky or prismatic structure - moderate intake rate
- Massive or platy structure - slowest intake rate

Density

Dense soils, which consist of soils with grains tightly packed together, have slower intake rates. Well-graded (a mixture of sizes) and densely packed, can have a slow intake rate.

Table 11-2 Maximum application rate (in/hr)							
Soil texture	Application Amount in Inches						
	0.25	0.5	0.75	1	1.25	1.5	2
Sand	6	6	6	6	6	6	6
Loamy sand	6	6	4.83	4.22	3.86	3.62	3.32
Sandy loam	4.91	2.97	2.32	1.99	1.8	1.67	1.51
Loam	3.11	1.69	1.21	0.98	0.84	0.74	0.62
Silt loam	2.7	1.45	1.03	0.82	0.7	0.61	0.51
Sandyclay lo	2	1	1	1	0	0	0
Clay loam	1.27	1	0	0	0	0	0
Silty clay loa	1	1	0	0	0	0	0
Sandy clay	0.61	0	0	0	0	0	0
Silty clay	0.84	0	0	0	0	0	0
Clay	0.39	0.21	0	0	0	0	0

Note: This table is for infiltration rate for full cover conditions and initial moisture content at 50 percent of the available water capacity. Field capacity of sand through sandy loam is assumed to be at 1/10 bar.

source: NRCS "Animal Waste Handbook"

This table is for liquid manure with solids content < .5 %

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (in)	1.48	1.38	1.33	0.86	0.91	0.84	0.52	0.42	0.58	0.88	1.38	1.54	1.8
Soil moisture (in)	0.43	0.68	0.68	0.63	0.63	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Storage available (in)	2.12	1.48	0.79	0.18	-0.47	-1.2	-1.93	-1.93	-1.93	-1.93	-1.93	-1.93	-1.93

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (in)	1.48	1.38	1.33	0.86	0.91	0.84	0.52	0.42	0.58	0.88	1.38	1.54	1.8
Soil moisture (in)	0.43	0.68	0.68	0.63	0.63	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Storage available (in)	2.12	1.48	0.79	0.18	-0.47	-1.2	-1.93	-1.93	-1.93	-1.93	-1.93	-1.93	-1.93

Hydraulic Balance

Date to Spray Calculations (for bare, unfrozen ground):

AWC 0.20
Depth 26 inches

Barrymore silt loam

Available water capacity (AWC):

depth	inches	WC (in/i)	in/in
0-8	8	0.2	0.062
8-16	8	0.2	0.062
16-26	10	0.19	0.073
			0.000
Total	26	AWC	0.20

NA

Available water capacity (AWC):

depth	inches	WC (in/i)	in/in
			#DIV/0!
			#DIV/0!
			#DIV/0!
			#DIV/0!
Total	0	AWC	#DIV/0!

Source: Soil Survey, Ada County Area,

Field capacity 5.1 in.
% filled 50% on
Space available 4 2.55 inches
IDAWM data for Jerome

4/15/00 (Beginning of irrigation season)

Precipitation	
Month	Jerome
Jan	1.46
Feb	1.26
Mar	1.33
Apr	0.86
May	0.91
Jun	0.84
Jul	0.25
Aug	0.42
Sep	0.58
Oct	0.69
Nov	1.36
Dec	1.54
25yr	1.8

Amount of application		0.5 inch	
1/2AWHC (in)	2.6		
Semi-monthly precip			
Jerome	inches	Storage available	
4/1-4/15	0.43		2.12
3/15-3/30	0.665		1.455
3/1-3/15	0.665		0.79
2/14-2/28	0.63		0.16
2/1-2/14	0.63		-0.47
1/15-1/30	0.73		-1.2
1/1-1/15	0.73		-1.93
First Date to store(inch)		0.5	1-Mar

Appendix G - Soil Information

LOCATION BARRYMORE

ID

Established Series
Rev. DWH/DA/CLM
02/1999

BARRYMORE SERIES

The Barrymore series consists of moderately deep, well drained soils that formed in alluvium and loess from mixed sources. Barrymore soils are on terraces. Slopes are 1 to 4 percent. Permeability is moderate. The average annual precipitation is about 9 inches and the average annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Coarse-silty, mixed, superactive, mesic Xeric Haplocalcids

TYPICAL PEDON: Barrymore silt loam--rangeland. On a 2 percent slope, south aspect, 3,860 feet elevation. (Colors are for dry soil unless otherwise noted.) When described on September 23, 1986, the soil was dry throughout.

A--0 to 5 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; moderate medium platy structure; soft, friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine irregular pores; neutral (pH 6.6); clear smooth boundary. (3 to 6 inches thick)

Bw--5 to 17 inches; yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; common very fine and few fine tubular pores; neutral (pH 7.1); clear smooth boundary. (8 to 17 inches thick)

Bk--17 to 25 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; hard, friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; 5 percent gravel; strongly effervescent (25 percent calcium carbonate); moderately alkaline (pH 7.9); abrupt smooth boundary. (6 to 26 inches thick)

2R--25 inches; fractured basalt bedrock with lime coatings on surface and in fractures.

TYPE LOCATION: Jerome County, Idaho; about 7 miles north of the city of Jerome; in the northeast 1/4, northeast 1/4, northwest 1/4, section 6, T. 7 S., R. 17 E.

RANGE IN CHARACTERISTICS:

Average annual soil temperature - 49 to 51 degrees F.

Depth to bedrock - 20 to 40 inches

Depth to the calcic horizon - 15 to 20 inches

Control section - averages 12 to 18 percent clay with 5 to 15 percent carbonate clay and 3 to 10 percent carbonate free clay.

A horizon

Value - 5 or 6 dry, 3 or 4 moist

Chroma - 2 through 4 dry or moist

Bw horizon

Value - 5 or 6 dry

Chroma - 3 or 4 dry or moist
Clay - 14 to 20 percent

Bk horizons
Value - 6 or 7 dry, 4 through 6 moist
Chroma - 2 or 3 dry or moist
Clay - 8 to 18 percent
Gravel - 0 to 10 percent
Calcium carbonate equivalent - 15 to 30 percent

COMPETING SERIES: These are the Bahem, Bram, Idahome, Nyssaton, Pogal and Portino series. All of these soils are over 40 inches deep. Portino soils have a calcic horizon at 6 to 15 inches.

GEOGRAPHIC SETTING: Barrymore soils are on terraces. They formed in alluvium and loess from mixed sources. Slopes range from 1 to 4 percent. Elevation ranges from 3,500 to 4,250 feet. The average annual precipitation is 8 to 11 inches. The average annual temperature is 47 to 49 degrees F. The frost-free period is 130 to 140 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Idow, Paulville and Starbuck soils. Idow soils are moderately deep to a duripan and have fine-loamy control sections. Paulville soils are very deep and have fine-loamy control sections. Starbuck soils are shallow to bedrock. All soils are on the same landform as Barrymore soils.

DRAINAGE AND PERMEABILITY: Well drained, slow runoff; moderate permeability.

USE AND VEGETATION: Barrymore soils are used for rangeland and irrigated cropland. Native vegetation is Wyoming big sagebrush and Thurber needlegrass. Irrigated crops are mainly wheat, barley, beans and alfalfa hay.

DISTRIBUTION AND EXTENT: This series is of moderate extent in south central Idaho.

MLRA OFFICE RESPONSIBLE: Portland, Oregon

SERIES ESTABLISHED: Jerome County, Idaho, 1992.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon

Cambic horizon - the zone from 5 to 17 inches (Bw horizon)

Calcic horizon - the zone from 17 to 25 inches (Bk horizon)

Particle size control section - 10 to 25 inches (Bw and Bk horizon)

National Cooperative Soil Survey
U.S.A.

Appendix H - Soil Sample Bulletin

Soil Sampling

Bulletin 704
(revised)

R. L. Mahler and
T. A. Tindall



*College of
Agriculture*



University of Idaho
Cooperative Extension System

Soil Sampling



Environmental concerns have brought nutrient management in agriculture under increased scrutiny. A goal of sound nutrient management is to maximize the proportion of applied nutrients that is used by the crop (nutrient use efficiency). Soil sampling is a best management practice (BMP) for fertilizer management that will help improve nutrient use efficiency and protect the environment.

Soil sampling is also one of the most important steps in a sound crop fertilization program. Poor soil sampling procedures account for more than 90 percent of all errors in fertilizer recommendations based on soil tests. Soil test results are only as good as the soil sample. Once you take a good sample, you must also handle it properly for it to remain a good sample.

A good soil testing program can be divided into four operations: (1) taking the sample, (2) analyzing the sample, (3) interpreting the sample analyses, and (4) making the fertilizer recommendations. This publication focuses on the first step, collecting the soil sample.

Once you take a sample, you must send it to a laboratory for analysis. Then the Extension agricultural educator or fertilizer fieldman in your county can interpret the analysis and make specific fertilizer recommendations. Fertilizer guides from the University of Idaho Cooperative Extension System are also available to help you select the correct fertilizer application rate.

The soil sampling guidelines in this publication meet sampling standards suggested by federal, state, and local nutrient management programs in Idaho.

What is a soil test?

A soil test is a chemical evaluation of the nutrient-supplying capability of a soil at the time of sampling. Not all soil-testing methods are alike nor are all fertilizer recommendations based on those soil tests equally reliable.

Reliable fertilizer recommendations are developed through research by calibrating laboratory soil test values and correlating them with crop responses to fertilizer rates. These soil test correlation trials must be conducted for several years on a particular crop growing on a specific soil type. If soil test calibration is incomplete, fertilizer recommendations based on soil-test results still can only be best guesses.

A soil test does not measure the total amount of a specific nutrient in the soil. There is usually little relationship between the total amount of a nutrient in the soil and the amount of a nutrient that plants can obtain.

A soil test also does not measure the amount of plant-available nutrients in the soil because not all the nutrients in the soil are in a form readily usable by plants. Through research, however, a relationship can usually be established between soil test nutrient levels and the total amount of a nutrient in the soil.

What does a soil test measure?

Present soil-testing methods measure a certain portion of the total nutrient content of the soil. During testing, this portion is removed from the soil by an extracting solution that is mixed with the soil for a given length of time. The solution containing the extracted portion of the nutrient is separated from the soil by filtration, and then the solution is analyzed.

A low soil-test value for a particular nutrient means the crop will be unable to obtain enough of that nutrient from the soil to produce the highest yield under average soil and climatic conditions. A nutrient deficiency should be corrected by adding the nutrient as a fertilizer. The amount of nutrient that needs to be added for a given soil-test value is calculated based on results from the correlation research test plots.

Sampling timing

Because nutrient concentrations in the soil vary with the season, you should take soil samples as close as possible to planting or to the time of crop need for the nutrient. Ideally, take the soil samples 2 to 4 weeks before planting or fertilizing the crop. It usually requires 1 to 3 weeks to take a soil sample, get the sample to the testing laboratory, and obtain results.

Sampling very wet, very dry, or frozen soils will not affect soil test results

though collecting soil samples under these conditions is difficult. Do not sample snow-covered fields. The snow makes it difficult to recognize and avoid unusual areas in the field, so you may not get a representative sample.

Sampling frequency

For best soil fertility management, especially for the mobile nutrients, sample each year and fertilize for the potential yield of the intended crop. Having an analysis performed for every nutrient each year is not necessary. Whether you need an analysis of a nutrient depends on such things as its mobility in the soil and the nutrient requirements of the crop.

Take soil samples at least once during each crop rotation cycle. Maintain a

record of soil test results on each field to evaluate long-term trends in nutrient levels.

Sampling procedure

One of the most important steps in a soil testing program is to collect a soil sample that represents the area to be fertilized. If the soil sample is not representative, the test results and recommendations can be misleading.

The correct steps in soil sampling are illustrated in figure 1. Before sampling, obtain necessary information, materials, and equipment from the Extension agricultural educator or fertilizer fieldman in your county.

Use proper soil sampling tools. A soil auger or probe is most convenient, but

you can use a shovel or spade for shallow samples. You will need a plastic bucket or other container for each sample to help you collect and mix a composite sample.

Be sure that all equipment is clean, and especially be sure it is free of fertilizer. Even a small amount of fertilizer dust can result in a highly erroneous analysis. Do not use a galvanized bucket when analyzing for zinc (Zn) or a rusty shovel or bucket when analyzing for iron (Fe). If the sample will be analyzed for Fe or manganese (Mn), do not dry the soil sample before shipping.

When sampling, avoid unusual areas such as eroded sections, dead furrows, and fence lines. If the field to be sampled covers a large area with

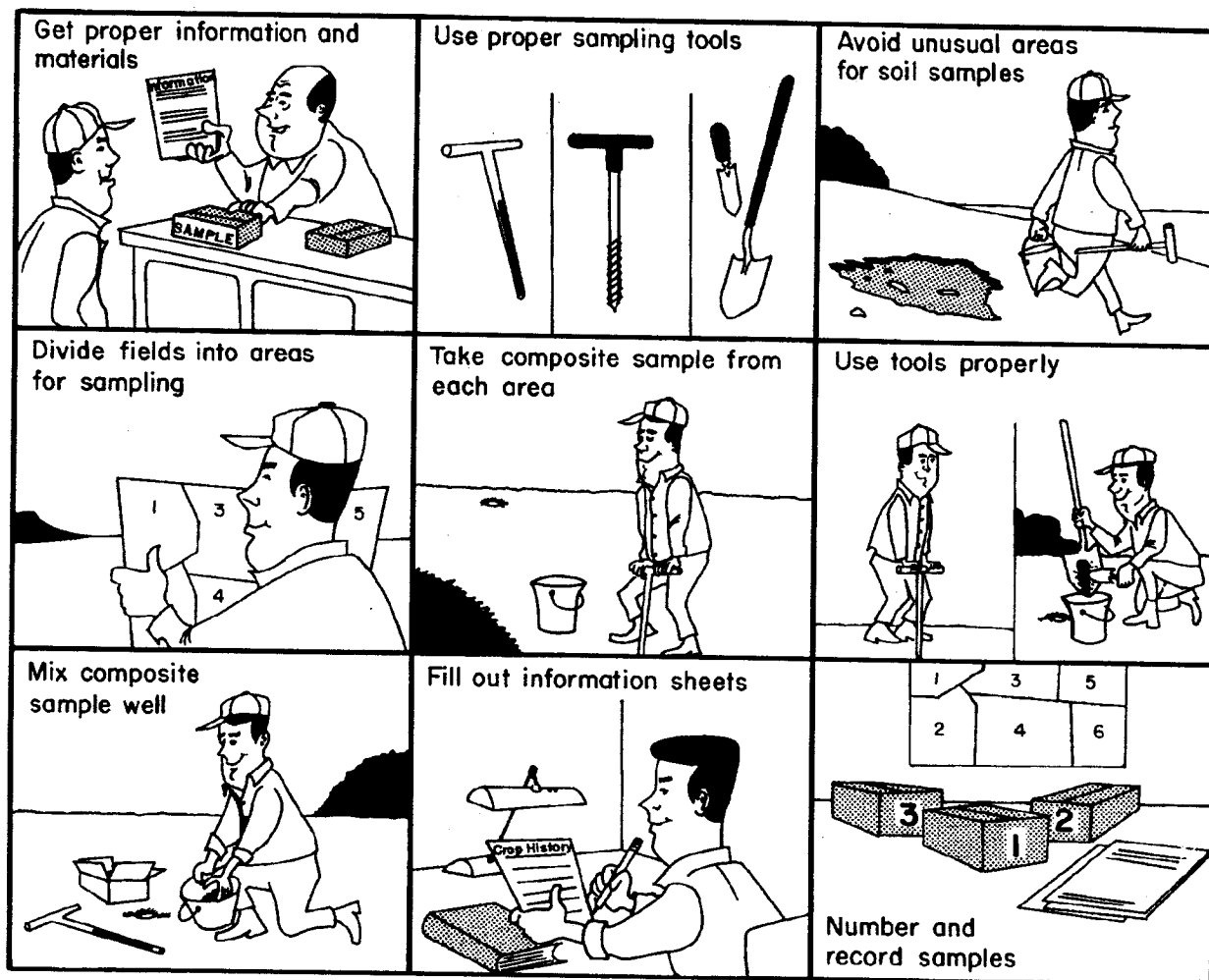


Fig. 1. Follow these steps to obtain a good sample for testing (redrawn courtesy of the National Fertilizer Institute).

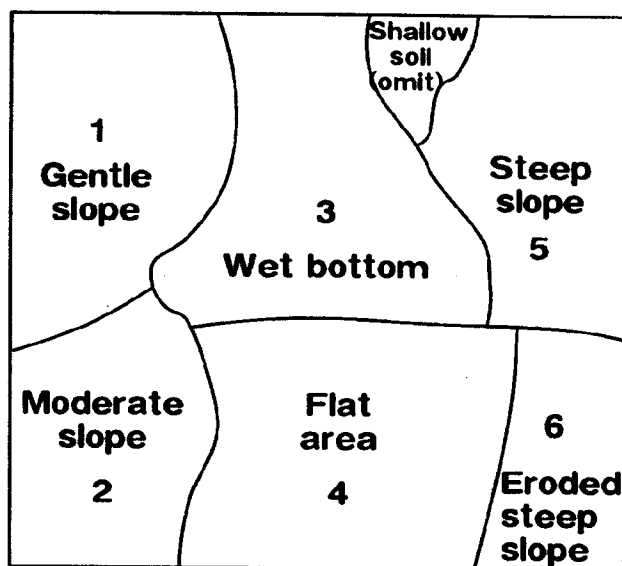


Fig. 2. A field with areas identified as sampling units.

varied topography, subdivide it into relatively uniform sampling units (fig. 2). Sampling subdivision units that are too small to fertilize separately may be of interest, but impractical if you do not treat the small units differently from the rest of the field. Omit these areas from the sampling.

Within each sampling unit take soil samples from several different locations and mix these subsamples into one composite sample. The number of subsamples needed to obtain a representative composite sample depends on the uniformity and size of the sampling unit (table 1). Although the numbers of subsamples in table 1 give the best results, they may be unrealistic if you plan to take a great number of samples. An absolute minimum of 10 subsamples from each sampling unit is necessary to obtain an

acceptable sample. The more subsamples you take, the better the representation of the area sampled.

Take all subsamples randomly from the sampling unit, but be sure to distribute subsample sites throughout the sampling unit. Meander or zig-zag throughout each sampling unit to sample the area. Special considerations are necessary in eroded areas, furrow irrigation, under no-till, and where fertilizer is banded (see "Special Sampling").

The total amount of soil you collect from the sampling unit may be more

Table 2. Effective rooting depth for some common Idaho crops.

Crop	Depth (feet)
Cereals (wheat, barley, oats)	5 to 6
Corn	5 to 6
Alfalfa, rapeseed	4 to 5
Hops, grapes, tree fruits	4 to 5
Sugarbeets	2 to 3
Peas, beans, lentils, onions, potatoes, mint	2
Vegetable seed	1 to 1 1/2

than you need for analyses. Mix the individual subsamples together thoroughly and take the soil sample from the composite mixture. The composite sample should be at least 1 pint—about 1 pound—in size.

Sampling depth

Depth of sampling is critical because tillage and nutrient mobility in the soil can greatly influence nutrient levels in different soil zones (fig. 3). Sampling depth depends on the crop, cultural practices, tillage depth, and the nutrients to be analyzed.

Because the greatest abundance of plant roots, greatest biological activity,

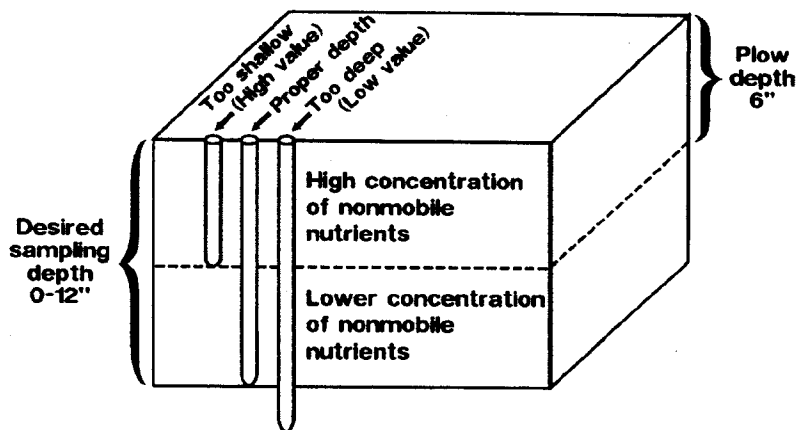


Fig. 3. Too deep or shallow a sampling depth can produce inaccurate soil test results. The plow layer is usually higher in nonmobile nutrients than the soil layers below it.

Table 1. Number of subsamples recommended for a representative composite sample based on field size.

Field size (acres)	Number of subsamples
fewer than 5	15
5 to 10	18
10 to 25	20
25 to 50	25
more than 50	30

and highest nutrient levels occur in the surface layers, the upper 12 inches of soil are used for most analyses. The analyses run on the surface sample include soil reaction (pH), phosphorus (P), potassium (K), organic matter, sulfur (S), boron (B), zinc (Zn), and other micronutrients.

Sampling depth is especially critical for nonmobile nutrients such as P and K. The recommended sampling depth for nonmobile nutrients is 12 inches (fig. 3).

The tillage zone, typically 6 to 8 inches deep, usually contains a relatively uniform, high concentration of nonmobile nutrients. Below the tillage zone the concentration is usually lower. Therefore, a sample from the tillage zone will usually have a higher content of nonmobile

nutrients than a sample from the desired 0- to 12-inch sample depth. This can lead to erroneous results.

Depth sampling

When sampling for mobile nutrients such as nitrogen (N), boron (B), and sulfur (S), take samples by 1-foot increments to the effective rooting depth of the crop (fig. 4). This can be a depth of 5 to 6 feet (table 2) unless the soil has a root-limiting layer such as bedrock or hardpan. For each foot depth, take 10 or more subsamples at random from the sampling unit.

If you plan to sample less than a year after banding or injecting fertilizer or if you have any question about fertilizer placement, use the sampling technique described under "Areas

Where Fertilizer Has Been Banded." Irrigation or precipitation should disperse mobile nutrients over a period of a year.

Sample handling

Soil samples need special handling to ensure accurate results and minimize changes in nutrient levels because of biological activity. Keep moist soil

samples cool at all times during and after sampling. Samples can be frozen or refrigerated for extended periods of time without adverse effects.

If the samples cannot be refrigerated or frozen soon after collection, air dry them or take them directly to the soil testing laboratory. Air dry by spreading the sample in a thin layer on a plastic sheet. Break up all clods or lumps, and spread the soil in a layer about 1/4 inch deep. Dry at room temperature. If a circulating fan is available, position it to move the air over the sample for rapid drying.

Caution: Do not dry where agricultural chemical or fertilizer fumes or dust will come in contact with the samples. Do not use artificial heat in drying. Ask the Extension agricultural educator or fertilizer fieldman in your county for more details concerning special handling of soil samples.

When the soil samples are dry, mix the soil thoroughly, crushing any coarse lumps. Take from the sample about 1 pint (roughly 1 pound) of well-mixed soil and place it in a soil sample bag or other container. Soil sample bags and soil test report forms are available from the Cooperative Extension System office in your county or from a fertilizer fieldman.

Label the bag carefully with your name, the sample number, sample depth, and field number. The field number should correspond with a field or farm map showing the areas

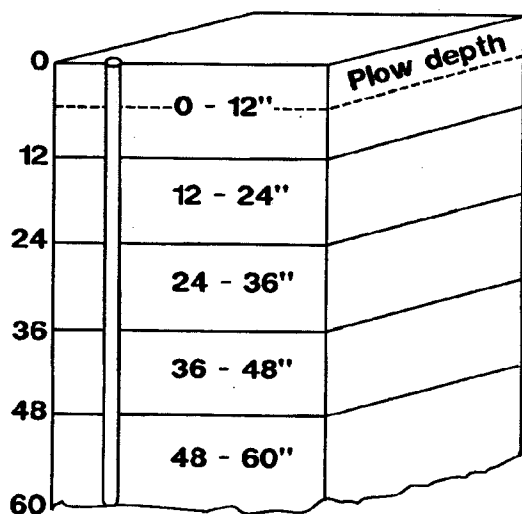


Fig. 4. Depth sampling (successive samples by 12-inch increments) for mobile nutrients (especially N) should be continued to rooting depth, which may be 5 to 6 feet for some crops.

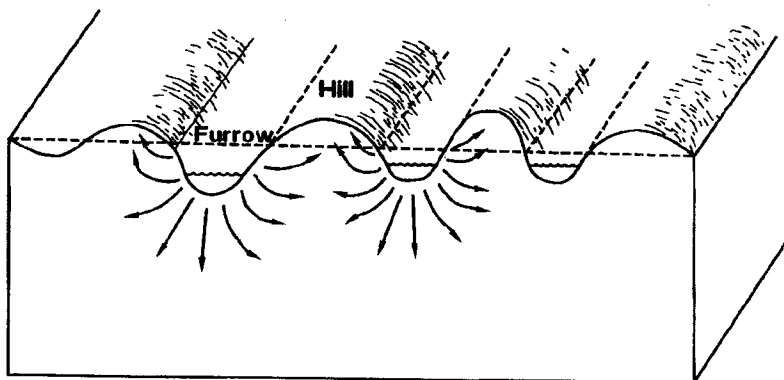


Fig. 5. Movement of mobile nutrients in furrow-irrigated fields.

Furrow-irrigated fields

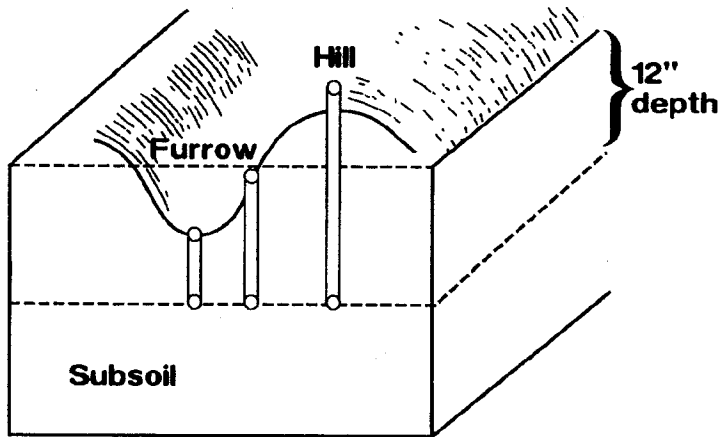


Fig. 6. Special sampling techniques are required when soil sampling furrow-irrigated fields. Take a sample from the hilltop, the furrow bottom, and at the midpoint between the hilltop and furrow bottom. The 12-inch sampling depth is based on the midpoint sampling location.

sampled. This will help you keep an accurate record of soil test reports. Provide information on crop to be grown, yield potential, recent history of crops grown, yields, fertilizer applied, and other information.

Sample analysis

Analyze regularly only for those nutrients that have been shown to be yield limiting in your area or for the crop to be grown. In general, all soils should be analyzed for N, P, K, and S. For determination of potential need for micronutrients, refer to PNW 276, *Current Nutrient Status of Soils in Idaho, Oregon, and Washington*. Occasional analyses for micronutrient concentrations may be advisable.

Special sampling

Special sampling problems occur in fields that have been leveled for irrigation, fields that have lost all or most topsoil as a result of erosion, fields that are surface (furrow)

irrigated, fields that have had a fertilizer band applied, and fields that are not thoroughly tilled.

Land-leveled and eroded areas

Areas that have been eroded or artificially leveled for irrigation usually have little or no original topsoil. The soil surface may be exposed subsoil material. These areas should be sampled separately if they are large enough to be managed differently from where topsoil has not been removed. Subsoil material is usually low in organic matter and can be high in clay, calcium carbonate (lime), or both.

For a representative soil sample, sample furrow-irrigated fields before the furrowing operation. If furrowing has already been completed, follow the special sampling procedures described here.

The movement of water and dissolved plant nutrients can create unique nutrient distribution patterns in the hills between the furrows (fig. 5). To obtain a representative sample, you need to be aware of furrow direction, spacing, and location, and to take closely spaced soil samples perpendicular to the furrow (fig. 6).

Approximately 20 sites (with at least three samples per site) are needed for a representative composite soil sample. At each sampling site, take a sample from the hilltop, from the midpoint between the hilltop and furrow, and from the furrow bottom. The sampling depth at the midpoint between the hilltop and furrow bottom should be 12 inches. The bottom point of this sample should be the same as for the furrow and hilltop samples. Thus, the furrow sampling depth will be less than 12 inches, while the hilltop sampling depth will be more than 12 inches (fig. 6).

Mix the hilltop, midpoint, and furrow samples to make a composite sample for each site. Mix the site samples for a representative composite field soil

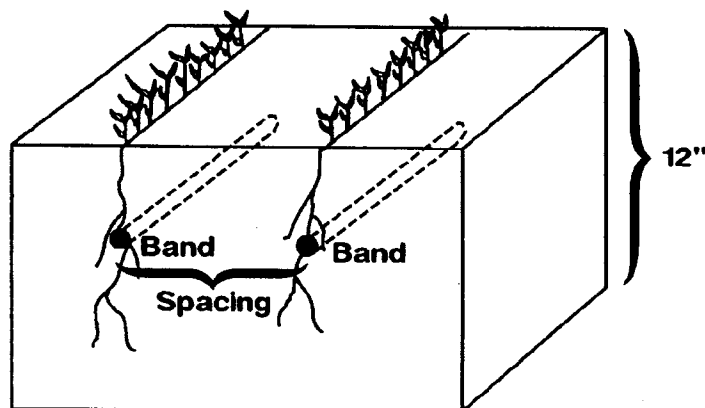


Fig. 7. Diagram of fertilizer location in soil where fertilizer has been banded.

sample to be analyzed for nonmobile nutrients (P, K, and micronutrients). Deeper profile sampling (depth sampling) is recommended for mobile nutrients (N and S).

Areas where fertilizer has been banded

Banding of fertilizers is becoming a more common practice (fig. 7). In fields where fertilizers have been banded and tillage has occurred before soil sampling, regular sampling procedures can be followed. However, if tillage has not adequately mixed the soil, special soil sampling is required. If a field has had a banded fertilizer application the previous growing season and has not been plowed, an ideal sample would be a continuous slice 1 to 2 inches thick and 12 inches deep extending from the center of one band to the center of the next band.

Little research has been conducted to determine the best method of sampling banded fields. Currently three different approaches are used widely. Each method produces a satisfactory representative sample, but the effort required to obtain these samples differs considerably.

Systematic sampling method . If you know the direction, depth, and spacing of the fertilizer band, you can obtain a representative soil sample with this sampling procedure. Take 5 to 10 soil samples perpendicular to the band row beginning in the edge of a fertilizer band and ending at the edge of an adjacent band (fig. 8). Follow this procedure on at least 20 sampling sites in each field or portion of a field being sampled. Mix and composite the soils collected from each site to obtain a representative soil sample.

Controlled sampling method. You also should know the direction, depth, and spacing of the fertilizer bands to obtain a representative soil sample with this method. Take 20 to 30 soil cores from locations scattered throughout the field or portion of the field. Avoid sampling directly in a fertilizer band.

The composite sample should adequately represent the area being sampled. This method may result in slightly lower soil test values of nonmobile nutrients (P, K, and micronutrients) than the systematic and random sampling methods.

Random sampling method . Use this sampling method when the location of the previous season's fertilizer bands is not known. Take 40 to 60 random soil cores to form a composite sample of the area being sampled.

Reduced tillage or no-till fields

You may need special approaches to soil sampling with reduced tillage or no-till fields because the soil has been disturbed so little that fertilizer, whether broadcast on the surface or banded below the surface, is not mixed into the soil. You need to know the history of fertilization, tillage, and other management practices to determine how to obtain a representative sample.

If nonmobile nutrients (P, K, and micronutrients other than B) have been surface broadcast and little or no tillage has been used since their application, remove the surface 1 inch of soil before sampling. Nutrients in the top inch of soil will probably not be available to the growing crop.

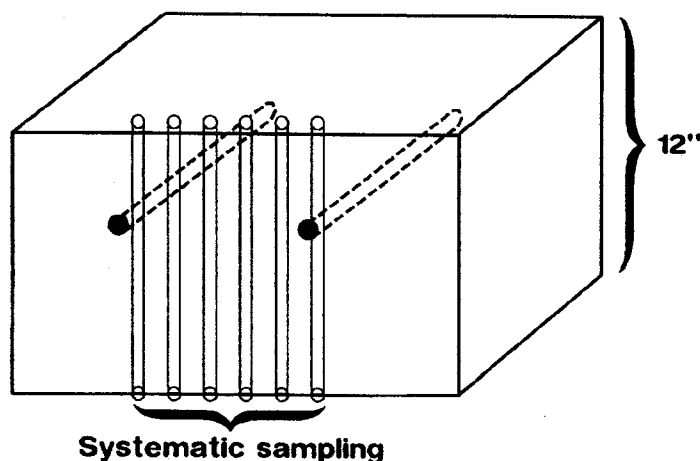


Fig. 8. Systematic soil sampling in a field where fertilizer has been banded (sampling method 1).

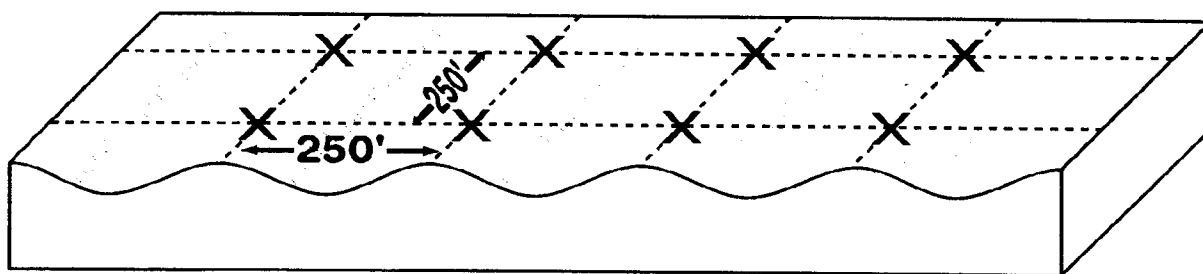


Fig. 9. Grid soil sampling pattern where samples are collected every 250 feet. Note that a complete soil sample is collected at each spot marked with an X.

If fertilizer has been banded with the no-till system, consider methods suggested in "Areas Where Fertilizer Has Been Banded." If a field has been under a continuous no-till system for a long time, determine the pH of the surface foot at 3-inch intervals (0 to 3, 3 to 6, 6 to 9, 9 to 12 inches) every 3 to 5 years. Soil pH will affect the availability of fertilizer nutrients as well as the activity of commonly used herbicides, insecticides, and fungicides.

Grid sampling in nonuniform fields

Many fields are not uniform and vary both horizontally and vertically across landscapes. Traditional soil sampling procedures average nutrient levels in soil subsamples to determine average nutrient levels in the field. The nutrient values obtained are good, but the manager must realize that many of the values in the field are either less than or greater than the values determined. When fields are broken into grids with shorter distances between the sampling points a more precise soil map can be developed to determine nutrient needs.

The technology is now available to combine grid sampling with variable

rate fertilizer application to handle spatial variability within a field. These application techniques make fertilizer nutrient application more precise, resulting in greater nutrient use efficiency and reducing pollution potential.

Irrigated fields including individual pivots should be set up in a 200- to 300-foot grid for potato, sugarbeets, corn, and other potentially high-N-use crops (fig. 9). A wider grid of 400 feet may be used for small grains, beans, and other crops where N management is less intensive or under dryland conditions.

Soil nutrient needs for each segment of the grid are entered into a computer-driven system mounted on specialized commercial fertilizer application equipment. Variable rates of nutrients are then applied based on individual soil samples over the entire field.

A similar system designed for fertilizer applications through pivot sprinklers is being developed by the University of Idaho. This system has the potential to apply variable rates of nutrients and water specifically related to changes across individual fields.

The Soil Conservation Service has a digitized soil survey information system (SSIS), which when combined with the results of grid sampling provides specific information and recommendations for soils and soil types within a field. The SSIS can locate pockets of sandy or coarse-textured soils where leaching is a major concern or areas of finer-textured soils where pockets of residual N may occur. The SSIS also indicates where erosion or surface runoff may be high and where areas should be targeted for federal programs such as the Conservation Reserve Program.

Another computer-mapping technique, Geographic Information Systems (GIS), can be combined with the results of grid sampling to provide growers and land managers with information for land-use planning.

Additional information on proper soil sampling procedures can be obtained from the Extension agricultural educator or fertilizer fieldman in your county.

The authors—Robert L. Mahler, soil scientist, Moscow, and Terry A. Tindall, former Extension soil scientist, Twin Falls Research and Extension Center; both with the University of Idaho Department of Plant, Soil, and Entomological Sciences.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, LeRoy D. Luft, Director of Cooperative Extension System, University of Idaho, Moscow, Idaho 83844. The University of Idaho provides equal opportunity in education and employment on the basis of race, color, religion, national origin, age, gender, disability, or status as a Vietnam-era veteran, as required by state and federal laws.

Facility Information Sheet

Facility	Larry Gulick Dairy	
Operator Information	Larry Gulick	(208) 536-5622
	329 S 300 E	
	Jerome ID 83338	
Legal Description	T9S R17E sect 4	
County	Jerome	
Soil Conservation District	Northside SCD	
Watershed Basin	Upper Snake	
Hydrologic Unit Code #	17040212- 050	
Stream Segment	Cedar Draw to Rock Creek (2374)	
GPS	N42° 40.51' W114° 27.76'	

	Nitrogen (lbs)	% of Total Produced	Phosphorus (lbs)	% of Total Produced	Potassium (lbs)	% of Total Produced
Nutrients Exported	16,521	78%	7,786	78%	29,661	78%
Animal Nutrients Applied	4,707	22%	2,176	22%	8,243	22%
Commercial Nutrients Applied						

Limiting Resource:	Comb GW> 5'	Vulnerability:	Medium
Plan Designed to			Crop Uptake
AU on the facility	406		
Total Acres Available for Nutrients			
Owned by the Facility	57.1		
Animal Equivalent Units per Acre			1.6

Action Required	Compliance Date	Completion Date
Containment Upgrade Required:		
Irrigation Mechanical Upgrade Required:	10/01/01	
Irrigation Management Upgrade Required:		
Water Quality Related Practice Required:		

Certified Planner: _____ Date _____
 Darwin Vander Stelt (# 212)

Operator: _____ Date _____
 Larry Gulick

Producer Summary

Facility Summary

The Larry Gulick Dairy is an existing dairy facility located in Jerome, Idaho at 329 S 300 E, and is operated by Larry Gulick.

The purpose of this nutrient management plan is to inform the producer and others of the value of animal waste and to certify that nutrients are utilized in an appropriate way which will not adversely impact surface or groundwater.

The Larry Gulick Dairy milks 250 Holstein cows and also maintains 40 mature dry cows. The animals are housed in open corrals which are bedded with straw. Manure and straw bedding is scraped and piled in the corrals or in storage areas until it can be hauled away. The dairy owns 57 acres of irrigated cropland. The crop rotation is corn and alfalfa in rotation.

Resource Concerns

The Larry Gulick Dairy is located in the hydrologic unit code 17040212- 050 in the Upper Snake watershed basin, within the Cedar Draw to Rock Creek (2374) stream segment. The Cedar Draw to Rock Creek (2374) stream segment is water quality limited. The pollutants of concern are sediment and temperature. The facility is found at N42° 40.51' W114° 27.76' using GPS co-ordinates.

The default resource concern on the Larry Gulick Dairy is a combination of surface runoff and groundwater quality, though depth to groundwater is greater than 5' on all the property. The dairy uses a center pivot for irrigation of field 1 and for the distribution of effluent on that field, and run-off is unlikely (on field 1) in a normal rainfall year, although, a particular concern is the presence of an irrigation lateral running under the path of the pivot in field 1, and also of a large rock outcrop NW of the center of the pivot. When using the pivot for applying effluent, there is a danger of surface water contamination if effluent is sprayed on the irrigation lateral (running water), and a risk of groundwater contamination if effluent is sprayed on the rock outcrop. Gravity irrigation is used on fields 2,3, and 4, and run-off of tailwater into tributaries of the Snake River are likely. In addition, excessive land applications of animal waste will also elevate soil potassium and salt concentrations which will reduce crop yields.

Facility Site Plan

Waste Storage and Handling Requirements

- Store, handle and mix nutrient products away from wells and other water sources. Keep manure and livestock wastes at least 100 ft away from wells to prevent problems with direct run-in.
- Install hardware and software improvements to the pivot so that effluent may be distributed in field one without contamination of the irrigation lateral or the groundwater via the rock outcrop. This is a requirement of the plan and is to be completed by 10/01/01.

Nutrient Management Plan Requirements

- Liquid wastes will be applied as appropriate to all fields through the irrigation system. Total acreage currently available for land application of liquid wastes is 36 acres. While the plan requires only a total of 12 acres for land disposal of liquid wastes, the availability of additional acreage allows for greater flexibility in meeting the requirements of the crop rotation. Liquid waste should be applied to growing crops, at appropriate times, until the lagoon is empty.
- The lagoon will be emptied during the growing season, starting with the first irrigation and ending with the last irrigation with no effluent application through the winter season, except that effluent may be applied to growing winter crops provided there is no run-off. **Effluent must not be applied to bare ground before 1-Mar without consulting the Idaho Department of Agriculture.**
- Irrigation times should be adjusted so that each field receives uniform coverage with nutrients. The lagoon should never be full in the fall.
- Apply liquid waste at a rate that is consistent with the infiltration rate and available water holding capacity of the soil. Avoid applying liquids at a rate that will bring the soil to its maximum available water holding capacity. This will prevent run-off and groundwater contamination.
- Solid wastes will be applied in the spring or fall, at agronomic rates (after accounting for planned liquid waste applications), to land going into a non-legume crop. Land applied manure will be incorporated through plowing or disking as soon as possible after spreading. **Eighty-two Percent** the solid waste will be exported off of the facility.
- For each field, keep a record of the date, time, and rate of manure or chemical fertilizer applications.
- Manure application rates developed in appendix D are based on **Crop Uptake** and are approximately as follows. This table is only a rough indicator of the application rates and must be adjusted after spring soil samples are available and budgets for each field can be prepared:

Application Schedule Field 2,3,4		Nutrients provided in current year by this application				
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001						
2002						
2003						
2004						
2005	2,3,4		2368	206	91	370
Application Schedule Field 1						
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001	1	100%		73	19	73
2002	1	100%		47	16	64
2003	1	100%		29	12	48
2004	1	100%		29	12	48
2005	1	100%	1737	185	78	313

- Annual Spring soil tests must be taken to ascertain the nitrogen and potassium requirements of each crop.

Facility Testing Requirements

- Regulatory soil samples will be required from each field every three years. These samples must be taken from the 0- 12" zone for surface runoff fields, and from 18-24" for groundwater concern fields. The samples will be reviewed for phosphorus level and compared with previous test data. These tests will indicate compliance with the nutrient management plan and the adequacy of the plan. Regulatory soil testing will be conducted every three years starting in 2001.

Storage and Handling Plan Recommendations

- Weed control along the top and inside surface of the lagoon will help control plugging problems associated with pumping lagoon water through sprinklers.
- Apply liquid wastes during daylight hours so that set times can be adjusted and run-off avoided.

A list of recommended practices relating to the storage and handling of manure is as follows: (from "BEST MANAGEMENT PRACTICES for Nutrient Management in the State Of Idaho")

ODOR CONTROL

- Maintain a distance from the facility to any occupied residence. When considering where to place corrals, lagoon, etc., one should take into consideration the prevailing wind direction and frequency, land topography, number of animal units, the size of structure (i.e. lagoon, etc.), and manure management practices in relationship to nearby residences.
- General housekeeping around the facility, such as gathering feed spillage around feed bunks, proper carcass disposal, and keeping manure accumulation to a minimum will assist in reducing odor.
- Using inoculants (bacteria, etc.) in lagoons can reduce the amount of solid manure in the lagoon and reduce odor.
- Manure storage management - cleaning solids, settling basins, and channels on a regular basis can have a significant effect on odor.

Analysis of Nutrient Management Practices

Facility Description

The Larry Gulick Dairy is an existing dairy facility located in Jerome, Idaho at 329 S 300 E, and is operated by Larry Gulick.

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Waste Storage and Handling

Solid waste and bedding deposited in the corrals are piled and stored in the corrals. Approximately 15% of the total manure produced is deposited in the milking parlor and holding pen. It is estimated that 200 tons of straw are used yearly for bedding purposes. Manure will be transported from the corrals and from the storage basin in spreader trucks and applied to owned or rented cropland.

Manure deposited in the milking parlor flows into a concrete, two cell separation device, and from there into a settling basin. Solids are allowed to settle out and liquids flow by gravity into the lagoons. All runoff is contained in the lagoons or in a run-off containment basin located near the low corner of the large corral (see site plan). Lagoon sizing is based

on owner estimates of water use. It is estimated that 1790 gallons per day are used for cow prep and clean up. The required storage for 180 days is 69,285 cubic feet. **The lagoons and run-off basin together hold a total 202,884 cu. ft.**, which is more than adequate for 180 days storage. The calculations for the required 180-day storage for liquid wastes are found in Appendix C.

Table 1 shows the total quantity of nutrients produced on the facility.

Table 1. Nutrients Produced

Description	Volume cu.ft	N lbs/yr	P lbs/yr	K lbs/yr	Ton@40#/cf) Gallons
Lagoon	95,832	1,087	469	1,744	718,742
Solid Waste	196,662	20,141	9,492	36,161	3,933
Total Nutrients Produced	292,494	21,228	9,962	37,904	
Deduct: Nutrients exported	161,314	16,521	7,786	29,661	
Total Nutrients for Land Application		4,707	2,176	8,243	

See Appendix A

Percentage of N, P, and K to be exported: 78%
 Percentage of solid waste to be exported: 82%

Raw data used to calculate the information illustrated in Table 1 is found in Appendix A. The actual tonnage of material to be applied or exported is dependent upon the degree of decomposition of the solid material, moisture levels and other factors. The producer is required to keep records, both of tonnage applied, and tonnage exported, to verify that an appropriate percentage of solid manure is exported.

A particular concern is the presence of an irrigation lateral running under the path of the pivot in field 1, and also of a large rock outcrop NW of the center of the pivot. When using the pivot for applying effluent, there is a danger of surface water contamination if effluent is sprayed on the irrigation lateral (running water), and a risk of groundwater contamination if effluent is sprayed on the rock outcrop. The owner has agreed to install an electronic switching system on the pivot which will turn off nozzles as they pass over the lateral or the rock outcrop. This is to be completed by 10/01/01.

A list of recommended practices relating to the storage and handling of manure is as follows: (from "BEST MANAGEMENT PRACTICES for Nutrient Management in the State Of Idaho")

ODOR CONTROL

- Maintain a distance from the facility to any occupied residence. When considering where to place corrals, lagoon, etc., one should take into consideration the prevailing wind direction and frequency, land topography, number of animal units, the size of structure (i.e. lagoon, etc.), and manure management practices in relationship to nearby residences.

Table 4. Soil Test Data										
Field	Date	Depth	N	P (ppm)	K	pH	% OM	CEC	Org	Salts
1		18-24								
2		0-12								
3		0-12								
4		0-12								

Table 5 illustrates the nutrients supplied by the liquids and solids when applied at crop uptake rates for phosphorous. It must be understood that the University of Idaho Guidelines make recommendations based on soil test, crop, and expected yield, so that **these average rates of application are not appropriate for any particular field or crop.** They are used to provide a crude indicator of the nutrient balance for this farm.

Table 5. Nutrient Applied to Cropland (using P application rates)			Total Lbs./acre available each year		
			0		0
Rotation 1	Crop	cu.ft./ac	N lb/acre	P lb/acre	K lb/acre
Solids	Field 2,3,4				
Year	Prev nut. credit		60		
1	Corn Silage	2368	206	91	370
2	Corn Silage	0	61	9	35
3	Corn Silage	2368	170	97	392
4	Corn Silage	0	61	9	35
5	Corn Silage	2368	170	97	392
6	Alfalfa Hay		61	9	35
7	Alfalfa Hay		24	6	22
8	Alfalfa Hay				
9	Alfalfa Hay				
Field 1 (L&S)	Prev nut. credit		60		
Yr 1 liquid	Corn Silage	2668			
Yr 1 solid		1737	185	78	313
2 liquid	Corn Silage	2668			
2 solid			70	18	71
3 liquid	Corn Silage	2668			
3 solid		1737	153	83	335
4 liquid	Corn Silage	2668			
4 solid			73	19	73
5 liquid	Corn Silage	2668			
5 solid		1737	153	83	335
6 liquid	Alfalfa Hay	2668			
6 solid			73	19	73
7 liquid	Alfalfa Hay	2637			
7 solid			47	16	64
8 liquid	Alfalfa Hay	2637			
8 solid			29	12	48
9 liquid	Alfalfa Hay	2637			
9 solid			29	12	48

Lagoon 2

No. of Cells	1	
Slope	1	:1
Depth (ft) (add 1' freeboard)	6	
Width of lagoon at top (ft)	270	
Width of lagoon at bottom(ft)	258	
Avg Width		264
Length at top	77	
Length at bottom	65	
Avg. Length		71
Actual Capacity in Cu. Ft.	112,464	

Basin 3 (Run-off)

No. of Cells	1	
Slope	1	:1
Depth (ft) (add 1' freeboard)	6	
Width of lagoon at top (ft)	35	
Width of lagoon at bottom(ft)	23	
Avg Width		29
Length at top	180	
Length at bottom	168	
Avg. Length		174
Actual Capacity in Cu. Ft.	30,276	

Lagoon 4

No. of Cells	0	
Slope	0.5	:1
Depth (ft) (add 1' freeboard)	8	
Width of lagoon at top (ft)	125	
Width of lagoon at bottom(ft)	113	
Avg Width		119
Length at top	84	1/2 base x's height
Length at bottom	72	
Avg. Length		78
Actual Capacity in Cu. Ft.	-	

Total storage 202,884
Reserve 133,599 Cu. Ft

As shown in Table 5, waste application at this level to meet crop phosphorus demands may supply enough nitrogen for this rotation. In general, where manure is applied at phosphorus uptake levels, non-legume crops will need more nitrogen, and legume crops will need more potassium. The application rates suggested in this plan are useful as general guidelines; however, mineralization plays an important role in the availability of nitrogen and potassium. Mineralization is dependent upon temperature, precipitation, nutrient content of the manure, as well as other factors. **Because these factors cannot be managed, mineralization can and will vary considerably from one year to the next. Therefore, due to the mobility and variability in the availability of nitrogen and potassium, a spring soil test is imperative to determine the exact nutrient needs of the crop.** This is especially true when using a nutrient budget approach to optimize nutrient applications.

Mineralization rates used to develop Table 5 are as follows:

General mineralization rates for nitrogen, phosphorus, and potassium for the PNW

Nutrient and location			Percent mineralized (years after application)		
			1st Year	2nd Year	3rd Year
Nitrogen					
West of Cascades			60%	20%	15%
East of Cascades, irrigated			60%	25%	10%
East of Cascades, dryland			45%	20%	15%
Phosphorus					
West of Cascades			76%	10%	6%
East of Cascades			80%	8%	5%
Potassium					
West of Cascades			80%	8%	5%
East of Cascades			85%	8%	5%

Source: How to Calculate Manure Application Rates In the Pacific Northwest, PNW0239, University of Idaho, Oregon State University, or Washington State University

Table 6 shows the total acres that should be utilized to land apply the liquid and solid waste from 406 AU's onto the current cropland rotation:

Table 6. Acres Needed for Land Application

Crop Uptake	
Liquids	12
Solids	249

The Larry Gulick Dairy has 57 acres in cropland rotation, 36 of which are currently available for disposal of liquid wastes. Where fields may receive both liquid and solid waste, care must be taken to leave room in the nutrient budget for future liquid manure applications. While it is possible and acceptable to apply all the phosphorous required for 5 years in the first year, if that is done through the application of solid waste, there will be no place to go with liquid manure in the subsequent years. Manure and liquid waste should be applied according to the following schedule:

Application Schedule Field 2,3,4		Nutrients provided in current year by this application				
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001						
2002						
2003						
2004						
2005	2,3,4		2368	206	91	370
Application Schedule Field 1						
Year	Field	Liquid (%lagoon)	Solids (CF/ac)	N	P	K
2001	1	100%		73	19	73
2002	1	100%		47	16	64
2003	1	100%		29	12	48
2004	1	100%		29	12	48
2005	1	100%	1737	185	78	313

Notice that because the operator farms all the fields the same way, and because alfalfa was planted this year, it is anticipated that no manure will be spread other than liquid until 2005. In 2005, 2007, and 2009, the dairy can use 57% of the total solids available.

In spreading the lagoon water, care should be used to distribute the applications throughout the season. Applications of lagoon water should be alternated with irrigation water or mixed with irrigation water to avoid burning crops.

Hydraulic Balance

Liquid waste may be applied to a growing crop through the irrigation system at any time of the year, **provided there is no run-off**. When applying liquid wastes to bare ground, there is an additional concern that nutrients will be leached into the ground water. Consequently, it is important to determine the date before which application to bare ground poses an unacceptable risk of groundwater contamination. The calculations which develop this date are found in Appendix F. The calculations are summarized in a chart which follows. Assuming that applications will be made in increments of .5 inches, 1-Mar is the earliest date applications may be made.

Amount of application		0.5 inch	
1/2AWHC (in)	2.6		
Semi-monthly precip			
Jerome	inches		Storage available
4/1-4/15	0.43		2.12
3/15-3/30	0.665		1.455
3/1-3/15	0.665		0.79
2/14-2/28	0.63		0.16
2/1-2/14	0.63		-0.47
1/15-1/30	0.73		-1.2
1/1-1/15	0.73		-1.93
First Date to store (inch)		0.5	1-Mar

A list of recommended practices relating to nutrient management and spreading manure is as follows: (from "BEST MANAGEMENT PRACTICES for Nutrient Management in the State of Idaho")

Table 5

ork-up

Nutrients available (summarized in Table 5)										Table 5					work-up				
Factor Used	Solids only	Year	Prev nut. credit	Amount to apply (CF/acre)	N Available each year		Total N available	P Available each year			Total P available	K Available each year							
					N1	N2		N3	P1	P2		P3	K1	K2	K3				
3	1		Corn Silage	2368	60	206	146	61	24	0	91	9	6	0	370	35	22		
0	2		Corn Silage	0		61	0	0	0		9	0	0		35	0	0		
	3		Corn Silage	2368		170	146	61	24		97	91	9	6	392	370	35		
	4		Corn Silage	0		61	0	0	0		9	0	0	0	35	0	0		
	5		Corn Silage	2368		170	146	61	24		97	91	9	6	392	370	35		
	Field 1		Prev nut. credit	0		60	0	0	0		0	0	0	0	0	0	0		
0.343	Yr 1 liquid		Corn Silage	2668		0	18	8	3		0	10	1	1	0	41	4		
2.2	Yr 1 solid			1737		185	107	44	18		78	67	7	4	313	271	26		
0.343	2liquid		Corn Silage	2668		0	18	8	3		0	10	1	1	0	41	4		
0	2 solid			0		70	0	0	0		18	0	0	0	71	0	0		
0.343	3 liquid		Corn Silage	2668		0	18	8	3		0	10	1	1	0	41	4		
	3 solid			1737		153	107	44	18		83	67	7	4	335	271	26		
0.343	4 liquid		Corn Silage	2668		0	18	8	3		0	10	1	1	0	41	4		
	4 solid			0		73	0	0	0		19	0	0	0	73	0	0		
0.343	5 liquid		Corn Silage	2668		0	18	8	3		0	10	1	1	0	41	4		
	5 solid			1737		153	107	44	18		83	67	7	4	335	271	26		
0.343	6 liquid		Alfalfa Hay	2668		0	18	8	3		0	10	1	1	0	41	4		
	6 solid			0		73	0	0	0		19	0	0	0	73	0	0		