

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WASTE UTILIZATION
(ACRE)
CODE 633

DEFINITION

Using agricultural waste or other waste on land in an environmentally acceptable manner while maintaining or improving soil and plant resources.

PURPOSE

To safely use wastes to provide fertility for crop, forage, or fiber production; to improve or maintain soil structure; to prevent erosion; and to safeguard water resources.

CONDITIONS WHERE PRACTICE APPLIES

On soils and vegetation suitable for the use of waste as a fertilizer. This includes animal waste from farm and feedlot, municipal treatment plant, and agricultural processing plants.

CRITERIA

1. The waste utilization plan will include all the animal waste generated on the farm.
2. Animal waste shall not be applied to wetlands or surface water or shall not reach wetlands or surface waters of the state by runoff, drift, manmade conveyances, direct application, or direct discharge during operation or land application. Proper application rate and method shall be used to ensure that these specifications are met.
3. Animal waste shall be applied on land eroding at less than 5 tons per acre per year. Waste may be applied to land that is eroding at 5 or more tons but less than 10 tons per acre per year providing grass filter strips are installed where runoff leaves the field. (See Standard 393-Filter Strips)
4. Animal waste shall not be applied to saturated soils, during rainfall events, or when the surface is frozen. When animal waste is to be applied on areas subject to flooding, it will be soil incorporated on conventionally tilled cropland. When applied to conservation tilled crops or grassland, the waste may be broadcast provided the application does not occur during a season prone to flooding.
5. Waste shall not be applied more than 30 days prior to planting of the crop or forages breaking dormancy. A suitable cover crop should be planted to scavenge nutrients especially on leachable soils. Also on soils with a high potential for leaching, multiple applications at lower rates should be used.
6. Animal waste (other than swine waste from facilities sited on or after October 1, 1995,) shall not be applied closer than 25 feet to perennial waters. (See Standard 393 - Filter Strips).
7. Any new swine facility, sited on or after October 1, 1995, shall comply with N.C.G.S. 106-801 thru 805. These provisions are as follows: The outer perimeter of the land area onto which waste is applied from a lagoon that is a component of a swine farm shall be at least 50 feet from any residential property boundary and from any perennial stream or river other than an irrigation ditch or canal.
8. Animal waste shall not be applied closer than 100 feet to wells.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

9. Animal waste shall not be applied within 200 feet of dwellings other than those owned by the landowner.
10. Waste shall be applied in a manner not to reach other property and public right-of-ways.
11. Animal waste applied on grassed waterways shall be at agronomic rates and in a manner that causes no runoff or drift from the site.
12. The waste utilization plan will contain documentation that the producer has adequate means for disposal of the animal waste generated on the farm. One or a combination of the following will be utilized:
- Producer owns adequate land for the use of wastes at agronomic rates.
 - If the producer does not own adequate land to properly use the waste, the technical specialist will evaluate the location of other land to determine the feasibility and practicability for land application.
- A notarized agreement with land owner(s) will be on file with the waste utilization plan for either:
- agreement for life of facility, or
 - annual or multi-year agreement.
- These agreements shall include tract number(s) and acres where waste may be applied.
See Exhibit B for sample agreement.
- Third party applicators may be used to apply waste on land that the producer does not own, or has agreement to land apply waste on. In this case the producer will obtain a notarized certification from the applicator that waste will be applied in a manner that meets the waste utilization standard. The third party may use an alternative waste utilization system that has been accepted in writing by Division of Environmental Management (DEM). See Exhibit C for sample agreement.
- d) Producer has an alternative waste utilization system accepted in writing by DEM.
13. Apply animal waste at rates that do not exceed the Nitrogen needs for Realistic Yield Expectation (R. Y. E.) for the Crop being grown. See Nutrient Management Standard (590) for criteria on establishing RYE. Actual yields may be used in lieu of realistic yield tables at the discretion of the planner. Regulations in some areas may be more restrictive and require application rates based on nutrients other than nitrogen.
14. Waste shall be tested within 60 days of utilization and soil shall be tested at least annually at crop sites where waste products are applied. Nitrogen shall be the rate-determining element. Zinc and Copper levels in the soils shall be monitored and alternative crop sites shall be used when these metals approach excess levels. The pH shall be adjusted for optimum crop production and maintained. Soil test and waste analysis records shall be kept for five years.
15. Liquid waste shall be applied at rates not to exceed the soil infiltration rate. No ponding shall occur.
16. Highly visible permanent markers shall be installed to mark the top and bottom elevations of the temporary storage (pumping volume) of all waste treatment lagoons. Pumping shall be managed to maintain the liquid level between the markers. A marker will be required to mark the maximum storage volume for waste storage ponds.
17. An irrigation design/plan shall be prepared as part of the waste utilization plan. The design will include the type of equipment, system layout, equipment settings, operating parameters, as well as

- the approximate maximum useable size of field, maximum application rate (in/hr) and maximum application per irrigation cycle. A map will be included that shows the fields and usable acres. See Exhibit D for an example of irrigation design parameters.
18. Records of waste application shall be maintained to establish actual application rates. The record will include date of application, amount of waste applied per acre by tract number and field number, most recent waste analysis and soil test report, and the realistic yield expectation (R.Y.E.) nitrogen rate. See Exhibit E for an acceptable form. Computer spreadsheets are acceptable. Poultry dry waste application records shall be maintained for three (3) years. See Exhibit F for an acceptable form. Waste application records for all other waste shall be maintained for five (5) years.
 19. The waste utilization plan shall include the number of acres that will be required for land application for a 5 year accumulation of sludge in waste treatment lagoons based on current agronomic rates. The sludge shall be analyzed prior to application.
 20. A group of tables showing the plant available nutrients for the most commonly used animal operations are found on pages 633-7 thru 633-107 of this standard. For other types of animals or operations, contact the engineer assigned to provide assistance to your field office. He/she has a complete set of tables.
 21. Land clearing for waste utilization shall be completed before certification. Cover must be established within 30 days of clearing.
 22. Reduce hayland nitrogen rate by 25% on grassland being grazed when applying animal waste. For each ton of hay harvested from a pasture system, the full R. Y. E. hay application rate for nitrogen may be applied.
 23. The Natural Resources Conservation Service (formerly SCS) Agriculture Waste Management Field Handbook (AWMFH) is a reference document that may be used to assist in developing waste management plans.
 24. An Emergency Action Plan is required. This plan shall include provisions for emergency spreading or transfer of waste from all waste storage structures in the system. This plan shall provide for emergency spreading of waste to prevent overtopping or other discharges during periods when soil or crop conditions are not conducive to normal spreading. The Emergency Action Plan shall include but not be limited to the following:
 - a) Contact DEM immediately when potential overtopping or other discharges conditions exists.
 - b) Specify fields on which waste will be applied.
 - c) Specify methods and rates at which waste will be spread.
 - d) Specify minimum buffer areas which may be greater than specified during normal spreading.
 - e) Specify location and manner of waste transfer.

CONSIDERATIONS

1. A waste utilization plan is based on average nutrient content and may vary by as much as plus or minus 20%. To properly implement this plan based on actual waste analysis you may need additional acres or to reduce animal numbers.
2. Evaluation of the soil analysis should consider concentration of elements to assess potential toxicity or whether increased concentrations of one element (such as Phosphorus) have reduced the availability of another element (such as Zinc) to plants.
3. Plant tissue analysis is recommended to evaluate nutrient status and confirm that nitrogen is not excessive.

4. Use a method of spreading that will result in uniform application of material at specified rates. Proper calibration of equipment should be done to assure desired spreading rates.
5. Animal waste should be applied on actively growing crops in such a manner that the crop is not covered with waste to a depth that would inhibit growth. The potential for salt damage from animal waste should be considered also.
6. Odors can be reduced by injecting the waste into soil or disking after waste application. Waste should not be applied when there is danger of drift from the irrigation field.
7. Producers are encouraged to take samples of groundwater and surface water on farms where animal waste is routinely applied. Samples should be analyzed for nutrients and bacteria.
8. Producer should remove hay from the fields within one year to prevent reintroduction of nutrients into the environment.
9. A grazing plan should be developed to encourage controlled frequent rotational grazing, multiple drinking water sites, and strategic harvesting to optimize fecal and urine distribution by grazing animals. These practices will minimize potential pollution from areas around stock camps, shade trees, water tanks, and other heavy use areas.
10. Animal waste can be used in a rotation that includes vegetables and other crops for direct human consumption. However, if animal waste is used on crops for direct human consumption it should only be applied preplant with no further applications of animal waste during the crop season.
11. Properly treated municipal sludge may be applied to agricultural land at agronomic rates in order to use the nutrients for the production of agricultural crops. Before use, all sludge must be analyzed for toxic or hazardous components. The United States Environmental Protection Agency has a comprehensive standard for the use and disposal of sewage sludge (40 CFR Part 503,

printed in the Federal Register 2/19/93). The standards for use and disposal of sewage sludge for the 503 Rule apply only to those residuals or biosolids which are generated from the treatment of domestic sewage. This also includes domestic septage, pumped from septic tanks. Sewage sludge that does not meet the 503 criteria and other residuals from industrial sources must follow the rules established and outlined in the EPA Process Design Manual for Land Application of Municipal Sludge (EPA-625/1-83-016, Oct. 1983).

The State of North Carolina also has a number of regulations and guidelines which must be adhered to in order to protect health and environmental quality. A permit from DEM must be obtained. The permit can be applied for by any party desiring responsibility for the application. Typically, it has been applied for by a sludge generator or landowner that receives the sludge or by a waste management contractor. In addition, a written notarized contract detailing responsibilities of the parties involved is required. A significant amount of supporting information such as an evaluation of soil suitability for application of sludge, site evaluation for sludge application, sludge analysis for heavy metals and nutrients and soil test for nutrients, cation exchange capacity, and the presence of heavy metals in milliequivalents per 100 grams of soil must accompany the permit application.

Many sludges contain heavy metals which may have an adverse effect on crop production and/or the food chain. Table 1 lists criteria from the Environmental Protection Agency's Regulations on Land Application of Sewage Sludge (40 CFR Part 503). The figures set performance standards for metal loading rates. In addition to lifetime loading rates, DEM suggests that not more than 1/20 of the lifetime limit be applied any one (1) year. No material deemed toxic or hazardous is suitable for routine land application. To maintain the long term productivity of North Carolina crop land, heavy metals like copper and zinc should not

than 1/20 of the lifetime limit be applied any one (1) year. No material deemed toxic or hazardous is suitable for routine land application. To maintain the long term productivity of North Carolina crop land, heavy metals like copper and zinc should not accumulate to levels that are toxic to plants. There is a significant deficit in the knowledge base concerning the specific soil index value at which plant toxicity occurs. The phytotoxic level is affected by pH. Peanuts are damaged by Zinc when the index for that nutrient reaches 500 (20 ppm) at a pH of 6.0. For other crops, when soil test values reach the levels in Table 2, then close monitoring of crop growth and plant tissue levels are suggested.

-MORE-

Table 1 EPA Regulations on Land Application of Sewage Sludge:
Metal Loading Rates (503 Regulations)

Metal	Ceiling concentration ¹	Monthly average concentration ²	Maximum cumulative loading rate	Maximum annual loading rate
	mg/kg	mg/kg	kg/ha	kg/ha
Arsenic (As)	75	41	41	2.0
Cadmium (Cd)	85	39	39	1.9
Chromium (Cr)	3000	1200	3000	150
Copper (Cu)	4300	1500	1500	75
Lead (Pb)	840	300	300	15
Mercury (Hg)	57	17	17	0.85
Molybdenum (Mo)	75	18	18	0.90
Nickel (Ni)	420	420	420	21
Selenium (Se)	100	36	100	5.0
Zinc (Zn)	7500	2800	2800	140

¹ All sludges applied to land must have concentrations less than the ceiling concentration.

² Sludges with this concentration or less and which meet Class A vector and pathogen reduction requirements are classified as clean biosolids. Do not require land application site permits.

TABLE 2 Soil Test Values Indicating Potential Phytotoxic Problems¹
Soil Cation Exchange Capacity (meq/100cm³)

Metal	1-5		6-10		11-15		15+	
	lbs/ac	Index	lbs/ac	Index	lbs/ac	Index	lbs/ac	Index
Zinc	50	704	75	1056	125	1761	250	3521
Copper	25	694	45	1250	65	1805	125	34

Any field office receiving a request for assistance involving municipal or industrial sludge should contact a resource specialist at the State Office by following the proper protocol.

¹ North Carolina Department of Agriculture Agronomic Division

PLANS AND SPECIFICATIONS

A written Waste Utilization Plan shall be a part of each waste management system design. Exhibit A is an example of the minimum acceptable Waste Utilization Plan and includes the minimum specifications.

Plans and specifications are to be prepared for specific field sites, based on the standard. Plans and specifications include construction plans, drawings, job sheets, construction specifications, narrative statements, or other similar documents. These documents are to specify the requirements for installing the practice, such as the kind, amount, or quality of materials to be used, or the timing or sequence of installation activities.

OPERATION AND MAINTENANCE

Operation and maintenance requirements shall be part of the waste utilization plan.

Dairy Paved Surface Scraped Manure Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land area needed for agronomic usage of soil incorporated dairy paved surface scraped manure. Values in cells I25-M53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure nutrient analyses are used, then a corresponding change in manure volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I61-163 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure storage capacities, and estimated annual manure volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk	Calf	Heifer	Milk	
	Cow			Cow			
	----per hd cap--			----per hd cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Manure accumulation:	23	67	93	23	67	93	lbs/head/day
Manure density:	62	62	62	62	62	62	lbs/ft ³
Manure storage periods:	91	91	91	91	91	91	days
Manure total nutrient analysis:							
Tot N:	10	10	10	10	10	10	lbs/ton
NH ₃ N:	26	26	26	26	26	26	% tot N or tKN
P ₂ O ₅ :	6.2	6.2	6.2	6.2	6.2	6.2	lbs/ton
K ₂ O:	8.7	8.7	8.7	8.7	8.7	8.7	lbs/ton
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.57	.57	.57	.57	.57	.57	
P ₂ O ₅ :	.75	.75	.75	.75	.75	.75	
K ₂ O:	.75	.75	.75	.75	.75	.75	

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH₃N</td> <td>-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.57 .57 .57</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.25</td> <td>.43 .43 .43</td> <td>.70</td> </tr> </table>	Application method:	NH ₃ N	-----N-----	P&K	soil incorp:	.75	.57 .57 .57	.75	broadcast:	.25	.43 .43 .43	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">%</td> <td style="text-align: center;">x</td> <td style="text-align: center;">20</td> <td style="text-align: center;">= lbs/ton</td> </tr> <tr> <td style="text-align: center;">mg/kg (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.002</td> <td style="text-align: center;">= lbs/ton</td> </tr> </table>	%	x	20	= lbs/ton	mg/kg (ppm)	x	0.002	= lbs/ton
Application method:	NH ₃ N	-----N-----	P&K																		
soil incorp:	.75	.57 .57 .57	.75																		
broadcast:	.25	.43 .43 .43	.70																		
%	x	20	= lbs/ton																		
mg/kg (ppm)	x	0.002	= lbs/ton																		

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 29. DAIRY PAVED SURFACE SCRAPED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Manure Storage Capacity, **	Total Scraped Manure, ***	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients	Plant Available Nutrients	
		init	final	mean						soil incorpora-	
		months	lbs							ft ³ /head capacity	tons/head capacity/year
Calf	0 - 10	100	600	350	34	4.1	N	.57	10	5.6	23
							P205	.75	6.2	4.7	19
							K20	.75	8.7	6.5	27
Heifer	12 - 33	700	1300	1000	97	12	N	.57	10	5.6	68
							P205	.75	6.2	4.7	57
							K20	.75	8.7	6.5	79
Milk cow	36 -	1400	1400	1400	136	17	N	.57	10	5.6	96
							P205	.75	6.2	4.7	80
							K20	.75	8.7	6.5	111

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** 3-month accumulation of manure and bedding with liquid drainage.

*** Manure collected within 2 days.

**** Soil incorporated: surface spread manure plowed or disked into soil within 2 days.

Table 2C. LAND APPLICATION OF DAIRY PAVED SURFACE SCRAPED MANURE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application							
		soil incorporated									soil incorporated							
		lbs/acre/year									lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
	N	8.9	18	27	36	45	54	62	71	.46	.23	.15	.12	.092	.077	.066	.058	
	P205	4.3	8.5	13	17	21	26	30	34	.97	.48	.32	.24	.19	.16	.14	.12	
	K20	7.7	15	23	31	38	46	54	61	.54	.27	.18	.13	.11	.090	.077	.067	
		tons/acre/year									acres/head capacity							
Calf	N	8.9	18	27	36	45	54	62	71	1.4	.68	.45	.34	.27	.23	.19	.17	
	P205	4.3	8.5	13	17	21	26	30	34	2.9	1.4	.95	.71	.57	.48	.41	.36	
	K20	7.7	15	23	31	38	46	54	61	1.6	.79	.53	.40	.32	.26	.23	.20	
Heifer	N	8.9	18	27	36	45	54	62	71	1.9	.96	.64	.48	.38	.32	.27	.24	
	P205	4.3	8.5	13	17	21	26	30	34	4.0	2.0	1.3	1.0	.80	.67	.57	.50	
	K20	7.7	15	23	31	38	46	54	61	2.2	1.1	.74	.56	.44	.37	.32	.28	
Milk cow	N	8.9	18	27	36	45	54	62	71									
	P205	4.3	8.5	13	17	21	26	30	34									
	K20	7.7	15	23	31	38	46	54	61									

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P205 soil immobilization unaccounted for.

Dairy Paved Surface Scraped Manure Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast dairy paved surface scraped manure. Values in cells I25-M53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H53 are typical values which may be used if more specific information is not available. If actual manure nutrient analyses are used, then a corresponding change in manure volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I61-I63 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure storage capacities, and estimated annual manure volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Manure accumulation:	23	67	93	23	67	93	lbs/head/day
Manure density:	62	62	62	62	62	62	lbs/ft ³
Manure storage period:	91	91	91	91	91	91	days
Manure total nutrient analysis:							
Tot N:	10	10	10	10	10	10	lbs/ton
NHSN:	26	26	26	26	26	26	% tot N or tkn
P2O5:	6.2	6.2	6.2	6.2	6.2	6.2	lbs/ton
K2O:	8.7	8.7	8.7	8.7	8.7	8.7	lbs/ton
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.43	.43	.43	.43	.43	.43	
P2O5:	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	

Application method: NHSN -----N----- P&K soil incorp: .75 .57 .57 .57 .75 broadcast: .25 .43 .43 .43 .70	$\frac{\text{mg}}{\text{kg}} (\text{ppm}) \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times 0.002 = \text{lbs/ton}$
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Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 29. DAIRY PAVED SURFACE SCRAPED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Manure Storage Capacity, **	Total Scraped Manure, ***	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients	Plant Availab- Nutrients broadcast	
		init	final	mean						lbs/ head capacity /year	lbs/ ton
		lbs									
Calf	0 - 10	100	600	350	34	4.1	N P2O5 K2O	.43 .70 .70	10 6.2 8.7	4.3 4.4 6.1	18 18 25
Heifer	12 - 33	700	1300	1000	97	12	N P2O5 K2O	.43 .70 .70	10 6.2 8.7	4.3 4.4 6.1	52 53 74
Milk cow	36 -	1400	1400	1400	136	17	N P2O5 K2O	.43 .70 .70	10 6.2 8.7	4.3 4.4 6.1	73 74 104

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture
** 3-month accumulation of manure and bedding with liquid drainage.
*** Manure collected within 2 days.
**** Broadcast: surface spread manure uncovered for 1 month or longer.

Table 2C. LAND APPLICATION OF DAIRY PAVED SURFACE SCRAPED MANURE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application broadcast							
		lbs/acre/year									lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Calf	N	12	23	35	46	58	70	81	93	.36	.18	.12	.089	.071	.059	.051	.04	
	P2O5	4.6	9.1	14	18	23	27	32	37	.90	.45	.30	.23	.18	.15	.13	.1	
	K2O	8.2	16	25	33	41	49	57	66	.50	.25	.17	.13	.10	.084	.072	.06	
Heifer	N	12	23	35	46	58	70	81	93	1.0	.52	.35	.26	.21	.17	.15	.1	
	P2O5	4.6	9.1	14	18	23	27	32	37	2.7	1.3	.89	.67	.55	.44	.38	.3	
	K2O	8.2	16	25	33	41	49	57	66	1.5	.74	.49	.37	.30	.25	.21	.1	
Milk cow	N	12	23	35	46	58	70	81	93	1.5	.73	.49	.37	.29	.24	.21	.1	
	P2O5	4.6	9.1	14	18	23	27	32	37	3.7	1.9	1.2	.93	.74	.62	.55	.4	
	K2O	8.2	16	25	33	41	49	57	66	2.1	1.0	.69	.52	.42	.35	.30	.2	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 19
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Dairy Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected dairy liquid manure slurry. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure storage capacities, and estimated annual manure slurry volumes to be land applied.

	Typical			Actual			
	-----			-----			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lb
final:	600	1300	1400	600	1300	1400	lb
average:	350	1000	1400	350	1000	1400	lb
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Manure slurry volume:							
manure and urine:	3.5	10	14	3.5	10	14	gals/head/day
excess water usage:	1.8	5	7	1.8	5	7	gals/head/day
total:	5.3	15	21	5.3	15	21	gals/head/day
Manure slurry density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Manure storage period:	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:							
Tot N:	23	23	23	23	23	23	lbs/1000 gals
NH3N:	41	41	41	41	41	41	2 tot N or tkn
P2O5:	14	14	14	14	14	14	lbs/1000 gals
K2O:	21	21	21	21	21	21	lbs/1000 gals
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.68	.68	.68	.68	.68	.68	
P2O5:	.80	.80	.80	.80	.80	.80	
K2O:	.80	.80	.80	.80	.80	.80	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: left;">NH3N</th> <th style="text-align: left;">-----N-----</th> <th style="text-align: left;">P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.68 .68 .68</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.60 .60 .60</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.44 .44 .44</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.40 .40 .40</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----	P&K	soil injection:	.95	.68 .68 .68	.80	soil incorp:	.75	.60 .60 .60	.75	broadcast:	.35	.44 .44 .44	.70	irrigation:	.25	.40 .40 .40	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;">2</td> <td style="text-align: left;">x</td> <td style="text-align: left;">83.5</td> <td style="text-align: left;">= lbs/1000 gals</td> </tr> <tr> <td style="text-align: right;">mg/L (ppm)</td> <td style="text-align: left;">x</td> <td style="text-align: left;">.00835</td> <td style="text-align: left;">= lbs/1000 gals</td> </tr> <tr> <td style="text-align: right;">lbs/1000 gals</td> <td style="text-align: left;">x</td> <td style="text-align: left;">27.154</td> <td style="text-align: left;">= lbs/acre-inch</td> </tr> </table>	2	x	83.5	= lbs/1000 gals	mg/L (ppm)	x	.00835	= lbs/1000 gals	lbs/1000 gals	x	27.154	= lbs/acre-inch
Application method:	NH3N	-----N-----	P&K																														
soil injection:	.95	.68 .68 .68	.80																														
soil incorp:	.75	.60 .60 .60	.75																														
broadcast:	.35	.44 .44 .44	.70																														
irrigation:	.25	.40 .40 .40	.70																														
2	x	83.5	= lbs/1000 gals																														
mg/L (ppm)	x	.00835	= lbs/1000 gals																														
lbs/1000 gals	x	27.154	= lbs/acre-inch																														

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 3B. DAIRY LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Manure Storage Capacity, **	Total Manure Slurry, gallons/head capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrient soil inject.	
		init	final	mean						lbs/1000 gals	lbs/head capacity/yea
Calf	0 - 10	100	600	350	129	1876	N	.68	23	15	21
							P2O5	.80	14	11	21
							K2O	.80	21	17	31
Heifer	12 - 33	700	1300	1000	370	5535	N	.68	23	15	81
							P2O5	.80	14	11	61
							K2O	.80	21	17	91
Milk cow	36 -	1400	1400	1400	518	7749	N	.68	23	15	111
							P2O5	.80	14	11	81
							K2O	.80	21	17	131

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** 6 months accumulation of manure, milking center wastewater, storage surface rainfall surplus; does not include fresh water for flushing or lot runoff.

*** Soil injected: manure slurry injected directly into soil and covered immediately.

Table 3C. LAND APPLICATION OF DAIRY LIQUID MANURE SLURRY *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **								Minimum Land Area for Manure Applicatic.								
		soil injected								soil injected								
		lbs/acre/year								lbs/acre/year								
		N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Calf	N	3245	6490	9736	12981	16226	19471	22717	25962	.58	.29	.19	.14	.12	.096	.083	.071	
	P2O5	1789	3578	5367	7155	8944	10733	12522	14311	1.0	.52	.35	.26	.21	.17	.15	.13	
	K2O	2964	5928	8892	11856	14820	17784	20748	23712	.65	.32	.21	.16	.13	.11	.090	.075	
Heifer	N	3245	6490	9736	12981	16226	19471	22717	25962	1.7	.85	.57	.43	.34	.28	.24	.21	
	P2O5	1789	3578	5367	7155	8944	10733	12522	14311	3.1	1.5	1.0	.77	.62	.52	.44	.39	
	K2O	2964	5928	8892	11856	14820	17784	20748	23712	1.9	.93	.62	.47	.37	.31	.27	.23	
Milk cow	N	3245	6490	9736	12981	16226	19471	22717	25962	2.4	1.2	.80	.60	.48	.40	.34	.31	
	P2O5	1789	3578	5367	7155	8944	10733	12522	14311	4.3	2.2	1.4	1.1	.87	.72	.62	.54	
	K2O	2964	5928	8892	11856	14820	17784	20748	23712	2.6	1.3	.87	.65	.52	.44	.37	.33	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Dairy Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage soil incorporated of dairy liquid manure slurry. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure storage capacities, and estimated annual manure slurry volumes to be land applied.

	Typical			Actual			
	-----			-----			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	---per head cap---			---per head cap---			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Manure slurry volume:							
manure and urine:	3.5	10	14	3.5	10	14	gals/head/day
excess water usage:	1.8	5	7	1.8	5	7	gals/head/day
total:	5.3	15	21	5.3	15	21	gals/head/day
Manure slurry density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Manure storage period:	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:							
Tot N:	23	23	23	23	23	23	lbs/1000 gals
NH3N:	41	41	41	41	41	41	% tot N or tKN
P2O5:	14	14	14	14	14	14	lbs/1000 gals
K2O:	21	21	21	21	21	21	lbs/1000 gals
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.60	.60	.60	.60	.60	.60	
P2O5:	.75	.75	.75	.75	.75	.75	
K2O:	.75	.75	.75	.75	.75	.75	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: left;">NH3N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: left;">P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.68</td> <td>.68</td> <td>.68</td> <td>.90</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.60</td> <td>.60</td> <td>.60</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.44</td> <td>.44</td> <td>.44</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.40</td> <td>.40</td> <td>.40</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----			P&K	soil injection:	.95	.68	.68	.68	.90	soil incorp:	.75	.60	.60	.60	.75	broadcast:	.35	.44	.44	.44	.70	irrigation:	.25	.40	.40	.40	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> $\% \times 23.5 = \text{lbs/1000 gals}$ $\text{mg/L (ppm)} \times .00235 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$ </td> </tr> </table>	$\% \times 23.5 = \text{lbs/1000 gals}$ $\text{mg/L (ppm)} \times .00235 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$
Application method:	NH3N	-----N-----			P&K																											
soil injection:	.95	.68	.68	.68	.90																											
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Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 38. DAIRY LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Manure Storage Capacity, **	Total Manure Slurry, gallons/head capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrient soil incorpora.	
		init	final	mean						lbs/1000 gals	lbs/head capacity/year
		months								lbs	
Calf	0 - 10	100	600	350	129	1876	N	.60	23	14	21
							P205	.75	14	10	21
							K20	.75	21	16	31
Heifer	12 - 33	700	1300	1000	370	5535	N	.60	23	14	71
							P205	.75	14	10	51
							K20	.75	21	16	81
Milk cow	36 -	1400	1400	1400	518	7749	N	.60	23	14	101
							P205	.75	14	10	81
							K20	.75	21	16	121

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** 6 months accumulation of manure, milking center wastewater, storage surface rainfall surplus; does not include fresh water for flushing or lot runoff.
 *** Soil incorporated: surface spread manure plowed or disked into soil within 2 days.

Table 3C. LAND APPLICATION OF DAIRY LIQUID MANURE SLURRY *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **								Minimum Land Area for Manure Application								
		soil incorporated								soil incorporated								
		lbs/acre/year								lbs/acre/year								
Calf	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
			K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350
Heifer	N	3687	7374	11061	14749	18436	22123	25810	29497	.51	.25	.17	.13	.10	.085	.073	.064	
		P205	1908	3816	5724	7632	9541	11449	13357	15265	.98	.49	.33	.25	.20	.16	.14	.12
			K20	3162	6323	9485	12647	15808	18970	22132	25293	.59	.30	.20	.15	.12	.099	.085
Milk cow	N	3687	7374	11061	14749	18436	22123	25810	29497	1.5	.75	.50	.38	.30	.25	.21	.18	
		P205	1908	3816	5724	7632	9541	11449	13357	15265	2.9	1.5	.97	.73	.58	.43	.31	.24
			K20	3162	6323	9485	12647	15808	18970	22132	25293	1.8	.88	.58	.44	.35	.29	.25

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 199
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Dairy Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast dairy liquid manure slurry. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure storage capacities, and estimated annual manure slurry volumes to be land applied.

	Typical			Actual			
	-----			-----			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	---per head cap---			---per head cap---			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Manure slurry volume:							
manure and urine:	3.5	10	14	3.5	10	14	gals/head/day
excess water usage:	1.8	5	7	1.8	5	7	gals/head/day
total:	5.3	15	21	5.3	15	21	gals/head/day
Manure slurry density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Manure storage period:	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:							
Tot N:	23	23	23	23	23	23	lbs/1000 gals
NH3N:	41	41	41	41	41	41	% tot N or tKN
P2O5:	14	14	14	14	14	14	lbs/1000 gals
K2O:	21	21	21	21	21	21	lbs/1000 gals
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.44	.44	.44	.44	.44	.44	
P2O5:	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	

Application method:	NH3N	-----N-----			P&K
soil injection:	.95	.68	.68	.68	.80
soil incorp:	.75	.60	.60	.60	.75
broadcast:	.35	.44	.44	.44	.70
irrigation:	.25	.40	.40	.40	.70

$\% \cdot x \ 25.5 = \text{lbs/1000 gals}$
$\text{mg/L (ppm)} \times .00235 = \text{lbs/1000 gals}$
$\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 3B. DAIRY LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Manure Storage Capacity, **	Total Manure Slurry,	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients	Plant Available Nutrients broadcast	
		init	final	mean						lbs/1000 gals	lbs/heac capacity/year
	months	-----lbs-----			ft ³ /head capacity	gallons/head capacity/year			lbs/1000 gals	lbs/1000 gals	
Calf	0 - 10	100	600	350	129	1876	N	.44	23	10	19
							P205	.70	14	10	18
							K20	.70	21	15	28
Heifer	12 - 33	700	1300	1000	370	5535	N	.44	23	10	55
							P205	.70	14	10	54
							K20	.70	21	15	82
Milk cow	36 -	1400	1400	1400	518	7749	N	.44	23	10	76
							P205	.70	14	10	76
							K20	.70	21	15	114

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** 6 months accumulation of manure, milking center wastewater, storage surface rainfall surplus; does not include fresh water for flushing or lot runoff.
 *** Broadcast: surface spread manure uncovered for 1 month or longer.

Table 3C. LAND APPLICATION OF DAIRY LIQUID MANURE SLURRY *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application							
		-----broadcast-----									-----broadcast-----							
		-----lbs/acre/year-----									-----lbs/acre/year-----							
		50	100	150	200	250	300	350	400		50	100	150	200	250	300	350	400
Calf	N	5067	10134	15201	20268	25336	30403	35470	40537	.37	.19	.12	.093	.074	.062	.055	.04	
	P205	2044	4089	6133	8178	10222	12266	14311	16355	.92	.46	.31	.23	.18	.15	.13	.1	
	K20	3387	6775	10162	13550	16937	20325	23712	27100	.55	.28	.18	.14	.11	.092	.079	.06	
Heifer	N	5067	10134	15201	20268	25336	30403	35470	40537	1.1	.55	.36	.27	.22	.18	.16	.1	
	P205	2044	4089	6133	8178	10222	12266	14311	16355	2.7	1.4	.90	.68	.54	.45	.39	.3	
	K20	3387	6775	10162	13550	16937	20325	23712	27100	1.6	.82	.54	.41	.33	.27	.23	.2	
Milk cow	N	5067	10134	15201	20268	25336	30403	35470	40537	1.5	.76	.51	.38	.31	.25	.22	.1	
	P205	2044	4089	6133	8178	10222	12266	14311	16355	3.8	1.9	1.3	.95	.76	.63	.54	.4	
	K20	3387	6775	10162	13550	16937	20325	23712	27100	2.3	1.1	.76	.57	.46	.38	.33	.2	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Dairy Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated dairy liquid manure slurry. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure storage capacities, and estimated annual manure slurry volumes to be land applied.

	Typical			Actual			
	-----			-----			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	---per head cap---			---per head cap---			
Animal live weights: initial:	100	700	1400	100	700	1400	lbs
	600	1300	1400	600	1300	1400	lbs
	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Manure slurry volume:							
manure and urine:	3.5	10	14	3.5	10	14	gals/head/day
excess water usage:	1.8	5	7	1.8	5	7	gals/head/day
total:	5.3	15	21	5.3	15	21	gals/head/day
Manure slurry density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Manure storage period:	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:							
Tot N:	611	611	611	611	611	611	lbs/acre-inch
NH3N:	41	41	41	41	41	41	% tot N or tkn
P2O5:	379	379	379	379	379	379	lbs/acre-inch
K2O:	573	573	573	573	573	573	lbs/acre-inch
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.40	.40	.40	.40	.40	.40	
P2O5:	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: left;">NH3N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: left;">P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.68</td> <td>.68</td> <td>.68</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.60</td> <td>.60</td> <td>.60</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.44</td> <td>.44</td> <td>.44</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.40</td> <td>.40</td> <td>.40</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----			P&K	soil injection:	.95	.68	.68	.68	.80	soil incorp:	.75	.60	.60	.60	.75	broadcast:	.35	.44	.44	.44	.70	irrigation:	.25	.40	.40	.40	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> $\text{mg/L (ppm)} \times .00255 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$ </td> </tr> </table>	$\text{mg/L (ppm)} \times .00255 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$
Application method:	NH3N	-----N-----			P&K																											
soil injection:	.95	.68	.68	.68	.80																											
soil incorp:	.75	.60	.60	.60	.75																											
broadcast:	.35	.44	.44	.44	.70																											
irrigation:	.25	.40	.40	.40	.70																											
$\text{mg/L (ppm)} \times .00255 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$																																

Crop fertilization rates: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Dairy Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected dairy anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk	Calf	Heifer	Milk	
	Cow			Cow			
	---per hd cap---			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lb
final:	600	1300	1400	600	1300	1400	lb
average:	350	1000	1400	350	1000	1400	lb
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon liquid accumulation :							
manure and urine:	3.9	11	16	3.9	11	16	gals/animal/day
excess water usage:	1.4	4	6	1.4	4	6	gals/animal/day
Lagoon surface rain surplus:	1.1	3	4	1.1	3	4	gals/animal/day
total:	6.4	18	26	6.4	18	26	gals/animal/day
Lagoon liquid total nutrient analysis:							
Tot N:	5.0	5.0	5.0	5.0	5.0	5.0	lb/1000 gals
NH3N:	64	64	64	64	64	64	% tot N or ttn
P205:	2.3	2.3	2.3	2.3	2.3	2.3	lb/1000 gals
K2O:	7.2	7.2	7.2	7.2	7.2	7.2	lb/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.79	.79	.79	.79	.79	.79	
P205:	.80	.80	.80	.80	.80	.80	
K2O:	.80	.80	.80	.80	.80	.80	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: center;">NH3N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: center;">PEK</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td style="text-align: center;">.95</td> <td style="text-align: center;">.79</td> <td style="text-align: center;">.79</td> <td style="text-align: center;">.79</td> <td style="text-align: center;">.80</td> </tr> <tr> <td>soil incorp:</td> <td style="text-align: center;">.85</td> <td style="text-align: center;">.73</td> <td style="text-align: center;">.73</td> <td style="text-align: center;">.73</td> <td style="text-align: center;">.75</td> </tr> <tr> <td>broadcast:</td> <td style="text-align: center;">.45</td> <td style="text-align: center;">.47</td> <td style="text-align: center;">.47</td> <td style="text-align: center;">.47</td> <td style="text-align: center;">.70</td> </tr> <tr> <td>irrigation:</td> <td style="text-align: center;">.50</td> <td style="text-align: center;">.50</td> <td style="text-align: center;">.50</td> <td style="text-align: center;">.50</td> <td style="text-align: center;">.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----			PEK	soil injection:	.95	.79	.79	.79	.80	soil incorp:	.85	.73	.73	.73	.75	broadcast:	.45	.47	.47	.47	.70	irrigation:	.50	.50	.50	.50	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">=</td> <td style="text-align: center;">x</td> <td style="text-align: center;">2266</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.2266</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> <tr> <td style="text-align: center;">lb/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> </table>	=	x	2266	=	lbs/acre-inch	mg/L (ppm)	x	0.2266	=	lbs/acre-inch	lb/1000 gals	x	27.154	=	lbs/acre-inch
Application method:	NH3N	-----N-----			PEK																																									
soil injection:	.95	.79	.79	.79	.80																																									
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mg/L (ppm)	x	0.2266	=	lbs/acre-inch																																										
lb/1000 gals	x	27.154	=	lbs/acre-inch																																										

Top fertilization rate: N:	50	lbs/ac/yr
P205:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 4B. DAIRY ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity			Total Lagoon Liquid Surplus, ** per head capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients soil injected	
		init	final	mean	single stage	2-stage 1st + 2nd	acre-inch gals	soil injected ***	lbs/1000 gals				lbs/1000 gals	lbs/head capacity/year
		months	lbs	lbs	lbs	gals	gals	gals	gals				gals	gals
Calf	0 - 10	100	600	350	525	394	131	2270	.084	N	.79	5.0	4.0	9.0
										P2O5	.80	2.8	2.3	5.1
										K2O	.80	7.2	5.8	13
Heifer	12 - 33	700	1300	1000	1500	1110	390	6662	.25	N	.79	5.0	4.0	27
										P2O5	.80	2.8	2.3	15
										K2O	.80	7.2	5.8	38
Milk cow	36 -	1400	1400	1400	2100	1407	696	9327	.34	N	.79	5.0	4.0	37
										P2O5	.80	2.8	2.3	21
										K2O	.80	7.2	5.8	54

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.
 *** Soil injected: lagoon liquid injected directly into soil and covered immediately.

Table 4C. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **								Minimum Land Area for Liquid Application soil injected															
		soil injected								soil injected															
		lbs/acre/year								lbs/acre/year															
		gallons/acre/year								acres/head capacity															
Calf	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	.18	.090	.060	.045	.036	.030	.026	.022
	P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	.26	.13	.085	.064	.051	.043	.037	.032
	K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	.26	.13	.087	.065	.052	.044	.037	.032
Heifer	N	12561	25123	37684	50246	62807	75369	87930	1.0e5	.55	.27	.18	.13	.11	.088	.076	.064	.75	.38	.25	.19	.15	.13	.11	.094
	P2O5	8859	17717	26576	35435	44294	53152	62011	70870	.77	.38	.26	.19	.15	.13	.11	.094	.75	.38	.25	.19	.15	.13	.11	.094
	K2O	8691	17382	26073	34764	43455	52146	60837	69528	.77	.38	.26	.19	.15	.13	.11	.094	.77	.38	.26	.19	.15	.13	.11	.094
Milk cow	N	12561	25123	37684	50246	62807	75369	87930	1.0e5	.74	.37	.25	.19	.15	.12	.11	.094	1.1	.53	.35	.26	.21	.18	.15	.12
	P2O5	8859	17717	26576	35435	44294	53152	62011	70870	1.1	.54	.36	.27	.21	.18	.15	.12	1.1	.54	.36	.27	.21	.18	.15	.12
	K2O	8691	17382	26073	34764	43455	52146	60837	69528	1.1	.54	.36	.27	.21	.18	.15	.12	1.1	.54	.36	.27	.21	.18	.15	.12

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Dairy Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated dairy anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon liquid accumulation :							
manure and urine:	3.9	11	16	3.9	11	16	gals/animal/day
excess water usage:	1.4	4	6	1.4	4	6	gals/animal/day
lagoon surface rain surplus:	1.1	3	4	1.1	3	4	gals/animal/day
total:	6.4	18	26	6.4	18	26	gals/animal/day
Lagoon liquid total nutrient analysis:							
Tot N:	5.0	5.0	5.0	5.0	5.0	5.0	lbs/1000 gals
NH ₃ N:	64	64	64	64	64	64	mg tot N or tbn
P ₂ O ₅ :	2.8	2.8	2.8	2.8	2.8	2.8	lbs/1000 gals
K ₂ O:	7.2	7.2	7.2	7.2	7.2	7.2	lbs/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.75	.75	.75	.75	.75	.75	
P ₂ O ₅ :	.75	.75	.75	.75	.75	.75	
K ₂ O:	.75	.75	.75	.75	.75	.75	

Application method:	NH ₃ N	-----N-----			P&K
soil injection:	.95	.79	.79	.79	.80
soil incorp:	.85	.75	.75	.75	.75
broadcast:	.45	.47	.47	.47	.70
irrigation:	.50	.50	.50	.50	.70

$\text{mg/L (ppm)} \times 2.266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 48. DAIRY ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity			Total Lagoon Liquid Surplus, ** per head capacity/yr	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Avail soil incorpor.		lbs./hect capacity/year
		init	final	mean	single stage	2-stage 1st + 2nd	acre-inch					soil incorporated ***	lbs/1000 gals	
		months	lbs		stage	1st + 2nd	gals					inch	gals	
Calf	0 - 10	100	600	350	525	394	131	2270	.084	N	.73	5.0	3.7	8.3
										P205	.75	2.8	2.1	4.8
										K20	.75	7.2	5.4	12
Heifer	12 - 33	700	1300	1000	1500	1110	390	6662	.25	N	.73	5.0	3.7	21
										P205	.75	2.8	2.1	14
										K20	.75	7.2	5.4	30
Milk cow	36 -	1400	1400	1400	2100	1407	696	9327	.34	N	.73	5.0	3.7	34
										P205	.75	2.8	2.1	20
										K20	.75	7.2	5.4	50

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.

*** Soil incorporated: surface spread lagoon liquid plowed or disked into soil within 2 days.

Table 4C. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **								Minimum Land Area for Liquid Application															
		soil incorporated								soil incorporated															
		lbs/acre/year								lbs/acre/year															
		gallons/acre/year								acres/head capacity															
Calf	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	.17	.083	.055	.041	.033	.028	.024	.021
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	.24	.12	.080	.060	.048	.040	.034	.030
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	.24	.12	.082	.061	.049	.041	.035	.031
Heifer	N	13676	27353	41029	54705	68382	82058	95734	1.1e5	.49	.24	.16	.12	.097	.081	.070	.061	.71	.35	.24	.18	.14	.12	.10	.081
	P205	9449	18899	28348	37797	47247	56696	66145	75595	.72	.36	.24	.18	.14	.12	.10	.091	.72	.36	.24	.18	.14	.12	.10	.091
	K20	9270	18541	27811	37082	46352	55622	64893	74163	.68	.34	.23	.17	.14	.11	.097	.081	.99	.49	.33	.25	.20	.16	.14	.11
Milk cow	N	13676	27353	41029	54705	68382	82058	95734	1.1e5	.68	.34	.23	.17	.14	.11	.097	.081	1.0	.50	.34	.25	.20	.17	.14	.11
	P205	9449	18899	28348	37797	47247	56696	66145	75595	.99	.49	.33	.25	.20	.16	.14	.11	1.0	.50	.34	.25	.20	.17	.14	.11
	K20	9270	18541	27811	37082	46352	55622	64893	74163	1.0	.50	.34	.25	.20	.17	.14	.11	1.0	.50	.34	.25	.20	.17	.14	.11

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Dairy Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast dairy anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon liquid accumulations:							
manure and urine:	3.9	11	16	3.9	11	16	gals/animal/day
excess water usage:	1.4	4	6	1.4	4	6	gals/animal/day
Lagoon surface rain surplus:	1.1	3	4	1.1	3	4	gals/animal/day
total:	6.4	18	26	6.4	18	26	gals/animal/day
Lagoon liquid total nutrient analysis:							
Tot N:	5.0	5.0	5.0	5.0	5.0	5.0	lbs/1000 gals
NH3N:	64	64	64	64	64	64	% tot N or tbn
P2O5:	2.8	2.8	2.8	2.8	2.8	2.8	lbs/1000 gals
K2O:	7.2	7.2	7.2	7.2	7.2	7.2	lbs/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.47	.47	.47	.47	.47	.47	
P2O5:	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	

Application method:	NH3N	-----N-----	P&K
soil injection:	.95	.79	.79
soil incorp:	.85	.75	.75
broadcast:	.45	.47	.47
irrigation:	.50	.50	.50

=	x	2266	=	lbs/acre-inch
mg/L (ppm)	x	0.2266	=	lbs/acre-inch
lbs/1000 gals	x	27.154	=	lbs/acre-inch

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 4a. DAIRY ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity			Total Lagoon Liquid Surplus, **		Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients: broadcast		
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals	inch	lbs/1000 gals				lbs/1000 gals	lbs/hear capacity/year	
		months	-lbs-		stage	1st + 2nd	gals	inch	***				gals	gals	gals
Calf	0 - 10	100	600	350	525	394	131	2270	.084	N	.47	5.0	2.4	5.4	
										P2O5	.70	2.3	2.0	4.5	
										K2O	.70	7.2	5.0	1*	
Heifer	12 - 33	700	1500	1000	1500	1110	390	6662	.25	N	.47	5.0	2.4	1*	
										P2O5	.70	2.3	2.0	1*	
										K2O	.70	7.2	5.0	3*	
Milk cow	36 -	1400	1400	1400	2100	1407	696	9327	.34	N	.47	5.0	2.4	2*	
										P2O5	.70	2.3	2.0	1*	
										K2O	.70	7.2	5.0	4*	

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture
** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.
*** Broadcast: surface spread liquid uncovered for 1 month or longer.

Table 4c. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **									Minimum Land Area for Liquid Application							
		broadcast									broadcast							
		lbs/acre/year									lbs/acre/year							
Calf	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
	P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
	K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Heifer	N	21204	42408	63613	84817	1.1e5	1.3e5	1.5e5	1.7e5	.11	.054	.036	.027	.021	.018	.015	.013	
	P2O5	10124	20249	30373	40497	50621	60746	70870	80994	.22	.11	.075	.056	.045	.037	.032	.028	
	K2O	9933	19865	29798	39730	49663	59595	69528	79461	.23	.11	.076	.057	.046	.038	.033	.029	
Milk cow	N	21204	42408	63613	84817	1.1e5	1.3e5	1.5e5	1.7e5	.31	.16	.10	.079	.063	.052	.045	.039	
	P2O5	10124	20249	30373	40497	50621	60746	70870	80994	.66	.33	.22	.16	.13	.11	.094	.082	
	K2O	9933	19865	29798	39730	49663	59595	69528	79461	.67	.34	.22	.17	.13	.11	.096	.084	
Milk cow	N	21204	42408	63613	84817	1.1e5	1.3e5	1.5e5	1.7e5	.44	.22	.15	.11	.088	.073	.063	.055	
	P2O5	10124	20249	30373	40497	50621	60746	70870	80994	.92	.46	.31	.23	.18	.15	.13	.11	
	K2O	9933	19865	29798	39730	49663	59595	69528	79461	.94	.47	.31	.23	.19	.16	.13	.11	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 199
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Dairy Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated dairy anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon liquid accumulation :							
manure and urine:	3.9	11	16	3.9	11	16	gals/animal/day
excess water usage:	1.4	4	6	1.4	4	6	gals/animal/day
lagoon surface rain surplus:	1.1	3	4	1.1	3	4	gals/animal/day
total:	6.4	18	26	6.4	18	26	gals/animal/day
Lagoon liquid total nutrient analysis:							
Tot N:	137	137	137	137	137	137	lbs/acre-inch
NH ₃ N:	64	64	64	64	64	64	% tot N or tkn
P ₂ O ₅ :	77	77	77	77	77	77	lbs/acre-inch
K ₂ O:	195	195	195	195	195	195	lbs/acre-inch
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.50	.50	.50	.50	.50	.50	
P ₂ O ₅ :	.70	.70	.70	.70	.70	.70	
K ₂ O:	.70	.70	.70	.70	.70	.70	

Application method:	NH ₃ N	-----N-----			P&K
soil injection:	.95	.79	.79	.79	.80
soil incorp:	.85	.73	.73	.73	.75
broadcast:	.45	.47	.47	.47	.70
irrigation:	.50	.50	.50	.50	.70

$\text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch}$
 $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Table 48. DAIRY ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity			Total Lagoon Liquid Surplus, per head capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients lbs/acre-inch	Plant Available Nutrient irrigated	
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals	inch	irrigated ***		lbs/acre-inch	lbs/acre-inch		head capacity/yr	
		months			lbs										
Calf	0 - 10	100	600	350	525	394	131	2270	.084	N	.50	137	68	5.1	
										P2O5	.70		77	54	4.1
										K2O	.70		195	137	1
Heifer	12 - 33	700	1300	1000	1500	1110	390	6662	.25	N	.50	137	68	1	
										P2O5	.70		77	54	1
										K2O	.70		195	137	3
Milk cow	36 -	1400	1400	1400	2100	1407	696	9327	.34	N	.50	137	68	2	
										P2O5	.70		77	54	11
										K2O	.70		195	137	4

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.

*** Irrigated: sprinkler irrigated liquid uncovered for 1 month or longer.

Table 4C. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON LIQUID **

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **									Minimum Land Area for Liquid Application irrigated							
		lbs/acre/year									lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Calf	N	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.8	.11	.057	.038	.029	.023	.019	.016	.014	
	P2O5	.37	.75	1.1	1.5	1.9	2.2	2.6	3.0	.22	.11	.075	.056	.045	.037	.032	.021	
	K2O	.37	.73	1.1	1.5	1.8	2.2	2.6	2.9	.23	.11	.076	.057	.046	.038	.033	.029	
Heifer	N	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.8	.34	.17	.11	.084	.067	.056	.048	.041	
	P2O5	.37	.75	1.1	1.5	1.9	2.2	2.6	3.0	.66	.33	.22	.16	.13	.11	.094	.081	
	K2O	.37	.73	1.1	1.5	1.8	2.2	2.6	2.9	.67	.34	.22	.17	.13	.11	.096	.081	
Milk cow	N	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.8	.47	.24	.16	.12	.094	.078	.067	.059	
	P2O5	.37	.75	1.1	1.5	1.9	2.2	2.6	3.0	.92	.46	.31	.23	.18	.15	.13	.11	
	K2O	.37	.73	1.1	1.5	1.8	2.2	2.6	2.9	.94	.47	.31	.23	.19	.16	.13	.11	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 199

** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Dairy Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected dairy anaerobic lagoon sludge. Values in cells D25-K54 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F54 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I64-I66 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual			
	Calf Heifer Milk Cow --per head cap--			Calf Heifer Milk Cow --per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon sludge accumulation:	1.3	3.8	5.3	1.3	3.8	5.3	gals/animal/day
Lagoon sludge density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Lagoon liquid total nutrient analysis:							
Tot N:	15	15	15	15	15	15	lbs/1000 gals
NH ₃ N:	41	41	41	41	41	41	% tot N or tdn
P ₂ O ₅ :	22	22	22	22	22	22	lbs/1000 gals
K ₂ O:	7.9	7.9	7.9	7.9	7.9	7.9	lbs/1000 gals
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.68	.68	.68	.68	.68	.68	
P ₂ O ₅ :	.80	.80	.80	.80	.80	.80	
K ₂ O:	.80	.80	.80	.80	.80	.80	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Application method:</th> <th>NH₃N</th> <th colspan="3">-----N-----</th> <th>P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.68</td> <td>.68</td> <td>.68</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.60</td> <td>.60</td> <td>.60</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.44</td> <td>.44</td> <td>.44</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.40</td> <td>.40</td> <td>.40</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH ₃ N	-----N-----			P&K	soil injection:	.95	.68	.68	.68	.80	soil incorp:	.75	.60	.60	.60	.75	broadcast:	.35	.44	.44	.44	.70	irrigation:	.25	.40	.40	.40	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> $\% \times 83.5 = \text{lbs/1000 gals}$ $\text{mg/L (ppm)} \times .00835 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$ </td> </tr> </table>	$\% \times 83.5 = \text{lbs/1000 gals}$ $\text{mg/L (ppm)} \times .00835 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$
Application method:	NH ₃ N	-----N-----			P&K																											
soil injection:	.95	.68	.68	.68	.80																											
soil incorp:	.75	.60	.60	.60	.75																											
broadcast:	.35	.44	.44	.44	.70																											
irrigation:	.25	.40	.40	.40	.70																											
$\% \times 83.5 = \text{lbs/1000 gals}$ $\text{mg/L (ppm)} \times .00835 = \text{lbs/1000 gals}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$																																

crop fertilization rate: N:	50	lbs/acre/year
P ₂ O ₅ :	20	lbs/acre/year
K ₂ O:	50	lbs/acre/year

Table 4B. DAIRY ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity			Total Lagoon Sludge Accumulation, ** per head capacity/yr			Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Available Nutrients soil inject.	
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³	soil injected ***	lbs/1000 gals		lbs/1000 gals	lbs/1000 gals	lbs/head capacity /year			
		months			lbs												
Calf	0 - 10	100	600	350	525	369	156	466	62	N	.68	15	10	4.7			
										P205	.80	22	18	8.3			
										K20	.80	7.9	6.3	2.9			
Heifer	12 - 33	700	1300	1000	1500	1055	445	1375	184	N	.68	15	10	14			
										P205	.80	22	18	25			
										K20	.80	7.9	6.3	8.7			
Milk cow	36 -	1400	1400	1400	2100	1477	623	1925	257	N	.68	15	10	19			
										P205	.80	22	18	34			
										K20	.80	7.9	6.3	12			

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** No manure solids removal prior to lagoon input.
 *** Soil injected: sludge injected directly into soil and covered immediately.

Table 4C. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **								Minimum Land Area for Sludge Application							
		soil injected								soil injected							
		lbs/acre/year								lbs/acre/year							
Calf	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Heifer	N	4998	9996	14993	19991	24989	29987	34984	39982	.093	.047	.031	.023	.019	.016	.013	.012
	P205	1119	2237	3356	4475	5593	6712	7831	8949	.42	.21	.14	.10	.083	.069	.059	.052
	K20	7913	15825	23738	31650	39563	47475	55388	63300	.059	.029	.020	.015	.012	.0098	.0084	.0074
Milk cow	N	4998	9996	14993	19991	24989	29987	34984	39982	.28	.14	.092	.069	.055	.046	.039	.034
	P205	1119	2237	3356	4475	5593	6712	7831	8949	1.2	.61	.41	.31	.25	.20	.18	.15
	K20	7913	15825	23738	31650	39563	47475	55388	63300	.17	.087	.058	.043	.035	.029	.025	.022
Milk cow	N	4998	9996	14993	19991	24989	29987	34984	39982	.39	.19	.13	.096	.077	.064	.055	.048
	P205	1119	2237	3356	4475	5593	6712	7831	8949	1.7	.86	.57	.43	.34	.29	.25	.21
	K20	7913	15825	23738	31650	39563	47475	55388	63300	.24	.12	.081	.061	.049	.041	.035	.031

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Dairy Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated dairy anaerobic lagoon sludge. Values in cells D25-K54 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F54 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I64-I66 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lbs
final:	600	1300	1400	600	1300	1400	lbs
average:	350	1000	1400	350	1000	1400	lbs
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon sludge density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Lagoon sludge accumulation:	1.3	3.8	5.3	1.3	3.8	5.3	gals/animal/day
Lagoon liquid total nutrient analysis:							
Tot N:	15	15	15	15	15	15	lbs/1000 gals
NH ₃ N:	41	41	41	41	41	41	% tot N or tkn
P ₂ O ₅ :	22	22	22	22	22	22	lbs/1000 gals
K ₂ O:	7.9	7.9	7.9	7.9	7.9	7.9	lbs/1000 gals
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.60	.60	.60	.60	.60	.60	
P ₂ O ₅ :	.75	.75	.75	.75	.75	.75	
K ₂ O:	.75	.75	.75	.75	.75	.75	

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">Application method:</td> <td style="width: 10%;">NH₃N</td> <td style="width: 10%;">-----N-----</td> <td style="width: 10%;">P&K</td> </tr> <tr> <td>soil injection:</td> <td>.95</td> <td>.68 .68 .68</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.60 .60 .60</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.44 .44 .44</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.40 .40 .40</td> <td>.70</td> </tr> </table>	Application method:	NH ₃ N	-----N-----	P&K	soil injection:	.95	.68 .68 .68	.80	soil incorp:	.75	.60 .60 .60	.75	broadcast:	.35	.44 .44 .44	.70	irrigation:	.25	.40 .40 .40	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">%</td> <td style="text-align: center;">x</td> <td style="text-align: center;">83.5</td> <td style="text-align: center;">= lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">.00835</td> <td style="text-align: center;">= lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td style="text-align: center;">= lbs/acre-inch</td> </tr> </table>	%	x	83.5	= lbs/1000 gals	mg/L (ppm)	x	.00835	= lbs/1000 gals	lbs/1000 gals	x	27.154	= lbs/acre-inch
Application method:	NH ₃ N	-----N-----	P&K																														
soil injection:	.95	.68 .68 .68	.80																														
soil incorp:	.75	.60 .60 .60	.75																														
broadcast:	.35	.44 .44 .44	.70																														
irrigation:	.25	.40 .40 .40	.70																														
%	x	83.5	= lbs/1000 gals																														
mg/L (ppm)	x	.00835	= lbs/1000 gals																														
lbs/1000 gals	x	27.154	= lbs/acre-inch																														

crop fertilization rate: N:	50	lbs/acre/year
P ₂ O ₅ :	20	lbs/acre/year
K ₂ O:	50	lbs/acre/year

Scroll down for results.

Table 48. DAIRY ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity			Total Lagoon Sludge Accumulation, ** per head capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrient: soil incorpora			
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³	soil incorporated ***				lbs/1000 gals	lbs/1000 gals	lbs./hectare capacity/yr	
		months			lbs			gals					ft ³			
Calf	0 - 10	100	600	350	525	369	156	466	62	N	.60	15	8.8	4.1		
										P2O5	.75	22	17	7.1		
										K2O	.75	7.9	5.9	2.1		
Heifer	12 - 33	700	1300	1000	1500	1055	445	1375	184	N	.60	15	8.3	1.1		
										P2O5	.75	22	17	2.1		
										K2O	.75	7.9	5.9	8.1		
Milk cow	36 -	1400	1400	1400	2100	1477	623	1925	257	N	.60	15	8.8	1.1		
										P2O5	.75	22	17	3.1		
										K2O	.75	7.9	5.9	1.1		

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** No manure solids removal prior to lagoon input.
 *** Soil incorporated: surface spread sludge plowed or disked into soil within 2 days.

Table 4C. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **									Minimum Land Area for Sludge Application							
		soil incorporated									soil incorporated							
		lbs/acre/year									lbs/acre/year							
Calf	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Heifer	N	5673	11346	17020	22693	28366	34039	39712	45385	.082	.041	.027	.021	.016	.014	.012	.011	
		1193	2386	3580	4773	5966	7159	8353	9546	.39	.20	.13	.098	.078	.065	.056	.041	
		8440	16880	25320	33760	42200	50640	59080	67520	.055	.028	.018	.014	.011	.0092	.0079	.0061	
Milk cow	N	5673	11346	17020	22693	28366	34039	39712	45385	.24	.12	.081	.061	.048	.040	.035	.031	
		1193	2386	3580	4773	5966	7159	8353	9546	1.2	.58	.38	.29	.23	.19	.16	.11	
		8440	16880	25320	33760	42200	50640	59080	67520	.16	.081	.054	.041	.033	.027	.023	.021	
Milk cow	N	5673	11346	17020	22693	28366	34039	39712	45385	.34	.17	.11	.085	.068	.057	.048	.04	
		1193	2386	3580	4773	5966	7159	8353	9546	1.6	.81	.54	.40	.32	.27	.23	.2	
		8440	16880	25320	33760	42200	50640	59080	67520	.23	.11	.076	.057	.046	.038	.033	.02	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 199
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Dairy Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast dairy anaerobic lagoon sludge. Values in cells I25-K54 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F54 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I64-I66 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk	Calf	Heifer	Milk	
	Cow			Cow			
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	lb
final:	600	1300	1400	600	1300	1400	lb
average:	350	1000	1400	350	1000	1400	lb
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon sludge accumulation:	1.3	3.8	5.3	1.3	3.8	5.3	gals/animal/day
Lagoon sludge density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Lagoon liquid total nutrient analysis:							
Tot N:	15	15	15	15	15	15	lbs/1000 gals
NH ₃ N:	41	41	41	41	41	41	% tot N or tin
P ₂ O ₅ :	22	22	22	22	22	22	lbs/1000 gals
K ₂ O:	7.9	7.9	7.9	7.9	7.9	7.9	lbs/1000 gals
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.44	.44	.44	.44	.44	.44	
P ₂ O ₅ :	.70	.70	.70	.70	.70	.70	
K ₂ O:	.70	.70	.70	.70	.70	.70	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: center;">NH₃N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: center;">P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td style="text-align: center;">.95</td> <td style="text-align: center;">.68</td> <td style="text-align: center;">.68</td> <td style="text-align: center;">.68</td> <td style="text-align: center;">.80</td> </tr> <tr> <td>soil incorp:</td> <td style="text-align: center;">.75</td> <td style="text-align: center;">.60</td> <td style="text-align: center;">.60</td> <td style="text-align: center;">.60</td> <td style="text-align: center;">.75</td> </tr> <tr> <td>broadcast:</td> <td style="text-align: center;">.35</td> <td style="text-align: center;">.44</td> <td style="text-align: center;">.44</td> <td style="text-align: center;">.44</td> <td style="text-align: center;">.70</td> </tr> <tr> <td>irrigation:</td> <td style="text-align: center;">.25</td> <td style="text-align: center;">.40</td> <td style="text-align: center;">.40</td> <td style="text-align: center;">.40</td> <td style="text-align: center;">.70</td> </tr> </tbody> </table>	Application method:	NH ₃ N	-----N-----			P&K	soil injection:	.95	.68	.68	.68	.80	soil incorp:	.75	.60	.60	.60	.75	broadcast:	.35	.44	.44	.44	.70	irrigation:	.25	.40	.40	.40	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">%</td> <td style="text-align: center;">x</td> <td style="text-align: center;">83.5</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">.00235</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> </table>	%	x	83.5	=	lbs/1000 gals	mg/L (ppm)	x	.00235	=	lbs/1000 gals	lbs/1000 gals	x	27.154	=	lbs/acre-inch
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mg/L (ppm)	x	.00235	=	lbs/1000 gals																																										
lbs/1000 gals	x	27.154	=	lbs/acre-inch																																										

Crop fertilization rate: N:	50	lbs/acre/year
P ₂ O ₅ :	20	lbs/acre/year
K ₂ O:	50	lbs/acre/year

Scroll down for results.

Table 4b. DAIRY ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity			Total Lagoon Sludge Accumulation, ** per head capacity/yr			Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients broadcast	
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³	***	lbs/1000 gals				lbs/1000 gals	lbs./heac capacity/year
		months			lbs										
Calf	0 - 10	100	600	350	525	369	156	466	62	N	.44	15	6.4	3.0	
										P205	.70	22	16	7.3	
										K20	.70	7.9	5.5	2.4	
Heifer	12 - 33	700	1300	1000	1500	1055	445	1375	184	N	.44	15	6.4	8.8	
										P205	.70	22	16	21	
										K20	.70	7.9	5.5	7.4	
Milk cow	36 -	1400	1400	1400	2100	1477	623	1925	257	N	.44	15	6.4	12	
										P205	.70	22	16	30	
										K20	.70	7.9	5.5	11	

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** No manure solids removal prior to lagoon input.
 *** Broadcast: surface spread sludge uncovered for 1 month or longer.

Table 4c. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON SLUDGE

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **									Minimum Land Area for Sludge Application							
		broadcast									broadcast							
		lbs/acre/year									lbs/acre/year							
Calf	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Heifer	N	7775	15549	23324	31099	38873	46648	54422	62197	.060	.030	.020	.015	.012	.010	.0086	.0075	
	P205	1278	2557	3835	5114	6392	7671	8949	10228	.36	.18	.12	.091	.073	.061	.052	.044	
	K20	9043	18086	27129	36171	45214	54257	63300	72343	.052	.026	.017	.013	.010	.0086	.0074	.0064	
Milk cow	N	7775	15549	23324	31099	38873	46648	54422	62197	.18	.088	.059	.044	.035	.029	.025	.022	
	P205	1278	2557	3835	5114	6392	7671	8949	10228	1.1	.54	.36	.27	.22	.18	.15	.13	
	K20	9043	18086	27129	36171	45214	54257	63300	72343	.15	.076	.051	.038	.030	.025	.022	.019	
Milk cow	N	7775	15549	23324	31099	38873	46648	54422	62197	.25	.12	.083	.062	.050	.041	.035	.031	
	P205	1278	2557	3835	5114	6392	7671	8949	10228	1.5	.75	.50	.38	.30	.25	.22	.19	
	K20	9043	18086	27129	36171	45214	54257	63300	72343	.21	.11	.071	.053	.043	.035	.030	.027	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Dairy Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated dairy anaerobic lagoon sludge. Values in cells I25-K54 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F54 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I64-I66 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual			
	Calf	Heifer	Milk Cow	Calf	Heifer	Milk Cow	
	--per head cap--			--per head cap--			
Animal live weight: initial:	100	700	1400	100	700	1400	
final:	600	1300	1400	600	1300	1400	lb
average:	350	1000	1400	350	1000	1400	lb
Groups per year:	1	1	1	1	1	1	groups/year
Days per group:	304	365	365	304	365	365	days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	350	1000	1400	350	1000	1400	ft ³ /animal cap
sludge storage:	19	55	77	19	55	77	ft ³ /animal cap
temporary storage:	156	445	623	156	445	623	ft ³ /animal cap
total:	525	1500	2100	525	1500	2100	ft ³ /animal cap
Lagoon sludge accumulation:	1.3	3.8	5.3	1.3	3.8	5.3	gals/animal/day
Lagoon sludge density:	8.3	8.3	8.3	8.3	8.3	8.3	lbs/gallon
Lagoon liquid total nutrient analysis:							
Tot N:	398	398	398	398	398	398	lbs/acre-inch
NH3N:	41	41	41	41	41	41	% tot N or tkn
P2O5:	607	607	607	607	607	607	lbs/acre-inch
K2O:	214	214	214	214	214	214	lbs/acre-inch
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.40	.40	.40	.40	.40	.40	
P2O5:	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH3N</td> <td colspan="3">-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil injection:</td> <td>.95</td> <td>.68</td> <td>.68</td> <td>.68</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.60</td> <td>.60</td> <td>.60</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.44</td> <td>.44</td> <td>.44</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.40</td> <td>.40</td> <td>.40</td> <td>.70</td> </tr> </table>	Application method:	NH3N	-----N-----			P&K	soil injection:	.95	.68	.68	.68	.80	soil incorp:	.75	.60	.60	.60	.75	broadcast:	.35	.44	.44	.44	.70	irrigation:	.25	.40	.40	.40	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">μ</td> <td style="text-align: center;">x</td> <td style="text-align: center;">23.5</td> <td style="text-align: center;">= lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">.00235</td> <td style="text-align: center;">= lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td style="text-align: center;">= lbs/acre-inch</td> </tr> </table>	μ	x	23.5	= lbs/1000 gals	mg/L (ppm)	x	.00235	= lbs/1000 gals	lbs/1000 gals	x	27.154	= lbs/acre-inch
Application method:	NH3N	-----N-----			P&K																																						
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lbs/1000 gals	x	27.154	= lbs/acre-inch																																								

Crop fertilization rate: N:	50	lbs/acre/year
P2O5:	20	lbs/acre/year
K2O:	50	lbs/acre/year

Scroll down for results.

Table 4B. DAIRY ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS

Type of Production Unit	Animal Age	Animal Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /head capacity		Total Lagoon Sludge Accumulation, per head capacity/yr			Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/acre-inch	Plant Avail. Nutrient irrigated		
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals	inch	irrigated ***				lbs/acre-inch	lbs/acre-inch	lbs/hea capacit/yea
		months			lbs			inch							
Calf	0 - 10	100	600	350	525	369	156	466	.017	N	.40	398	158	2.	
										P205	.70	607	425	7.	
										K20	.70	214	150	2.	
Heifer	12 - 33	700	1300	1000	1500	1055	445	1375	.051	N	.40	398	158	8.	
										P205	.70	607	425	2	
										K20	.70	214	150	7.	
Milk cow	36 -	1400	1400	1400	2100	1477	623	1925	.071	N	.40	398	158	1	
										P205	.70	607	425	31	
										K20	.70	214	150	1	

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** No manure solids removal prior to lagoon input.
 *** Irrigated: sprinkler irrigated sludge uncovered for 1 month or longer.

Table 4C. LAND APPLICATION OF DAIRY ANAEROBIC LAGOON SLUDGE

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **									Minimum Land Area for Sludge Application							
		irrigated									irrigated							
		lbs/acre/year									lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
	N	.32	.63	.95	1.3	1.6	1.9	2.2	2.5	.054	.027	.018	.014	.011	.0091	.0078	.0064	
	P205	.047	.094	.14	.19	.24	.28	.33	.38	.36	.18	.12	.091	.073	.061	.052	.04	
	K20	.33	.67	1.0	1.3	1.7	2.0	2.3	2.7	.052	.025	.017	.013	.010	.0086	.0074	.0064	
		inches/year									acres/head capacity							
Calf	N	.32	.63	.95	1.3	1.6	1.9	2.2	2.5	.054	.027	.018	.014	.011	.0091	.0078	.0064	
	P205	.047	.094	.14	.19	.24	.28	.33	.38	.36	.18	.12	.091	.073	.061	.052	.04	
	K20	.33	.67	1.0	1.3	1.7	2.0	2.3	2.7	.052	.025	.017	.013	.010	.0086	.0074	.0064	
Heifer	N	.32	.63	.95	1.3	1.6	1.9	2.2	2.5	.16	.080	.053	.040	.032	.027	.023	.021	
	P205	.047	.094	.14	.19	.24	.28	.33	.38	1.1	.54	.36	.27	.22	.18	.15	.11	
	K20	.33	.67	1.0	1.3	1.7	2.0	2.3	2.7	.15	.076	.051	.038	.030	.025	.022	.017	
Milk cow	N	.32	.63	.95	1.3	1.6	1.9	2.2	2.5	.22	.11	.075	.056	.045	.037	.032	.02	
	P205	.047	.094	.14	.19	.24	.28	.33	.38	1.5	.75	.50	.38	.30	.25	.22	.17	
	K20	.33	.67	1.0	1.3	1.7	2.0	2.3	2.7	.21	.11	.071	.053	.043	.035	.030	.02	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 199
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Paved Surface Scraped Manure Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land area needed for agronomic usage of soil incorporated swine paved surface scraped manure. Values in cells I25-M53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H53 are typical values which may be used if more specific information is not available. If actual manure nutrient analyses are used, then a corresponding change in manure volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I61-I63 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure storage capacities, and estimated annual manure volumes to be land applied.

	Typical					Actual					
	Mean-Feed per hd cap	Feedr -Fin cap	Farr- Wean --per	Farr- Feedr active	Farr- Fin sow	Mean-Feedr per hd cap	Feedr -Fin cap	Farr- Wean --per	Farr- Feedr active	Farr- Fin sow	
Animal live weight: initial:	10	50				10	50				lbs
final:	50	220				50	220				lbs
average:	30	135	433	522	1417	30	135	433	522	1417	lbs
Groups per year:	6	3	2	2	2	6	3	2	2	2	groups/year
Days per group:	49	105	11	63	168	49	105	11	63	168	days/group
Manure accumulation:	2.0	8.9	19	23	94	2.0	8.9	19	23	94	lbs/animal/day
Manure density:	62	62	62	62	62	62	62	62	62	62	lbs/ft ³
Manure storage period:	91	91	91	91	91	91	91	91	91	91	days
Manure total nutrient analysis:											
Tot N:	13	13	13	13	13	13	13	13	13	13	lbs/ton
NH3N:	50	50	50	50	50	50	50	50	50	50	% tot N or tbn
P2O5:	12	12	12	12	12	12	12	12	12	12	lbs/ton
K2O:	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	lbs/ton
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)											
N:	.63	.63	.63	.63	.63	.63	.63	.63	.63	.63	
P2O5:	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	
K2O:	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	

Application method: NH3N -----N----- P&K soil incorp: .75 .63 .63 .63 .63 .63 .75 broadcast: .25 .37 .37 .37 .37 .37 .70	ppm x 20 = lbs/ton ppm x 0.002 = lbs/ton
--	---

Crop fertilization rate: N:	50	
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

roll down for results.

Table 168. SWINE PAVED SURFACE SCRAPED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Manure Storage Capacity, *** ft ³ /animal unit	Total Scraped Manure, tons/animal unit/year	Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients lbs/ton	Plant Available Nutrients soil incorporated	
		init	final	mean				soil incorporated ****	lbs/ton		lbs/ton	lbs/animal unit/year
		-----lbs-----										
Weanling-to Feeder capacity	per head	10	50	30	2.6	.30	N	.63	13	8.2	2.5	
							P205	.75	12	8.9	2.7	
							K20	.75	9.0	6.7	2.0	
Feeder-to Finish capacity	per head	50	220	135	13	1.5	N	.63	13	8.2	12	
							P205	.75	12	8.9	12	
							K20	.75	9.0	6.7	10	
Farrow-to Weanling active sow	per active sow	433			28	3.5	N	.63	13	8.2	25	
		P205	.75	12			8.9	31				
		K20	.75	9.0			6.7	23				
Farrow-to Feeder active sow	per active sow	522			34	4.2	N	.63	13	8.2	34	
		P205	.75	12			8.9	37				
		K20	.75	9.0			6.7	28				
Farrow-to Finish active sow	per active sow	1417			137	17	N	.63	13	8.2	140	
		P205	.75	12			8.9	152				
		K20	.75	9.0			6.7	115				

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1995
 Agronomic Division, North Carolina Department of Agriculture
 ** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow
 *** 3-month accumulation of manure and bedding with liquid drainage.
 **** Soil incorporated: surface spread manure plowed or disked into soil within 2 days.

Table 16C. LAND APPLICATION OF SWINE PAVED SURFACE SCRAPED MANURE *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Manure Application Rate **										Minimum Land Area for Manure Application **							
			soil incorporated										soil incorporated							
			lbs/acre/year										lbs/acre/year							
Weanling-to Feeder capacity	per head	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400		
			P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
			K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Feeder-to Finish capacity	per head	N	6.1	12	18	24	31	37	43	49	.24	.12	.081	.061	.049	.041	.035	.030		
			P205	2.2	4.5	6.7	9.0	11	13	16	18	.66	.33	.22	.17	.13	.11	.095	.083	
			K20	7.4	15	22	30	37	45	52	60	.20	.10	.067	.050	.040	.033	.029	.025	
Farrow-to Weanling active sow	per active sow	N	6.1	12	18	24	31	37	43	49	.57	.29	.19	.14	.11	.095	.082	.07		
			P205	2.2	4.5	6.7	9.0	11	13	16	18	1.6	.78	.52	.39	.31	.26	.22	.19	
			K20	7.4	15	22	30	37	45	52	60	.47	.23	.16	.12	.094	.078	.067	.059	
Farrow-to Feeder active sow	per active sow	N	6.1	12	18	24	31	37	43	49	.69	.34	.23	.17	.14	.11	.098	.08		
			P205	2.2	4.5	6.7	9.0	11	13	16	18	1.9	.94	.62	.47	.37	.31	.27	.2	
			K20	7.4	15	22	30	37	45	52	60	.57	.28	.19	.14	.11	.094	.081	.07	
Farrow-to Finish active sow	per active sow	N	6.1	12	18	24	31	37	43	49	2.8	1.4	.93	.70	.56	.47	.40			
			P205	2.2	4.5	6.7	9.0	11	13	16	18	7.5	3.3	2.5	1.9	1.5	1.3	1.1		
			K20	7.4	15	22	30	37	45	52	60	2.3	1.2	.77	.58	.46	.38	.33		

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1995
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected swine liquid manure slurry. Values in cells I25-M56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H56 are typical values which may be used if more specific information is not available. If actual liquid manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure slurry storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical					Actual					
	Mean- Feed per hd cap	Feedr -Fin cap	Farr- --per active	Farr- Feedr active	Farr- Fin sow	Mean- Feedr per hd cap	Feedr -Fin cap	Farr- --per active	Farr- Feedr active	Farr- Fin sow	
Animal live weight: initial:	10	50				10	50				lbs
final:	50	220				50	220				lbs
average:	30	135	433	522	1417	30	135	433	522	1417	lbs
Groups per year:	6	3	2	2	2	6	3	2	2	2	groups/year
Days per group:	49	105	11	63	168	49	105	11	63	168	days/group
Manure slurry accumulation :											
manure and urine:	.30	1.4	4.3	5.2	14	.30	1.4	4.3	5.2	14	gals/animal/day
excess water usage:	.20	.9	2.9	3.5	9	.20	.9	2.9	3.5	9	gals/animal/day
total:	.50	2.3	7.2	8.7	24	.50	2.3	7.2	8.7	24	gals/animal/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon
Slurry storage period:	183	183	183	183	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:											
Tot N:	31	31	21	21	31	31	31	21	21	31	lbs/1000 gals
NH3N:	63	63	63	63	63	63	63	63	63	63	% tot N or tkn
P2O5:	22	22	15	15	22	22	22	15	15	22	lbs/1000 gals
K2O:	17	17	12	12	17	17	17	12	12	17	lbs/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)											
N:	.78	.78	.78	.78	.78	.78	.78	.78	.78	.78	
P2O5:	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	
K2O:	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	

Application method:	NHEN	-----N-----					P&K
soil injection:	.95	.78	.78	.78	.78	.78	.80
soil incorp:	.75	.66	.66	.66	.66	.66	.75
broadcast:	.35	.41	.41	.41	.41	.41	.70
irrigation:	.25	.34	.34	.34	.34	.34	.70

$\text{N} \times 2256 = \text{lbs/acre-inch}$
 $\text{P} \times 0.2256 = \text{lbs/acre-inch}$
 $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 17B. SWINE LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Manure Slurry Storage Capacity, *** ft ³ /animal unit	Total Manure Slurry, gallons/animal unit/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients soil injected	
		init	final	mean						lbs/1000 gals	lbs/animal unit/year
Weanling-to Feeder capacity	per head	10	50	30	10	152	N	.78	31	24	3.7
							P2O5	.80	22	18	2.7
							K2O	.80	17	14	2.1
Feeder-to Finish capacity	per head	50	220	135	52	751	N	.78	31	24	18
							P2O5	.80	22	18	13
							K2O	.80	17	14	10
Farrow-to Weanling active sow	per active			433	176	2638	N	.78	21	16	42
							P2O5	.80	15	12	31
							K2O	.80	12	9.3	24
Farrow-to Feeder active sow	per active			522	213	3180	N	.78	21	16	51
							P2O5	.80	15	12	38
							K2O	.80	12	9.3	29
Farrow-to Finish active sow	per active			1417	577	8630	N	.78	31	24	208
							P2O5	.80	22	18	153
							K2O	.80	17	14	120

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 19 Agronomic Division, North Carolina Department of Agriculture
 ** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow.
 *** 6-month accumulation of manure, urine, excess water usage; does not include fresh water for flushing or lot runoff.
 **** Soil Injected: manure slurry injected directly into the soil and covered immediately.

Table 17C. LAND APPLICATION OF SWINE LIQUID MANURE SLURRY *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Manure Slurry Application Rate **							Minimum Land Area for Slurry Application **									
			soil injected lbs/acre/year							soil injected lbs/acre/year									
Weanling-to Feeder capacity	per head	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
			P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
			K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			gallons/acre/year							acres/animal unit									
Weanling-to Feeder capacity	per head	N	2074	4148	6221	8295	10369	12443	14516	16590	.073	.037	.024	.018	.015	.012	.010	.0092	
			P2O5	1129	2257	3386	4514	5643	6771	7900	9028	.13	.067	.045	.034	.027	.022	.019	.017
			K2O	3601	7202	10802	14403	18004	21605	25206	28807	.042	.021	.014	.011	.0084	.0070	.0060	.0053
Feeder-to Finish capacity	per head	N	2074	4148	6221	8295	10369	12443	14516	16590	.36	.18	.12	.091	.072	.060	.052	.045	
			P2O5	1129	2257	3386	4514	5643	6771	7900	9028	.67	.33	.22	.17	.13	.11	.095	.083
			K2O	3601	7202	10802	14403	18004	21605	25206	28807	.21	.10	.070	.052	.042	.035	.030	.026
Farrow-to Weanling active sow	per active	N	3111	6221	9332	12443	15553	18664	21774	24885	.85	.42	.28	.21	.17	.14	.12	.11	
			P2O5	1693	3386	5078	6771	8464	10157	11850	13543	1.6	.78	.52	.39	.31	.26	.22	.19
			K2O	5401	10802	16204	21605	27006	32407	37809	43210	.49	.24	.16	.12	.098	.081	.070	.061
Farrow-to Feeder active sow	per active	N	3111	6221	9332	12443	15553	18664	21774	24885	1.0	.51	.34	.26	.20	.17	.15	.13	
			P2O5	1693	3386	5078	6771	8464	10157	11850	13543	1.9	.94	.63	.47	.38	.31	.27	.23
			K2O	5401	10802	16204	21605	27006	32407	37809	43210	.59	.29	.20	.15	.12	.098	.084	.07
Farrow-to Finish active sow	per active	N	2074	4148	6221	8295	10369	12443	14516	16590	4.2	2.1	1.4	1.0	.83	.69	.59		
			P2O5	1129	2257	3386	4514	5643	6771	7900	9028	7.6	3.8	2.5	1.9	1.5	1.3	1.1	
			K2O	3601	7202	10802	14403	18004	21605	25206	28807	2.4	1.2	.80	.60	.48	.40	.34	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Swine Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated swine liquid manure slurry. Values in cells D25-M54 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H54 are typical values which may be used if more specific information is not available. If actual liquid manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I64-I66 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure slurry storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical					Actual					
	Mean-Feed per hd	Feedr -Fin cap	Farr- Mean --per	Farr- Feedr active	Farr- Fin sow	Mean-Feedr per hd	Feedr -Fin cap	Farr- Mean --per	Farr- Feedr active	Farr- Fin sow	
Animal live weight: initial:	10	50				10	50				lb
final:	50	220				50	220				lb
average:	30	135	433	522	1417	30	135	433	522	1417	lb
Groups per year:	6	3	2	2	2	6	3	2	2	2	groups/year
Days per group:	49	105	11	63	168	49	105	11	63	168	days/group
Manure slurry accumulation:											
manure and urine:	.30	1.4	4.3	5.2	14	.30	1.4	4.3	5.2	14	gals/animal/day
excess water usage:	.20	.9	2.9	3.5	9	.20	.9	2.9	3.5	9	gals/animal/day
total:	.50	2.3	7.2	8.7	24	.50	2.3	7.2	8.7	24	gals/animal/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon
Slurry storage period:	183	183	183	183	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:											
Tot N:	31	31	21	21	31	31	31	21	21	31	lbs/1000 gals
NH3N:	63	63	63	63	63	63	63	63	63	63	% tot N or tbn
P2O5:	22	22	15	15	22	22	22	15	15	22	lbs/1000 gals
K2O:	17	17	12	12	17	17	17	12	12	17	lbs/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)											
N:	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66	
P2O5:	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	
K2O:	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Application method:</th> <th>NH3N</th> <th colspan="5">-----N-----</th> <th>P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.78</td><td>.78</td><td>.78</td><td>.78</td><td>.78</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.66</td><td>.66</td><td>.66</td><td>.66</td><td>.66</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.41</td><td>.41</td><td>.41</td><td>.41</td><td>.41</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.34</td><td>.34</td><td>.34</td><td>.34</td><td>.34</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----					P&K	soil injection:	.95	.78	.78	.78	.78	.78	.80	soil incorp:	.75	.66	.66	.66	.66	.66	.75	broadcast:	.35	.41	.41	.41	.41	.41	.70	irrigation:	.25	.34	.34	.34	.34	.34	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> $\% \times 2266 = \text{lbs/acre-inch}$ $\text{ppm} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$ </td> </tr> </table>	$\% \times 2266 = \text{lbs/acre-inch}$ $\text{ppm} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$
Application method:	NH3N	-----N-----					P&K																																			
soil injection:	.95	.78	.78	.78	.78	.78	.80																																			
soil incorp:	.75	.66	.66	.66	.66	.66	.75																																			
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irrigation:	.25	.34	.34	.34	.34	.34	.70																																			
$\% \times 2266 = \text{lbs/acre-inch}$ $\text{ppm} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$																																										

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 17B. SWINE LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Manure Slurry Storage Capacity, *** ft ³ /animal unit	Total Manure Slurry, gallons/animal unit/year	Plant Nutrient Availability Coefficients			Plant Available Nutrients soil incorporated ****		
		init	final	mean			N	P205	K20	lbs/1000 gals	lbs/1000 gals	lbs/animal unit/year
		-----lbs-----										
Weanling-to Feeder capacity	per head	10	50	30	10	152	N	.66	31	20	3.1	
							P205	.75	22	17	2.5	
							K20	.75	17	13	2.0	
Feeder-to Finish capacity	per head	50	220	135	52	751	N	.66	31	20	15	
							P205	.75	22	17	12	
							K20	.75	17	13	9.8	
Farrow-to Weanling	per active sow			433	176	2638	N	.66	21	13	36	
							P205	.75	15	11	29	
							K20	.75	12	8.7	23	
Farrow-to Feeder	per active sow			522	213	3180	N	.66	21	13	43	
							P205	.75	15	11	35	
							K20	.75	12	8.7	28	
Farrow-to Finish	per active sow			1417	577	8630	N	.66	31	20	175	
							P205	.75	22	17	143	
							K20	.75	17	13	112	

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan Agronomic Division, North Carolina Department of Agriculture
 ** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow/year
 *** 6-month accumulation of manure, urine, excess water usage; does not include fresh water for flushing or lot runoff.
 **** Soil Incorporated: surface spread manure slurry plowed or disked into soil within 2 days.

Table 17C. LAND APPLICATION OF SWINE LIQUID MANURE SLURRY *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Manure Slurry Application Rate **										Minimum Land Area for Slurry Application **							
			-----soil incorporated-----										-----soil incorporated-----							
			lbs/acre/year										lbs/acre/year							
Weanling-to Feeder capacity	per head	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400		
			P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
			K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Feeder-to Finish capacity	per head	N	2471	4943	7414	9885	12357	14828	17299	19771	.061	.031	.020	.015	.012	.010	.0088	.0077		
			P205	1204	2408	3611	4815	6019	7223	8426	9630	.13	.063	.042	.032	.025	.021	.018	.016	
			K20	3841	7682	11523	15363	19204	23045	26886	30727	.040	.020	.013	.0099	.0079	.0066	.0056	.0049	
Farrow-to Weanling	per active sow	N	2471	4943	7414	9885	12357	14828	17299	19771	.30	.15	.10	.076	.061	.051	.043	.036		
			P205	1204	2408	3611	4815	6019	7223	8426	9630	.62	.31	.21	.16	.12	.10	.089	.078	
			K20	3841	7682	11523	15363	19204	23045	26886	30727	.20	.098	.065	.049	.039	.033	.028	.024	
Farrow-to Feeder	per active sow	N	3707	7414	11121	14828	18535	22242	25949	29656	.71	.36	.24	.18	.14	.12	.10	.085		
			P205	1806	3611	5417	7223	9028	10834	12640	14445	1.5	.73	.49	.37	.29	.24	.21	.18	
			K20	5761	11523	17284	23045	28807	34568	40329	46090	.46	.23	.15	.11	.092	.076	.065	.057	
Farrow-to Finish	per active sow	N	3707	7414	11121	14828	18535	22242	25949	29656	.86	.43	.29	.21	.17	.14	.12	.11		
			P205	1806	3611	5417	7223	9028	10834	12640	14445	1.8	.88	.59	.44	.35	.29	.25	.22	
			K20	5761	11523	17284	23045	28807	34568	40329	46090	.55	.28	.18	.14	.11	.092	.079	.07	
Farrow-to Finish	per active sow	N	2471	4943	7414	9885	12357	14828	17299	19771	3.5	1.7	1.2	.87	.70	.58	.50			
			P205	1204	2408	3611	4815	6019	7223	8426	9630	7.2	3.6	2.4	1.8	1.4	1.2	1.0		
			K20	3841	7682	11523	15363	19204	23045	26886	30727	2.2	1.1	.75	.56	.45	.37	.32		

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast swine liquid manure slurry. Values in cells I25-M54 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H54 are typical values which may be used if more specific information is not available. If actual liquid manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I64-I66 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure slurry storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical					Actual					
	Mean-Feed per hd cap	Feedr-Fin -per cap	Farr-Wean --per	Farr-Feedr active	Farr-Fin sow	Mean-Feedr per hd cap	Feedr-Fin -per cap	Farr-Wean --per	Farr-Feedr active	Farr-Fin sow	
Animal live weight: initial:	10	50				10	50				lbs
final:	50	220				50	220				lbs
average:	30	135	433	522	1417	30	135	433	522	1417	lbs
Groups per year:	6	3	2	2	2	6	3	2	2	2	groups/year
Days per group:	49	105	11	63	168	49	105	11	63	168	days/group
Manure slurry accumulation:											
manure and urine:	.30	1.4	4.3	5.2	14	.30	1.4	4.3	5.2	14	gals/animal/day
excess water usage:	.20	.9	2.9	3.5	9	.20	.9	2.9	3.5	9	gals/animal/day
total:	.50	2.3	7.2	8.7	24	.50	2.3	7.2	8.7	24	gals/animal/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon
Slurry storage period:	183	183	183	183	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:											
Tot N:	31	31	21	21	31	31	31	21	21	31	lbs/1000 gals
NH3N:	63	63	63	63	63	63	63	63	63	63	% tot N or tbn
P2O5:	22	22	15	15	22	22	22	15	15	22	lbs/1000 gals
K2O:	17	17	12	12	17	17	17	12	12	17	lbs/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)											
N:	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41	
P2O5:	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	

Application method:	NH3N	N					P&K
soil injection:	.95	.78	.78	.78	.78	.78	.80
soil incorp:	.75	.66	.66	.66	.66	.66	.75
broadcast:	.35	.41	.41	.41	.41	.41	.70
irrigation:	.25	.34	.34	.34	.34	.34	.70

$\% \times 2266 = \text{lbs/acre-inch}$
 $\text{ppm} \times 0.2266 = \text{lbs/acre-inch}$
 $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 17B. SWINE LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Manure Slurry Storage Capacity, *** ft ³ /animal unit	Total Manure Slurry, gallons/animal unit/year	Plant Nutrient	Plant Nutrient Availability Coefficients broadcast ****	Total Nutrients			Plant Available Nutrients, broadcast										
		init	final	mean					lbs/1000 gals	lbs/1000 gals	lbs/1000 gals	lbs/animal unit/year										
		-----lbs-----																				
Weanling-to Feeder capacity	per head	10	50	30	10	152	N P205 K20	.41 .70 .70	31 22 17	12 16 12	1.9 2.4 1.8											
												Feeder-to Finish capacity	50	220	135	52	751	N P205 K20	.41 .70 .70	31 22 17	12 16 12	9.4 12 9.1
Farrow-to Feeder active sow	522	213	3180	N P205 K20	.41 .70 .70	21 15 12	8.3 10 8.1	26 33 26														
									Farrow-to Finish active sow	1417	577	8630	N P205 K20	.41 .70 .70	31 22 17	12 16 12	108 134 105					

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 19
Agronomic Division, North Carolina Department of Agriculture
** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow,
*** 6-month accumulation of manure, urine, excess water usage; does not include fresh water for flushing or lot runoff.
**** Broadcast: surface spread manure slurry uncovered for 1 month or longer.

Table 17C. LAND APPLICATION OF SWINE LIQUID MANURE SLURRY *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Manure Slurry Application Rate ** broadcast								Minimum Land Area for Slurry Application ** broadcast							
			lbs/acre/year								lbs/acre/year							
			50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Weanling-to Feeder capacity	per head	N P205 K20	4008	8016	12025	16033	20041	24049	28058	32066	.038	.019	.013	.0095	.0076	.0063	.0054	.0047
			1290	2580	3869	5159	6449	7739	9028	10318	.12	.059	.039	.029	.024	.020	.017	.015
			4115	8230	12346	16461	20576	24691	28807	32922	.037	.018	.012	.0092	.0074	.0061	.0053	.0046
Feeder-to Finish capacity	per head	N P205 K20	4008	8016	12025	16033	20041	24049	28058	32066	.19	.094	.062	.047	.037	.031	.027	.023
			1290	2580	3869	5159	6449	7739	9028	10318	.58	.29	.19	.15	.12	.097	.083	.073
			4115	8230	12346	16461	20576	24691	28807	32922	.18	.091	.061	.046	.036	.030	.026	.023
Farrow-to Weanling active sow	per active	N P205 K20	6012	12025	18037	24049	30062	36074	42086	48099	.44	.22	.15	.11	.088	.073	.063	.055
			1935	3869	5804	7739	9673	11608	13543	15477	1.4	.68	.45	.34	.27	.23	.19	.17
			6173	12346	18518	24691	30864	37037	43210	49383	.43	.21	.14	.11	.085	.071	.061	.053
Farrow-to Feeder active sow	per active	N P205 K20	6012	12025	18037	24049	30062	36074	42086	48099	.55	.26	.18	.13	.11	.088	.076	.066
			1935	3869	5804	7739	9673	11608	13543	15477	1.6	.82	.55	.41	.33	.27	.23	.21
			6173	12346	18518	24691	30864	37037	43210	49383	.52	.26	.17	.13	.10	.086	.074	.064
Farrow-to Finish active sow	per active	N P205 K20	4008	8016	12025	16033	20041	24049	28058	32066	2.2	1.1	.72	.54	.43	.36	.31	.27
			1290	2580	3869	5159	6449	7739	9028	10318	6.7	3.3	2.2	1.7	1.3	1.1	.96	.84
			4115	8230	12346	16461	20576	24691	28807	32922	2.1	1.0	.70	.52	.42	.35	.30	.26

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated swine liquid manure slurry. Values in cells I25-M54 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H54 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I61-I66 with the results calculated in columns C and K in Table C. The spreadsheet also computes herd live weight equivalents, manure slurry storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical					Actual					
	Mean- Feedr per hd	Feedr- Fin cap	Farr- Wean --per	Farr- Feed active	Farr- Fin sow	Mean- Feedr per hd	Feedr- Fin cap	Farr- Wean --per	Farr- Feed active	Farr- Fin sow	
Animal live weight: initial:	10	50				10	50				lbs
final:	50	220				50	220				lbs
average:	30	135	433	522	1417	30	135	433	522	1417	lbs
Groups per year:	6	3	2	2	2	6	3	2	2	2	groups/year
Days per group:	49	105	11	63	168	49	105	11	63	168	days/group
Manure slurry accumulation:											
manure and urines:	.30	1.4	4.3	5.2	14	.30	1.4	4.3	5.2	14	gals/animal/day
excess water usage:	.20	.9	2.9	3.5	9	.20	.9	2.9	3.5	9	gals/animal/day
total:	.50	2.3	7.2	8.7	24	.50	2.3	7.2	8.7	24	gals/animal/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon
Slurry storage period:	183	183	183	183	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:											
Tot N:	835	835	557	557	835	835	835	557	557	835	lbs/acre-inch
NH3N:	63	63	63	63	63	63	63	63	63	63	% tot N or ton
P2O5:	602	602	401	401	602	602	602	401	401	602	lbs/acre-inch
K2O:	471	471	314	314	471	471	471	314	314	471	lbs/acre-inch
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)											
N:	.34	.34	.34	.34	.34	.34	.34	.34	.34	.34	
P2O5:	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Application method:</th> <th>NH3N</th> <th colspan="5">N</th> <th>P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.78</td> <td>.78</td> <td>.78</td> <td>.78</td> <td>.78</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.66</td> <td>.66</td> <td>.66</td> <td>.66</td> <td>.66</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.41</td> <td>.41</td> <td>.41</td> <td>.41</td> <td>.41</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.34</td> <td>.34</td> <td>.34</td> <td>.34</td> <td>.34</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	N					P&K	soil injection:	.95	.78	.78	.78	.78	.78	.80	soil incorp:	.75	.66	.66	.66	.66	.66	.75	broadcast:	.35	.41	.41	.41	.41	.41	.70	irrigation:	.25	.34	.34	.34	.34	.34	.70	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;"> ppm x 2.266 = lbs/acre-inch ppm x 0.2266 = lbs/acre-inch lbs/1000 gals x 27.154 = lbs/acre-inch </p> </div>
Application method:	NH3N	N					P&K																																		
soil injection:	.95	.78	.78	.78	.78	.78	.80																																		
soil incorp:	.75	.66	.66	.66	.66	.66	.75																																		
broadcast:	.35	.41	.41	.41	.41	.41	.70																																		
irrigation:	.25	.34	.34	.34	.34	.34	.70																																		

Drop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 17a. SWINE LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Manure Slurry Storage Capacity, *** ft ³ / animal unit	Total Manure Slurry, per animal unit/year		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Available Nutrients irrigated	
		init	final	mean		gals	acre-inch		irrigated ****	lbs/acre-inch	lbs/acre-inch	lbs/animal unit/year		
		-----lbs-----												
Weanling-to Feeder capacity	per head	10	50	30	10	152	.0056	N	.34	835	286	1.6		
								P2O5	.70	602	421	2.4		
								K2O	.70	471	330	1.8		
Feeder-to Finish capacity	per head	50	220	135	52	751	.028	N	.34	835	286	7.9		
								P2O5	.70	602	421	12		
								K2O	.70	471	330	9.1		
Farrow-to Weanling sow	per active	433			176	2638	.097	N	.34	557	191	19		
		P2O5	.70	401				281	27					
		K2O	.70	314				220	21					
Farrow-to Feeder sow	per active	522			213	3180	.12	N	.34	557	191	22		
		P2O5	.70	401				281	33					
		K2O	.70	314				220	26					
Farrow-to Finish sow	per active	1417			577	8632	.32	N	.34	835	286	91		
		P2O5	.70	602				421	134					
		K2O	.70	471				330	105					

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow
 *** 6-month accumulation of manure, urine, excess water usage; does not include fresh water for flushing or lot runoff.
 **** Irrigated: sprinkler irrigated manure slurry uncovered for 1 month or longer.

Table 17c. LAND APPLICATION OF SWINE LIQUID MANURE SLURRY *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Manure Slurry Application Rate **								Minimum Land Area for Slurry Application **								
			-----irrigated-----								-----irrigated-----								
			lbs/acre/year								lbs/acre/year								
Weanling-to Feeder capacity	per head	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
			P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
			K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Feeder-to Finish capacity	per head	N	.17	.35	.52	.70	.87	1.0	1.2	1.4	.032	.016	.011	.0080	.0064	.0053	.0046	.0040	
			P2O5	.047	.095	.14	.19	.24	.28	.33	.38	.12	.059	.039	.029	.024	.020	.017	.015
			K2O	.15	.30	.45	.61	.76	.91	1.1	1.2	.057	.018	.012	.0092	.0074	.0061	.0053	.0046
Farrow-to Weanling sow	per active	N	.26	.52	.79	1.0	1.3	1.6	1.8	2.1	.37	.19	.12	.093	.074	.062	.053	.046	
			P2O5	.071	.14	.21	.28	.36	.43	.50	.57	1.4	.68	.45	.34	.27	.23	.19	.17
			K2O	.23	.45	.68	.91	1.1	1.4	1.6	1.8	.43	.21	.14	.11	.085	.071	.061	.053
Farrow-to Feeder sow	per active	N	.26	.52	.79	1.0	1.3	1.6	1.8	2.1	.45	.22	.15	.11	.089	.074	.064	.056	
			P2O5	.071	.14	.21	.28	.36	.43	.50	.57	1.6	.82	.55	.41	.33	.27	.23	.21
			K2O	.23	.45	.68	.91	1.1	1.4	1.6	1.8	.52	.26	.17	.13	.10	.086	.074	.07
Farrow-to Finish sow	per active	N	.17	.35	.52	.70	.87	1.0	1.2	1.4	1.8	.91	.61	.45	.36	.30	.26	.23	
			P2O5	.047	.095	.14	.19	.24	.28	.33	.38	6.7	3.3	2.2	1.7	1.3	1.1	.96	.86
			K2O	.15	.30	.45	.61	.76	.91	1.1	1.2	2.1	1.0	.70	.52	.42	.35	.30	.26

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated swine anaerobic lagoon liquid. Values in cells J25-P56 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-I56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J66-J68 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical								Actual								
	Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to----			Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to----					
	-----per head cap-----				-per active sow-				-----per head cap-----				-per active sow-				
Animal live initial:	10	50	50	250					10	50	50	250					lbs
weight: final:	50	220	250	550					50	220	250	550					lbs
mean:	30	135	150	400	433	522	1417		30	135	150	400	433	522	1417		lbs
Groups per year:	6	3	2	1	2	2	2		6	3	2	1	2	2	2		groups/yr
Days per group:	49	105	140	365	11	63	168		49	105	140	365	11	63	168		days/group
Lagoon liquid capacity:	(does not include freeboard on 25-yr storm storage)																
design treatment:	30	135	150	200	289	348	1417		30	135	150	200	289	348	1417		ft ³ /an cap
sludge storage:	15	68	75	100	144	174	708		15	68	75	100	144	174	708		ft ³ /an cap
temporary storage:	15	68	75	200	217	261	708		15	68	75	200	217	261	708		ft ³ /an cap
	60	270	300	500	650	783	2833		60	270	300	500	650	783	2833		ft ³ /an cap
Lagoon liquid accumulation:																	
manure and urine:	.30	1.4	1.5	4.0	4.3	5	14		.30	1.4	1.5	4.0	4.3	5	14		gal/an/day
excess water usage:	.20	.9	1.0	2.7	2.9	3	9		.20	.9	1.0	2.7	2.9	3	9		gal/an/day
surface rain surplus:	.11	.5	.5	1.4	1.6	2	5		.11	.5	.5	1.4	1.6	2	5		gal/an/day
total:	.61	2.7	3.0	8.1	8.8	11	29		.61	2.7	3.0	8.1	8.8	11	29		gal/an/day
Lagoon liquid total nutrient analysis:																	
Tot N:	136	136	136	68	91	91	136		136	136	136	68	91	91	136		lbs/ac-in
NH3N:	82	82	82	82	82	82	82		82	82	82	82	82	82	82		% N or tkn
P2O5:	53	53	53	26	35	35	53		53	53	53	26	35	35	53		lbs/ac-in
K2O:	133	133	133	67	89	89	133		133	133	133	67	89	89	133		lbs/ac-in
Org N mineralizat rate:	.50	.50	.50	.50	.50	.50	.50		.50	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients:	(from application method box)																
N:	.50	.50	.50	.50	.50	.50	.50		.50	.50	.50	.50	.50	.50	.50		
P2O5:	.70	.70	.70	.70	.70	.70	.70		.70	.70	.70	.70	.70	.70	.70		
K2O:	.70	.70	.70	.70	.70	.70	.70		.70	.70	.70	.70	.70	.70	.70		

Application method	NH3N	N							P&K
soil injection:	.95	.87	.87	.87	.87	.87	.87	.87	.80
soil incorp:	.85	.79	.79	.79	.79	.79	.79	.79	.75
broadcast:	.45	.46	.46	.46	.46	.46	.46	.46	.70
irrigation:	.50	.50	.50	.50	.50	.50	.50	.50	.70

% x 2266 = lbs/acre-inch
 ppm x 0.2266 = lbs/acre-inch
 lbs/1000 gals x 27.154 = lbs/acre-inch

Crop fertilization N:	50	lbs/ac/yr
rate: P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 18B. SWINE ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Liquid Surplus, *** per animal unit/year	Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Avail Nutrie irrigat...	
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals			inch	irrigated ****	lbs/acre inch	lbs/acre inch	lbs/animal unit/year	
		-----lbs-----													
Weanling-to Feeder per head capacity	per head	10	50	30	60	45	15	191	.0070	N	.50	136	68	.48	
										P205	.70	53	37	.26	
										K20	.70	133	93	.66	
Feeder-to Finish per head capacity	per head	50	220	135	270	200	70	927	.034	N	.50	136	68	2.3	
										P205	.70	53	37	1.3	
										K20	.70	133	93	3.2	
Gilt Developmt per head capacity	per head	50	250	150	300	225	75	1015	.037	N	.50	136	68	2.5	
										P205	.70	53	37	1.4	
										K20	.70	133	93	3.5	
Boar stud per head capacity	per head	250	550	400	500	375	125	2959	.11	N	.50	68	34	3.7	
										P205	.70	26	19	2.0	
										K20	.70	67	47	5.1	
Farrow-to Weanling active sow	per active sow			433	650	435	215	3203	.12	N	.50	91	45	5.4	
										P205	.70	35	25	2.9	
										K20	.70	89	62	7.3	
Farrow-to Feeder active sow	per active sow			522	783	523	260	3861	.14	N	.50	91	45	6.5	
										P205	.70	35	25	3.5	
										K20	.70	89	62	8.8	
Farrow-to Finish active sow	per active sow			1417	2833	2125	708	10478	.39	N	.50	136	68	26	
										P205	.70	53	37	14	
										K20	.70	133	93	36	

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow
 *** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.
 **** Irrigated: sprinkler irrigated liquid uncovered for 1 month or longer.

Table 18C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **							Minimum Land Area for Liquid Application **								
			-----irrigated-----							-----irrigated-----								
			lbs/acre/year							lbs/acre/year								
			N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350
Weanling-to Feeder per head capacity	per head	N	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.9	.0096	.0048	.0032	.0024	.0019	.0016	.0014	.0012
		P205	.54	1.1	1.6	2.2	2.7	3.2	3.8	4.3	.013	.0065	.0043	.0033	.0026	.0022	.0019	.0016
		K20	.54	1.1	1.6	2.1	2.7	3.2	3.7	4.3	.013	.0066	.0044	.0033	.0026	.0022	.0019	.0016
Feeder-to Finish per head capacity	per head	N	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.9	.047	.023	.016	.012	.0093	.0078	.0066	.0058
		P205	.54	1.1	1.6	2.2	2.7	3.2	3.8	4.3	.063	.032	.021	.016	.013	.011	.0090	.0079
		K20	.54	1.1	1.6	2.1	2.7	3.2	3.7	4.3	.064	.032	.021	.016	.013	.011	.0091	.0080
Gilt Developmt per head capacity	per head	N	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.9	.051	.025	.017	.013	.010	.0085	.0073	.0064
		P205	.54	1.1	1.6	2.2	2.7	3.2	3.8	4.3	.069	.035	.023	.017	.014	.012	.0099	.0087
		K20	.54	1.1	1.6	2.1	2.7	3.2	3.7	4.3	.070	.035	.023	.017	.014	.012	.010	.0087
Boar Stud per head capacity	per head	N	1.5	2.9	4.4	5.9	7.3	8.8	10	12	.074	.037	.025	.019	.015	.012	.011	.0093
		P205	1.1	2.2	3.2	4.3	5.4	6.5	7.6	8.6	.10	.050	.034	.025	.020	.017	.014	.013
		K20	1.1	2.1	3.2	4.3	5.4	6.4	7.5	8.6	.10	.051	.034	.025	.020	.017	.015	.013
Farrow-to Weanling active sow	per active sow	N	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	.11	.054	.036	.027	.021	.018	.015	.013
		P205	.81	1.6	2.4	3.2	4.0	4.9	5.7	6.5	.15	.073	.049	.036	.029	.024	.021	.018
		K20	.80	1.6	2.4	3.2	4.0	4.8	5.6	6.4	.15	.073	.049	.037	.029	.024	.021	.018
Farrow-to Feeder active sow	per active sow	N	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	.13	.065	.043	.032	.026	.022	.018	.016
		P205	.81	1.6	2.4	3.2	4.0	4.9	5.7	6.5	.18	.088	.059	.044	.035	.029	.025	.022
		K20	.80	1.6	2.4	3.2	4.0	4.8	5.6	6.4	.18	.088	.059	.044	.035	.029	.025	.022
Farrow-to Finish active sow	per active sow	N	.73	1.5	2.2	2.9	3.7	4.4	5.1	5.9	.53	.26	.18	.13	.11	.088	.075	
		P205	.54	1.1	1.6	2.2	2.7	3.2	3.8	4.3	.72	.36	.24	.18	.14	.12	.10	
		K20	.54	1.1	1.6	2.1	2.7	3.2	3.7	4.3	.72	.36	.24	.18	.14	.12	.10	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected swine anaerobic lagoon liquid. Values in cells J25-P56 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-I56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J66-J68 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical								Actual							
	Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to----			Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to----				
	-----per head cap-----				-per active sow-				-----per head cap-----				-per active sow-			
	initial:				Mean	Feedr	Fin		initial:				Mean	Feedr	Fin	
Animal live weight:	10	50	50	250				10	50	50	250				lbs	
weight: final:	50	220	250	550				50	220	250	550				lbs	
mean:	30	135	150	400	433	522	1417	30	135	150	400	433	522	1417	lbs	
Groups per year:	6	3	2	1	2	2	2	6	3	2	1	2	2	2	groups/yr	
Days per group:	49	105	140	365	11	63	168	49	105	140	365	11	63	168	days/group	
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)																
design treatment:	30	135	150	200	289	348	1417	30	135	150	200	289	348	1417	ft3/an cap	
sludge storage:	15	68	75	100	144	174	708	15	68	75	100	144	174	708	ft3/an cap	
temporary storage:	15	68	75	200	217	261	708	15	68	75	200	217	261	708	ft3/an cap	
	60	270	300	500	650	783	2833	60	270	300	500	650	783	2833	ft3/an cap	
Lagoon liquid accumulation:																
manure and urine:	.30	1.4	1.5	4.0	4.3	5	14	.30	1.4	1.5	4.0	4.3	5	14	gal/an/day	
excess water usage:	.20	.9	1.0	2.7	2.9	3	9	.20	.9	1.0	2.7	2.9	3	9	gal/an/day	
surface rain surplus:	.11	.5	.5	1.4	1.6	2	5	.11	.5	.5	1.4	1.6	2	5	gal/an/day	
total:	.61	2.7	3.0	8.1	8.8	11	29	.61	2.7	3.0	8.1	8.8	11	29	gal/an/day	
Lagoon liquid total nutrient analysis:																
Tot N:	5.0	5.0	5.0	2.5	3.3	3.3	5.0	5.0	5.0	5.0	2.5	3.3	3.3	5.0	lb/1000gal	
NH3N:	82	82	82	82	82	82	82	82	82	82	82	82	82	82	% N or tkn	
P2O5:	1.9	1.9	1.9	1.0	1.3	1.3	1.9	1.9	1.9	1.9	1.0	1.3	1.3	1.9	lb/1000gal	
K2O:	4.9	4.9	4.9	2.5	3.3	3.3	4.9	4.9	4.9	4.9	2.5	3.3	3.3	4.9	lb/1000gal	
Org N mineralizat rate:	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients: (from application method box)																
N:	.87	.87	.87	.87	.87	.87	.87	.87	.87	.87	.87	.87	.87	.87		
P2O5:	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80		
K2O:	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80		
Application method	NH3N	-----N-----							P&K							
soil injection:	95	.87	.87	.87	.87	.87	.87	.87	.80							
soil incorp:	85	.79	.79	.79	.79	.79	.79	.79	.75							
broadcast:	45	.46	.46	.46	.46	.46	.46	.46	.70							
irrigation:	50	.50	.50	.50	.50	.50	.50	.50	.70							
Crop fertilization N:								50								lbs/ac/yr
rate: P2O5:								20								lbs/ac/yr
K2O:								50								lbs/ac/yr

$2 \times 2266 = \text{lbs/acre-inch}$
 $\text{ppm} \times 0.2266 = \text{lbs/acre-inch}$
 $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$

Scroll down for results.

Table 188. SWINE ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Liquid Surplus, *** per animal unit/year		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Avail Nutrient soil inje.	
		init	final	mean	single stage	2-stage 1st + 2nd	gals	acre-inch	soil injected ****		lbs/acre inch	lbs/acre inch	lbs/animal unit/year			
		-----lbs-----														
Weanling-to Feeder	per head capacity	10	50	30	60	45	15	191	.0070	N	.87	5.0	4.4	.83		
										P205	.80	1.9	1.6	.30		
										K20	.80	4.9	3.9	.75		
Feeder-to Finish	per head capacity	50	220	135	270	200	70	927	.034	N	.87	5.0	4.4	4.0		
										P205	.80	1.9	1.6	1.4		
										K20	.80	4.9	3.9	3.6		
Gilt Developmt	per head capacity	50	250	150	300	225	75	1015	.037	N	.87	5.0	4.4	4.4		
										P205	.80	1.9	1.6	1.6		
										K20	.80	4.9	3.9	4.0		
Boar stud	per head capacity	250	550	400	500	375	125	2959	.11	N	.87	2.5	2.2	6.4		
										P205	.80	.97	.78	2.3		
										K20	.80	2.5	2.0	5.8		
Farrow-to Weanling	per active sow			433	650	435	215	3203	.12	N	.87	3.3	2.9	9.3		
										P205	.80	1.3	1.0	3.3		
										K20	.80	3.3	2.6	8.4		
Farrow-to Feeder	per active sow			522	783	523	260	3861	.14	N	.87	3.3	2.9	11		
										P205	.80	1.3	1.0	4.0		
										K20	.80	3.3	2.6	10		
Farrow-to Finish	per active sow		1417	2833	2125	708	10478	.39	N	.87	5.0	4.4	46			
										P205	.80	1.9	1.6	16		
										K20	.80	4.9	3.9	41		

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow
 *** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.
 **** Soil injected: lagoon liquid injected directly into the soil and covered immediately.

Table 18C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Animal Unit	Rate Limiting Nutrient	Lagoon Liquid Application Rate **								Minimum Land Area for Liquid Application **							
			soil injected								soil injected							
			lbs/acre/year								lbs/acre/year							
			N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350
Weanling-to Feeder	per head capacity	N	11487	22974	34460	45947	57434	68921	80407	91894	.017	.0083	.0055	.0042	.0033	.0028	.0024	.0021
		P205	12822	25644	38466	51288	64109	76931	89753	1.0e5	.015	.0074	.0050	.0037	.0030	.0025	.0021	.0019
		K20	12725	25450	38174	50899	63624	76349	89073	1.0e5	.015	.0075	.0050	.0038	.0030	.0025	.0021	.0019
Feeder-to Finish	per head capacity	N	11487	22974	34460	45947	57434	68921	80407	91894	.081	.040	.027	.020	.016	.013	.012	.010
		P205	12822	25644	38466	51288	64109	76931	89753	1.0e5	.072	.036	.024	.018	.014	.012	.010	.0090
		K20	12725	25450	38174	50899	63624	76349	89073	1.0e5	.073	.036	.024	.018	.015	.012	.010	.0091
Gilt Developmt	per head capacity	N	11487	22974	34460	45947	57434	68921	80407	91894	.088	.044	.029	.022	.018	.015	.013	.011
		P205	12822	25644	38466	51288	64109	76931	89753	1.0e5	.079	.040	.026	.020	.016	.013	.011	.0099
		K20	12725	25450	38174	50899	63624	76349	89073	1.0e5	.080	.040	.027	.020	.016	.013	.011	.010
Boar Stud	per head capacity	N	22974	45947	68921	91894	1.1e5	1.4e5	1.6e5	1.8e5	.13	.064	.043	.032	.026	.021	.018	.016
		P205	25644	51288	76931	1.0e5	1.3e5	1.5e5	1.8e5	2.1e5	.12	.058	.038	.029	.023	.019	.016	.014
		K20	25450	50899	76349	1.0e5	1.3e5	1.5e5	1.8e5	2.0e5	.12	.058	.039	.029	.023	.019	.017	.015
Farrow-to Weanling	per active sow	N	17230	34460	51690	68921	86151	1.0e5	1.2e5	1.4e5	.19	.093	.062	.046	.037	.031	.027	.023
		P205	19233	38466	57698	76931	96164	1.2e5	1.3e5	1.5e5	.17	.083	.056	.042	.033	.028	.024	.021
		K20	19087	38174	57261	76349	95436	1.1e5	1.3e5	1.5e5	.17	.084	.056	.042	.034	.028	.024	.021
Farrow-to Feeder	per active sow	N	17230	34460	51690	68921	86151	1.0e5	1.2e5	1.4e5	.22	.11	.075	.056	.045	.037	.032	.028
		P205	19233	38466	57698	76931	96164	1.2e5	1.3e5	1.5e5	.20	.10	.067	.050	.040	.033	.029	.025
		K20	19087	38174	57261	76349	95436	1.1e5	1.3e5	1.5e5	.20	.10	.067	.051	.040	.034	.029	.025
Farrow-to Finish	per active sow	N	11487	22974	34460	45947	57434	68921	80407	91894	.91	.46	.30	.23	.18	.15	.13	
		P205	12822	25644	38466	51288	64109	76931	89753	1.0e5	.82	.41	.27	.20	.16	.14	.12	
		K20	12725	25450	38174	50899	63624	76349	89073	1.0e5	.82	.41	.27	.21	.16	.14	.12	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated swine anaerobic lagoon liquid. Values in cells J25-P56 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-I56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J66-J68 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

		Typical							Actual						
		Mean-Feedr	Gilt-Dev	Boar-Stud	----Farrow-to---			Mean-Feedr	Gilt-Dev	Boar-Stud	----Farrow-to---				
		-Fin			Mean	Feedr	Fin	-Fin			Mean	Feedr	Fin		
		per head cap	per head cap	per head cap	per active sow	per active sow	per active sow	per head cap	per head cap	per head cap	per active sow	per active sow	per active sow		
Animal live	initial:	10	50	50	250			10	50	50	250			lbs	
weight:	final:	50	220	250	550			50	220	250	550			lbs	
	mean:	30	135	150	400	433	522	1417	30	135	150	400	433	522	1417
Groups per year:		6	3	2	1	2	2	2	6	3	2	1	2	2	2
Days per group:		49	105	140	365	11	63	168	49	105	140	365	11	63	168
Lagoon liquid capacity:	(does not include freeboard or 25-yr storm storage)														
design treatment:		30	135	150	200	289	348	1417	30	135	150	200	289	348	1417
sludge storage:		15	68	75	100	144	174	708	15	68	75	100	144	174	708
temporary storage:		15	68	75	200	217	261	708	15	68	75	200	217	261	708
		60	270	300	500	650	783	2833	60	270	300	500	650	783	2833
Lagoon liquid accumulation:															
manure and urine:		.30	1.4	1.5	4.0	4.3	5	14	.30	1.4	1.5	4.0	4.3	5	14
excess water usage:		.20	.9	1.0	2.7	2.9	3	9	.20	.9	1.0	2.7	2.9	3	9
surface rain surplus:		.11	.5	.5	1.4	1.6	2	5	.11	.5	.5	1.4	1.6	2	5
total:		.61	2.7	3.0	8.1	8.8	11	29	.61	2.7	3.0	8.1	8.8	11	29
Lagoon liquid total nutrient analysis:															
Tot N:		5.0	5.0	5.0	2.5	3.3	3.3	5.0	5.0	5.0	5.0	2.5	3.3	3.3	5.0
NH3N:		82	82	82	82	82	82	82	82	82	82	82	82	82	82
P2O5:		1.9	1.9	1.9	1.0	1.3	1.3	1.9	1.9	1.9	1.9	1.0	1.3	1.3	1.9
K2O:		4.9	4.9	4.9	2.5	3.3	3.3	4.9	4.9	4.9	4.9	2.5	3.3	3.3	4.9
Org N mineralizat rate:		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
Plant nutrient availability coefficients:	(from application method box)														
N:		.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79
P2O5:		.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
K2O:		.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75

Application method	NH3N	N							P&K
soil injection:	.95	.87	.87	.87	.87	.87	.87	.87	.80
soil incorp:	.85	.79	.79	.79	.79	.79	.79	.79	.75
broadcast:	.45	.46	.46	.46	.46	.46	.46	.46	.70
irrigation:	.50	.50	.50	.50	.50	.50	.50	.50	.70

% x 2266 = lbs/acre-inch
 ppm x 0.2266 = lbs/acre-inch
 lbs/1000 gals x 27.154 = lbs/acre-inch

Crop fertilization N:	50	lbs/ac/yr
rate: P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 188. SWINE ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Liquid Surplus, *** per animal unit/year		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Avail Nutrie soil incorpo	
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals	inch	soil incorporated ****		lbs/1000 gals	lbs/1000 gals	lbs/1000 gals	lbs/animal unit/year		
		-----lbs-----														
Weanling-to Feeder per head capacity		10	50	30	60	45	15	191	.0070	N	.79	5.0	3.9	.75		
		P205									.75	1.9	1.5	.28		
		K20									.75	4.9	3.7	.70		
Feeder-to Finish per head capacity		50	220	135	270	200	70	927	.034	N	.79	5.0	3.9	3.7		
		P205									.75	1.9	1.5	1.4		
		K20									.75	4.9	3.7	3.4		
Gilt Developmt per head capacity		50	250	150	300	225	75	1015	.037	N	.79	5.0	3.9	4.0		
		P205									.75	1.9	1.5	1.5		
		K20									.75	4.9	3.7	3.7		
Boar stud per head capacity		250	550	400	500	375	125	2959	.11	N	.79	2.5	2.0	5.8		
		P205									.75	.97	.73	2.2		
		K20									.75	2.5	1.8	5.4		
Farrow-to Weanling active sow				433	650	435	215	3203	.12	N	.79	3.3	2.6	8.4		
		P205									.75	1.3	.97	3.1		
		K20									.75	3.3	2.5	7.9		
Farrow-to Feeder active sow				522	783	523	260	3861	.14	N	.79	3.3	2.6	10		
		P205									.75	1.3	.97	3.8		
		K20									.75	3.3	2.5	9.5		
Farrow-to Finish active sow				1417	2833	2125	708	10478	.39	N	.79	5.0	3.9	41		
		P205									.75	1.9	1.5	15		
		K20									.75	4.9	3.7	39		

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990 Agronomic Division, North Carolina Department of Agriculture

** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow

*** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.

**** Soil incorporated: surface spread liquid plowed or disked into soil within 2 days.

Table 18C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **										Minimum Land Area for Liquid Application **							
			soil incorporated										soil incorporated							
			-----lbs/acre/year-----										-----lbs/acre/year-----							
Weanling-to Feeder per head capacity		N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400		
			P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
			K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Feeder-to Finish per head capacity		N	12681	25362	38044	50725	63406	76087	88768	1.0e5	.073	.037	.024	.018	.015	.012	.010	.0091		
			P205	13677	27353	41030	54707	68383	82060	95737	1.1e5	.068	.034	.023	.017	.014	.011	.0097	.0085	
			K20	13573	27146	40719	54292	67865	81438	95012	1.1e5	.068	.034	.023	.017	.014	.011	.0098	.0085	
Gilt Developmt per head capacity		N	12681	25362	38044	50725	63406	76087	88768	1.0e5	.080	.040	.027	.020	.016	.013	.011	.010		
			P205	13677	27353	41030	54707	68383	82060	95737	1.1e5	.074	.037	.025	.019	.015	.012	.011	.0093	
			K20	13573	27146	40719	54292	67865	81438	95012	1.1e5	.075	.037	.025	.019	.015	.012	.011	.0093	
Boar Stud per head capacity		N	25362	50725	76087	1.0e5	1.3e5	1.5e5	1.8e5	2.0e5	.12	.058	.039	.029	.023	.019	.017	.015		
			P205	27353	54707	82060	1.1e5	1.4e5	1.6e5	1.9e5	2.2e5	.11	.054	.036	.027	.022	.018	.015	.014	
			K20	27146	54292	81438	1.1e5	1.4e5	1.6e5	1.9e5	2.2e5	.11	.054	.036	.027	.022	.018	.016	.014	
Farrow-to Weanling active sow		N	19022	38044	57065	76087	95109	1.1e5	1.3e5	1.5e5	.17	.084	.056	.042	.034	.028	.024	.021		
			P205	20515	41030	61545	82060	1.0e5	1.2e5	1.4e5	1.6e5	.16	.078	.052	.039	.031	.024	.022	.020	
			K20	20360	40719	61079	81438	1.0e5	1.2e5	1.4e5	1.6e5	.16	.079	.052	.039	.031	.024	.022	.020	
Farrow-to Feeder active sow		N	19022	38044	57065	76087	95109	1.1e5	1.3e5	1.5e5	.20	.10	.068	.051	.041	.034	.029	.025		
			P205	20515	41030	61545	82060	1.0e5	1.2e5	1.4e5	1.6e5	.19	.094	.063	.047	.038	.031	.027	.023	
			K20	20360	40719	61079	81438	1.0e5	1.2e5	1.4e5	1.6e5	.19	.095	.063	.047	.038	.032	.027	.023	
Farrow-to Finish active sow		N	12681	25362	38044	50725	63406	76087	88768	1.0e5	.83	.41	.28	.21	.17	.14	.12			
			P205	13677	27353	41030	54707	68383	82060	95737	1.1e5	.77	.38	.26	.19	.15	.13	.11		
			K20	13573	27146	40719	54292	67865	81438	95012	1.1e5	.77	.39	.26	.19	.15	.13	.11		

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast swine anaerobic lagoon liquid. Values in cells I25-P56 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-I56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J66-J68 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical								Actual									
	Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to----			Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to----						
	-----per head cap-----				-per active sow-				-----per head cap-----				-per active sow-					
Animal live weight:	initial:	10	50	50	250					10	50	50	250					lbs
	final:	50	220	250	550					50	220	250	550					lbs
	mean:	30	135	150	400	433	522	1417		30	135	150	400	433	522	1417		lbs
Groups per year:		6	3	2	1	2	2	2		6	3	2	1	2	2	2		groups/yr
Days per group:		49	105	140	365	11	63	168		49	105	140	365	11	63	168		days/group
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)																		
design treatment:		30	135	150	200	289	348	1417		30	135	150	200	289	348	1417		ft ³ /an cap
sludge storage:		15	68	75	100	144	174	708		15	68	75	100	144	174	708		ft ³ /an cap
temporary storage:		15	68	75	200	217	261	708		15	68	75	200	217	261	708		ft ³ /an cap
		60	270	300	500	650	783	2833		60	270	300	500	650	783	2833		ft ³ /an cap
Lagoon liquid accumulation:																		
manure and urine:		.30	1.4	1.5	4.0	4.3	5	14		.30	1.4	1.5	4.0	4.3	5	14		gal/an/day
excess water usage:		.20	.9	1.0	2.7	2.9	3	9		.20	.9	1.0	2.7	2.9	3	9		gal/an/day
surface rain surplus:		.11	.5	.5	1.4	1.6	2	5		.11	.5	.5	1.4	1.6	2	5		gal/an/day
total:		.61	2.7	3.0	8.1	8.8	11	29		.61	2.7	3.0	8.1	8.8	11	29		gal/an/day
Lagoon liquid total nutrient analysis:																		
Tot N:		5.0	5.0	5.0	2.5	3.3	3.3	5.0		5.0	5.0	5.0	2.5	3.3	3.3	5.0		lb/1000gal
NH3N:		82	82	82	82	82	82	82		82	82	82	82	82	82	82		% N or tkn
P2O5:		1.9	1.9	1.9	1.0	1.3	1.3	1.9		1.9	1.9	1.9	1.0	1.3	1.3	1.9		lb/1000gal
K2O:		4.9	4.9	4.9	2.5	3.3	3.3	4.9		4.9	4.9	4.9	2.5	3.3	3.3	4.9		lb/1000gal
Org N mineralizat rate:		.50	.50	.50	.50	.50	.50	.50		.50	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients: (from application method box)																		
N:		.46	.46	.46	.46	.46	.46	.46		.46	.46	.46	.46	.46	.46	.46		
P2O5:		.70	.70	.70	.70	.70	.70	.70		.70	.70	.70	.70	.70	.70	.70		
K2O:		.70	.70	.70	.70	.70	.70	.70		.70	.70	.70	.70	.70	.70	.70		

Application method	NH3N	N							P&K
soil injection:	.95	.87	.87	.87	.87	.87	.87	.87	.80
soil incorp:	.85	.79	.79	.79	.79	.79	.79	.79	.75
broadcast:	.45	.46	.46	.46	.46	.46	.46	.46	.70
irrigation:	.50	.50	.50	.50	.50	.50	.50	.50	.70

% x 2266 = lbs/acre-inch
 ppm x 0.2266 = lbs/acre-inch
 lbs/1000 gals x 27.154 = lbs/acre-inch

Crop fertilization N:		50		lbs/ac/yr
rate:	P2O5:	20		lbs/ac/yr
	K2O:	50		lbs/ac/yr

Scroll down for results.

Table 188. SWINE ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Liquid Surplus, *** per animal unit/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients	Plant Avail Nutrient broadcast			
		init	final	mean	single stage	2-stage 1st + 2nd	acre-					broadcast ****	lbs/1000 gals	lbs/1000 gals	lbs/animal unit/year
		-----lbs-----			-----gals inch										
Weanling-to Feeder capacity	per head	10	50	30	60	45	15	191	.0070	N P205 K20	.46 .70 .70	5.0 1.9 4.9	2.3 1.4 3.4	.44 .26 .66	
Feeder-to Finish capacity	per head	50	220	135	270	200	70	927	.034	N P205 K20	.46 .70 .70	5.0 1.9 4.9	2.3 1.4 3.4	2.1 1.3 3.2	
Gilt Developmt capacity	per head	50	250	150	300	225	75	1015	.037	N P205 K20	.46 .70 .70	5.0 1.9 4.9	2.3 1.4 3.4	2.3 1.4 3.5	
Boar stud capacity	per head	250	550	400	500	375	125	2959	.11	N P205 K20	.46 .70 .70	2.5 1.0 2.5	1.2 .68 1.7	3.4 2.0 5.1	
Farrow-to Weanling active sow	per active sow			433	650	435	215	3203	.12	N P205 K20	.46 .70 .70	3.3 1.3 3.3	1.5 .91 2.3	4.9 2.9 7.3	
Farrow-to Feeder active sow	per active sow			522	783	523	260	3861	.14	N P205 K20	.46 .70 .70	3.3 1.3 3.3	1.5 .91 2.3	5.9 3.5 8.8	
Farrow-to Finish active sow	per active sow			1417	2833	2125	708	10478	.39	N P205 K20	.46 .70 .70	5.0 1.9 4.9	2.3 1.4 3.4	24 14 36	

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture
** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow/
*** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.
**** Broadcast: surface spread liquid uncovered for one month or longer.

Table 18C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **								Minimum Land Area for Liquid Application ***							
			broadcast								broadcast							
			-----lbs/acre/year-----								-----lbs/acre/year-----							
Weanling-to Feeder capacity	per head	N	50	100	150	200	250	300	350	400	.0088	.0044	.0029	.0022	.0018	.0015	.0013	.0011
		P205	20	40	60	80	100	120	140	160	.013	.0065	.0043	.0033	.0026	.0022	.0019	.0016
		K20	50	100	150	200	250	300	350	400	.013	.0066	.0044	.0033	.0026	.0022	.0019	.0016
Feeder-to Finish capacity	per head	N	21712	43423	65135	86847	1.1e5	1.3e5	1.5e5	1.7e5	.043	.021	.014	.011	.0085	.0071	.0061	.0053
		P205	14654	29307	43961	58614	73268	87921	1.0e5	1.2e5	.063	.032	.021	.016	.013	.011	.0090	.0079
		K20	14543	29085	43628	58170	72713	87255	1.0e5	1.2e5	.064	.032	.021	.016	.013	.011	.0091	.0080
Gilt Developmt capacity	per head	N	21712	43423	65135	86847	1.1e5	1.3e5	1.5e5	1.7e5	.047	.023	.016	.012	.0093	.0078	.0067	.0058
		P205	14654	29307	43961	58614	73268	87921	1.0e5	1.2e5	.069	.035	.023	.017	.014	.012	.0099	.0087
		K20	14543	29085	43628	58170	72713	87255	1.0e5	1.2e5	.070	.035	.023	.017	.014	.012	.010	.0087
Boar Stud capacity	per head	N	43423	86847	1.3e5	1.7e5	2.2e5	2.6e5	3.0e5	3.5e5	.068	.034	.023	.017	.014	.011	.0097	.0085
		P205	29307	58614	87921	1.2e5	1.5e5	1.8e5	2.1e5	2.3e5	.10	.050	.034	.025	.020	.017	.014	.013
		K20	29085	58170	87255	1.2e5	1.5e5	1.7e5	2.0e5	2.3e5	.10	.051	.034	.025	.020	.017	.015	.013
Farrow-to Weanling active sow	per active sow	N	32568	65135	97703	1.3e5	1.6e5	2.0e5	2.3e5	2.6e5	.098	.049	.033	.025	.020	.016	.014	.012
		P205	21980	43961	65941	87921	1.1e5	1.3e5	1.5e5	1.8e5	.15	.073	.049	.036	.029	.024	.021	.018
		K20	21814	43628	65442	87255	1.1e5	1.3e5	1.5e5	1.7e5	.15	.073	.049	.037	.029	.024	.021	.018
Farrow-to Feeder active sow	per active sow	N	32568	65135	97703	1.3e5	1.6e5	2.0e5	2.3e5	2.6e5	.12	.059	.040	.030	.024	.020	.017	.015
		P205	21980	43961	65941	87921	1.1e5	1.3e5	1.5e5	1.8e5	.18	.088	.059	.044	.035	.029	.025	.022
		K20	21814	43628	65442	87255	1.1e5	1.3e5	1.5e5	1.7e5	.18	.088	.059	.044	.035	.029	.025	
Farrow-to Finish active sow	per active sow	N	21712	43423	65135	86847	1.1e5	1.3e5	1.5e5	1.7e5	.48	.24	.16	.12	.097	.080	.069	
		P205	14654	29307	43961	58614	73268	87921	1.0e5	1.2e5	.72	.36	.24	.18	.14	.12	.10	
		K20	14543	29085	43628	58170	72713	87255	1.0e5	1.2e5	.72	.36	.24	.18	.14	.12	.10	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected swine anaerobic lagoon sludge. Values in cells J25-P54 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-I54 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J64-J66 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical								Actual							
	Mean	Feedr	Gilt	Boar	----Farrow-to---			Mean	Feedr	Gilt	Boar	----Farrow-to---				
	Feedr	-Fin	Dev	Stud	Mean	Feedr	Fin	Feedr	-Fin	Dev	Stud	Mean	Feedr	Fin		
	-----per head cap-----				-per active sow-				-----per head cap-----				-per active sow-			
Animal live weight:	initial:	10	50	50	250				10	50	50	250				lbs
	final:	50	220	250	550				50	220	250	550				lbs
	mean:	30	135	150	400	433	522	1417	30	135	150	400	433	522	1417	lbs
Groups per year:		6	3	2	1	2	2	2	6	3	2	1	2	2	2	groups/yr
Days per group:		49	105	140	365	11	63	168	49	105	140	365	11	63	168	days/group
Lagoon liquid capacity:	(does not include freeboard or 25-yr storm storage)															
design treatment:	30	135	150	200	289	348	1417	30	135	150	200	289	348	1417	ft ³ /an cap	
sludge storage:	15	68	75	100	144	174	708	15	68	75	100	144	174	708	ft ³ /an cap	
temporary storage:	15	68	75	200	217	261	708	15	68	75	200	217	261	708	ft ³ /an cap	
	60	270	300	500	650	783	2833	60	270	300	500	650	783	2833	ft ³ /an cap	
Lag sludge accumulatin:	.022	.10	.11	.15	.21	.26	1.0	.022	.10	.11	.15	.21	.26	1.0	gal/an/day	
Lagoon sludge density :	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	lbs/gallon	
Lagoon sludge total nutrient analysis:																
Tot N:	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	lb/1000gal
NH3M:	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	% N or tkn
P2O5:	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	lb/1000gal
K2O:	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	lb/1000gal
Org N mineralizat rate:	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)																
N:	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	.60	
P2O5:	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	
K2O:	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	

Application method	NH3M	-----N-----							P&K
soil injection:	.95	.60	.60	.60	.60	.60	.60	.60	.80
soil incorp:	.75	.56	.56	.56	.56	.56	.56	.56	.75
broadcast:	.35	.47	.47	.47	.47	.47	.47	.47	.70
irrigation:	.25	.44	.44	.44	.44	.44	.44	.44	.70

$\% \times 2266 = \text{lbs/acre-inch}$ $\text{ppm} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$

Crop fertilization N:	50	lbs/ac/yr
rate: P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 19B. SWINE ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Sludge Accumulation, ***		Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients		Plant Avail. Nutri soil in, lbs/animal unit/year														
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³	soil injected ****			lbs/1000 gals	lbs/1000 gals	lbs/1000 gals	lbs/animal unit/year													
		-----lbs-----																										
Weanling-to Feeder capacity	per head	10	50	30	60	45	15	6.7	.90	N P205 K20	.60 .80 .80	24 52 6.6	15 42 5.3	.098 .28 .035														
															per head capacity	50	220	135	270	200	70	33	4.4	N P205 K20	.60 .80 .80	24 52 6.6	15 42 5.3	.48 1.4 .18
Boar stud capacity	per head capacity	250	550	400	500	375	125	54	7.2	N P205 K20	.60 .80 .80	24 52 6.6	15 42 5.3	.78 2.3 .28														
															per head capacity	433	650	435	215	78	10	N P205 K20	.60 .80 .80	24 52 6.6	15 42 5.3	1.1 3.2 .41		
																											per active sow	522
Farrow-to Finish active sow	per active sow	1417	2833	2125	708	382	51	N P205 K20	.60 .80 .80	24 52 6.6	15 42 5.3	5.6 16 2.0																

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1993
Agronomic Division, North Carolina Department of Agriculture
** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow
*** No manure solids removal prior to lagoon input.
**** Soil injected: lagoon sludge injected directly into the soil and covered immediately.

Table 19C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **								Minimum Land Area for Sludge Application **							
			soil injected								soil injected							
			lbs/acre/year								lbs/acre/year							
			-----gallons/acre/year-----								-----acres/animal unit-----							
Weanling-to Feeder capacity	per head capacity	N P205 K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			3435	6870	10305	13740	17176	20611	24046	27481	.0020	.0010	.0007	.0005	.0004	.0003	.0003	.0002
			478	957	1435	1914	2392	2871	3349	3828	.014	.0070	.0047	.0035	.0028	.0023	.0020	.0018
Feeder-to Finish capacity	per head capacity	N P205 K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			3435	6870	10305	13740	17176	20611	24046	27481	.0097	.0048	.0032	.0024	.0019	.0016	.0014	.0012
			478	957	1435	1914	2392	2871	3349	3828	.069	.035	.023	.017	.014	.012	.0099	.0087
Gilt Developat capacity	per head capacity	N P205 K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			3435	6870	10305	13740	17176	20611	24046	27481	.011	.0055	.0037	.0027	.0022	.0018	.0016	.0014
			478	957	1435	1914	2392	2871	3349	3828	.079	.039	.026	.020	.016	.013	.011	.0098
Boar Stud capacity	per head capacity	N P205 K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			3435	6870	10305	13740	17176	20611	24046	27481	.016	.0078	.0052	.0039	.0031	.0026	.0022	.0020
			478	957	1435	1914	2392	2871	3349	3828	.11	.056	.038	.028	.023	.019	.016	.014
Farrow-to Weanling active sow	per active sow	N P205 K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			3435	6870	10305	13740	17176	20611	24046	27481	.023	.011	.0075	.0057	.0045	.0038	.0032	.0028
			478	957	1435	1914	2392	2871	3349	3828	.16	.081	.054	.041	.032	.027	.023	.020
Farrow-to Feeder active sow	per active sow	N P205 K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			3435	6870	10305	13740	17176	20611	24046	27481	.027	.014	.0091	.0068	.0055	.0045	.0039	.0034
			478	957	1435	1914	2392	2871	3349	3828	.20	.098	.065	.049	.039	.033	.028	.024
Farrow-to Finish active sow	per active sow	N P205 K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			3435	6870	10305	13740	17176	20611	24046	27481	.11	.056	.037	.028	.022	.019	.016	.1
			478	957	1435	1914	2392	2871	3349	3828	.80	.40	.27	.20	.16	.13	.11	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1993
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated swine anaerobic lagoon sludge. Values in cells J25-PS4 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-IS4 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J64-J66 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

		Typical							Actual							
		Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to- Mean Feedr Fin -per active sow-			Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to- Mean Feedr Fin -per active sow-			
		-----per head cap-----														
Animal live weight:	initial:	10	50	50	250				10	50	50	250				lbs
	final:	50	220	250	550				50	220	250	550				lbs
	mean:	30	135	150	400	433	522	1417	30	135	150	400	433	522	1417	lbs
Groups per year:		6	3	2	1	2	2	2	6	3	2	1	2	2	2	groups/yr
Days per group:		49	105	140	365	11	63	168	49	105	140	365	11	63	168	days/group
Lagoon liquid capacity:	(does not include freeboard or 25-yr storm storage)															
	design treatment:	30	135	150	200	289	348	1417	30	135	150	200	289	348	1417	ft ³ /an cap
	sludge storage:	15	68	75	100	144	174	708	15	68	75	100	144	174	708	ft ³ /an cap
	temporary storage:	15	68	75	200	217	261	708	15	68	75	200	217	261	708	ft ³ /an cap
		60	270	300	500	650	783	2833	60	270	300	500	650	783	2833	ft ³ /an cap
Lag sludge accumulatin:		.022	.10	.11	.15	.21	.26	1.0	.022	.10	.11	.15	.21	.26	1.0	gal/an/day
Lagoon sludge density:		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	lbs/gallon
Lagoon sludge total nutrient analysis:																
	Tot N:	24	24	24	24	24	24	24	24	24	24	24	24	24	24	lb/1000gal
	NH3N:	22	22	22	22	22	22	22	22	22	22	22	22	22	22	% N or tcn
	P2O5:	52	52	52	52	52	52	52	52	52	52	52	52	52	52	lb/1000gal
	K2O:	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	lb/1000gal
Org N mineralizat rate:		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients:	(from application method box)															
	N:	.56	.56	.56	.56	.56	.56	.56	.56	.56	.56	.56	.56	.56	.56	
	P2O5:	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	
	K2O:	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	

Application method	NH3N	-----N-----							P&K
soil injection:	.95	.60	.60	.60	.60	.60	.60	.60	.80
soil incorp:	.75	.56	.56	.56	.56	.56	.56	.56	.75
broadcast:	.35	.47	.47	.47	.47	.47	.47	.47	.70
irrigation:	.25	.44	.44	.44	.44	.44	.44	.44	.70

% x 2266 = lbs/acre-inch
 ppm x 0.2266 = lbs/acre-inch
 lbs/1000 gals x 27.154 = lbs/acre-inch

Crop fertilization N:	50	lbs/ac/yr
rate: P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 19B. SWINE ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Sludge Accumulation, per animal unit/year		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Available Nutrient soil incorp.	
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³	soil incorporated		lbs/1000 gals	lbs/1000 gals	lbs/1000 gals	lbs/animal unit/year		
		-----lbs-----														
Weanling-to Feeder capacity	per head	10	50	30	60	45	15	6.7	.90	N	.56	24	13	.090		
										P205	.75	52	39	.26		
										K20	.75	6.6	5.0	.033		
Feeder-to Finish capacity	per head	50	220	135	270	200	70	33	4.4	N	.56	24	13	.45		
										P205	.75	52	39	1.3		
										K20	.75	6.6	5.0	.16		
Gilt Develop capacity	per head	50	250	150	300	225	75	38	5.0	N	.56	24	13	.51		
										P205	.75	52	39	1.5		
										K20	.75	6.6	5.0	.19		
Boar stud capacity	per head	250	550	400	500	375	125	54	7.2	N	.56	24	13	.73		
										P205	.75	52	39	2.1		
										K20	.75	6.6	5.0	.27		
Farrow-to Weanling active sow	per active sow				433	650	435	215	78	10	N	.56	24	13	1.0	
		P205	.75	52							39	3.0				
		K20	.75	6.6							5.0	.39				
Farrow-to Feeder active sow	per active sow				522	783	523	260	94	13	N	.56	24	13	1.3	
		P205	.75	52							39	3.7				
		K20	.75	6.6							5.0	.46				
Farrow-to Finish active sow	per active sow				1417	2833	2125	708	382	51	N	.56	24	13	5.1	
		P205	.75	52							39	15				
		K20	.75	6.6							5.0	1.9				

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1993
Agronomic Division, North Carolina Department of Agriculture
** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow/v
*** No manure solids removal prior to lagoon input.
**** Soil incorporated: surface spread sludge plowed or disked into soil within 2 days.

Table 19C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **								Minimum Land Area for Sludge Application **								
			-----soil incorporated-----								-----soil incorporated-----								
			-----lbs/acre/year-----								-----lbs/acre/year-----								
Weanling-to Feeder capacity	per head	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
			P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
			K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
			-----gallons/acre/year-----								-----acres/animal unit-----								
Weanling-to Feeder capacity	per head	N	3713	7425	11138	14850	18563	22276	25988	29701	.0018	.0009	.0006	.0005	.0004	.0003	.0003	.0002	
			P205	510	1021	1531	2041	2552	3062	3572	4083	.013	.0066	.0044	.0033	.0026	.0022	.0019	.0016
			K20	10090	20180	30270	40360	50451	60541	70631	80721	.0007	.0003	.0002	.0002	.0001	.0001	.0001	.0001
Feeder-to Finish capacity	per head	N	3713	7425	11138	14850	18563	22276	25988	29701	.0089	.0045	.0030	.0022	.0018	.0015	.0013	.0011	
			P205	510	1021	1531	2041	2552	3062	3572	4083	.065	.033	.022	.016	.013	.011	.0093	.0081
			K20	10090	20180	30270	40360	50451	60541	70631	80721	.0033	.0016	.0011	.0008	.0007	.0005	.0005	.0004
Gilt Develop capacity	per head	N	3713	7425	11138	14850	18563	22276	25988	29701	.010	.0051	.0034	.0025	.0020	.0017	.0015	.0013	
			P205	510	1021	1531	2041	2552	3062	3572	4083	.074	.037	.025	.018	.015	.012	.011	.0092
			K20	10090	20180	30270	40360	50451	60541	70631	80721	.0037	.0019	.0012	.0009	.0007	.0006	.0005	.0005
Boar Stud capacity	per head	N	3713	7425	11138	14850	18563	22276	25988	29701	.015	.0073	.0048	.0036	.0029	.0024	.0021	.0018	
			P205	510	1021	1531	2041	2552	3062	3572	4083	.11	.053	.035	.026	.021	.018	.015	.013
			K20	10090	20180	30270	40360	50451	60541	70631	80721	.0053	.0027	.0018	.0013	.0011	.0009	.0008	.0007
Farrow-to Weanling active sow	per active sow	N	3713	7425	11138	14850	18563	22276	25988	29701	.021	.010	.0070	.0052	.0042	.0035	.0030	.0026	
			P205	510	1021	1531	2041	2552	3062	3572	4083	.15	.076	.051	.038	.030	.025	.022	.019
			K20	10090	20180	30270	40360	50451	60541	70631	80721	.0077	.0039	.0026	.0019	.0015	.0013	.0011	.0010
Farrow-to Feeder active sow	per active sow	N	3713	7425	11138	14850	18563	22276	25988	29701	.025	.012	.0084	.0063	.0050	.0042	.0036	.0032	
			P205	510	1021	1531	2041	2552	3062	3572	4083	.18	.092	.061	.046	.037	.031	.026	.023
			K20	10090	20180	30270	40360	50451	60541	70631	80721	.0093	.0046	.0031	.0023	.0019	.0015	.0013	.0012
Farrow-to Finish active sow	per active sow	N	3713	7425	11138	14850	18563	22276	25988	29701	.10	.051	.034	.026	.021	.017	.015		
			P205	510	1021	1531	2041	2552	3062	3572	4083	.75	.37	.25	.19	.15	.12	.11	
			K20	10090	20180	30270	40360	50451	60541	70631	80721	.038	.019	.013	.0095	.0076	.0063	.0054	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1993
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast swine anaerobic lagoon sludge. Values in cells J25-P54 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-I54 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J64-J66 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical								Actual									
	Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to---			Mean- Feedr	Feedr -Fin	Gilt Dev	Boar Stud	----Farrow-to---						
	-----per head cap-----				-per active sow-				-----per head cap-----				-per active sow-					
Animal live weight:	initial:	10	50	50	250					10	50	50	250					lbs
	final:	50	220	250	550					50	220	250	550					lbs
	mean:	30	135	150	400	433	522	1417		30	135	150	400	433	522	1417		lbs
Groups per year:		6	3	2	1	2	2	2		6	3	2	1	2	2	2		groups/yr
Days per group:		49	105	140	365	11	63	168		49	105	140	365	11	63	168		days/group
Lagoon liquid capacity:	(does not include freeboard or 25-yr storm storage)																	
design treatment:	30	135	150	200	289	348	1417		30	135	150	200	289	348	1417			ft ³ /an cap
sludge storage:	15	68	75	100	144	174	708		15	68	75	100	144	174	708			ft ³ /an cap
temporary storage:	15	68	75	200	217	261	708		15	68	75	200	217	261	708			ft ³ /an cap
	60	270	300	500	650	783	2833		60	270	300	500	650	783	2833			ft ³ /an cap
Lag sludge accumulatin:	.022	.10	.11	.15	.21	.26	1.0		.022	.10	.11	.15	.21	.26	1.0			gal/an/day
Lagoon sludge density:	8.8	8.8	8.8	8.8	8.8	8.8	8.8		8.8	8.8	8.8	8.8	8.8	8.8	8.8			lbs/gallon
Lagoon sludge total nutrient analysis:																		
Tot N:	24	24	24	24	24	24	24		24	24	24	24	24	24	24			lb/1000gal
NH3N:	22	22	22	22	22	22	22		22	22	22	22	22	22	22			% N or tkn
P2O5:	52	52	52	52	52	52	52		52	52	52	52	52	52	52			lb/1000gal
K2O:	6.6	6.6	6.6	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	6.6	6.6			lb/1000gal
Org N mineralizat rate:	.50	.50	.50	.50	.50	.50	.50		.50	.50	.50	.50	.50	.50	.50			
Plant nutrient availability coefficients:	(from application method box)																	
N:	.47	.47	.47	.47	.47	.47	.47		.47	.47	.47	.47	.47	.47	.47			
P2O5:	.70	.70	.70	.70	.70	.70	.70		.70	.70	.70	.70	.70	.70	.70			
K2O:	.70	.70	.70	.70	.70	.70	.70		.70	.70	.70	.70	.70	.70	.70			

Application method	NH3N	-----N-----							P&K
soil injection:	.95	.60	.60	.60	.60	.60	.60	.60	.80
soil incorp:	.75	.56	.56	.56	.56	.56	.56	.56	.75
broadcast:	.35	.47	.47	.47	.47	.47	.47	.47	.70
irrigation:	.25	.44	.44	.44	.44	.44	.44	.44	.70

% x 2266 = lbs/acre-inch
 ppm x 0.2266 = lbs/acre-inch
 lbs/1000 gals x 27.154 = lbs/acre-inch

Crop fertilization N:	50	lbs/ac/yr	
rate:	P2O5:	20	lbs/ac/yr
	K2O:	50	lbs/ac/yr

Scroll down for results.

Table 19B. SWINE ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Sludge Accumulation, ***		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Available Nutrient broadcast	
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³	broadcast		lbs/1000 gals	lbs/1000 gals	lbs/1000 gals	lbs/animal unit/year		
		-----lbs-----														
Weanling-to Feeder capacity	per head	10	50	30	60	45	15	6.7	.90	N P205 K20	.47 .70 .70	24 52 6.6	11 37 4.6	.076 .25 .031		
Feeder-to Finish capacity	per head	50	220	135	270	200	70	33	4.4	N P205 K20	.47 .70 .70	24 52 6.6	11 37 4.6	.37 1.2 .15		
Gilt Development capacity	per head	50	250	150	300	225	75	38	5.0	N P205 K20	.47 .70 .70	24 52 6.6	11 37 4.6	.43 1.4 .17		
Boar stud capacity	per head	250	550	400	500	375	125	54	7.2	N P205 K20	.47 .70 .70	24 52 6.6	11 37 4.6	.61 2.0 .25		
Farrow-to Weanling active sow	per active sow			433	650	435	215	78	10	N P205 K20	.47 .70 .70	24 52 6.6	11 37 4.6	.88 2.8 .36		
Farrow-to Feeder active sow	per active sow			522	783	523	260	94	13	N P205 K20	.47 .70 .70	24 52 6.6	11 37 4.6	1.1 3.4 .43		
Farrow-to Finish active sow	per active sow			1417	2833	2125	708	382	51	N P205 K20	.47 .70 .70	24 52 6.6	11 37 4.6	4.3 14 1.8		

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1993
Agronomic Division, North Carolina Department of Agriculture
** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow
*** No manure solids removal prior to lagoon input.
**** Broadcast: surface spread sludge uncovered for 1 month or longer.

Table 19C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **								Minimum Land Area for Sludge Application **							
			broadcast								broadcast							
			lbs/acre/year								lbs/acre/year							
			50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Weanling-to Feeder capacity	per head	N P205 K20	4428	8856	13284	17712	22140	26568	30996	35425	.0015	.0008	.0005	.0004	.0003	.0003	.0002	.0002
			547	1094	1640	2187	2734	3281	3828	4374	.012	.0061	.0041	.0031	.0025	.0020	.0018	.0015
			10811	21622	32432	43243	54054	64865	75676	86487	.0006	.0003	.0002	.0002	.0001	.0001	.0001	.0001
Feeder-to Finish capacity	per head	N P205 K20	4428	8856	13284	17712	22140	26568	30996	35425	.0075	.0037	.0025	.0019	.0015	.0012	.0011	.0009
			547	1094	1640	2187	2734	3281	3828	4374	.061	.030	.020	.015	.012	.010	.0087	.0076
			10811	21622	32432	43243	54054	64865	75676	86487	.0031	.0015	.0010	.0008	.0006	.0005	.0004	.0004
Gilt Development capacity	per head	N P205 K20	4428	8856	13284	17712	22140	26568	30996	35425	.0085	.0043	.0028	.0021	.0017	.0014	.0012	.0011
			547	1094	1640	2187	2734	3281	3828	4374	.069	.034	.023	.017	.014	.011	.0098	.0086
			10811	21622	32432	43243	54054	64865	75676	86487	.0035	.0017	.0012	.0009	.0007	.0006	.0005	.0004
Boar Stud capacity	per head	N P205 K20	4428	8856	13284	17712	22140	26568	30996	35425	.012	.0061	.0041	.0030	.0024	.0020	.0017	.0015
			547	1094	1640	2187	2734	3281	3828	4374	.098	.049	.033	.025	.020	.016	.014	.012
			10811	21622	32432	43243	54054	64865	75676	86487	.0050	.0025	.0017	.0012	.0010	.0008	.0007	.0006
Farrow-to Weanling active sow	per active sow	N P205 K20	4428	8856	13284	17712	22140	26568	30996	35425	.018	.0088	.0059	.0044	.0035	.0029	.0025	.0022
			547	1094	1640	2187	2734	3281	3828	4374	.14	.071	.047	.036	.028	.024	.020	.018
			10811	21622	32432	43243	54054	64865	75676	86487	.0072	.0036	.0024	.0018	.0014	.0012	.0010	.0009
Farrow-to Feeder active sow	per active sow	N P205 K20	4428	8856	13284	17712	22140	26568	30996	35425	.021	.011	.0071	.0053	.0042	.0035	.0030	.0026
			547	1094	1640	2187	2734	3281	3828	4374	.17	.086	.057	.043	.034	.029	.024	.021
			10811	21622	32432	43243	54054	64865	75676	86487	.0087	.0043	.0029	.0022	.0017	.0014	.0012	.0011
Farrow-to Finish active sow	per active sow	N P205 K20	4428	8856	13284	17712	22140	26568	30996	35425	.086	.043	.029	.022	.017	.014	.012	.01
			547	1094	1640	2187	2734	3281	3828	4374	.70	.35	.23	.17	.14	.12	.10	.09
			10811	21622	32432	43243	54054	64865	75676	86487	.035	.018	.012	.0088	.0071	.0059	.0050	.0045

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1993
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Swine Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated swine anaerobic lagoon sludge. Values in cells J25-P54 represent inputs which need to be entered to use this spreadsheet. Values in cells C25-I54 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells J64-J66 with the results calculated in columns W and AE in Table C. The spreadsheet also computes herd live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

		Typical							Actual							
		Wean- Feedr	Feedr- Fin	Gilt Dev	Boar Stud	----Farrow-to- Wean	Feedr	Fin	Wean- Feedr	Feedr- Fin	Gilt Dev	Boar Stud	----Farrow-to- Wean	Feedr	Fin	
		-----per head cap-----				-per active sow-			-----per head cap-----				-per active sow-			
Animal live weight:	initial:	10	50	50	250				10	50	50	250				lbs
	final:	50	220	250	550				50	220	250	550				lbs
	mean:	30	135	150	400	433	522	1417	30	135	150	400	433	522	1417	lbs
Groups per year:		6	3	2	1	2	2	2	6	3	2	1	2	2	2	groups/yr
Days per group:		49	105	140	365	11	63	168	49	105	140	365	11	63	168	days/group
Lagoon liquid capacity:	(does not include freeboard or 25-yr storm storage)															
	design treatment:	30	135	150	200	289	348	1417	30	135	150	200	289	348	1417	ft3/an cap
	sludge storage:	15	68	75	100	144	174	708	15	68	75	100	144	174	708	ft3/an cap
	temporary storage:	15	68	75	200	217	261	708	15	68	75	200	217	261	708	ft3/an cap
		60	270	300	500	650	783	2833	60	270	300	500	650	783	2833	ft3/an cap
Lag sludge accumulatin:		.022	.10	.11	.15	.21	.26	1.0	.022	.10	.11	.15	.21	.26	1.0	gal/an/day
Lagoon sludge density:		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	lbs/gallon
Lagoon sludge total nutrient analysis:																
	Tot N:	658	658	658	658	658	658	658	658	658	658	658	658	658	658	lbs/ac-in
	NH3N:	22	22	22	22	22	22	22	22	22	22	22	22	22	22	% N or tcn
	P2O5:	1419	1419	1419	1419	1419	1419	1419	1419	1419	1419	1419	1419	1419	1419	lbs/ac-in
	K2O:	179	179	179	179	179	179	179	179	179	179	179	179	179	179	lbs/ac-in
Org N mineralizat rate:		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients:	(from application method box)															
	N:	.44	.44	.44	.44	.44	.44	.44	.44	.44	.44	.44	.44	.44	.44	
	P2O5:	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	
	K2O:	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	

Application method	NH3N	N							P&K
soil injection:	.95	.60	.60	.60	.60	.60	.60	.60	.80
soil incorp:	.75	.56	.56	.56	.56	.56	.56	.56	.75
broadcast:	.35	.47	.47	.47	.47	.47	.47	.47	.70
irrigation:	.25	.44	.44	.44	.44	.44	.44	.44	.70

%	x	2266	=	lbs/acre-inch
ppm	x	0.2266	=	lbs/acre-inch
lbs/1000 gals	x	27.154	=	lbs/acre-inch

Crop fertilization N:	50	lbs/ac/yr
rate: P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 19B. SWINE ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit **	Animal Unit	Animal Unit Equivalent Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /animal unit			Total Lagoon Sludge Accumulation, per animal unit/year	Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Avail- Nutrient irrigate	
		init	final	mean	single stage	2-stage 1st + 2nd	acre gals			irrigated ***	lbs/ acre inch	lbs/ acre inch	lbs/ animal unit/year		
		-----lbs-----													
Weanling-to Feeder capacity	per head	10	50	30	60	45	15	6.7	.0002	N	.44	658	292	.072	
											.70	1419	993	.25	
											.70	179	126	.031	
Feeder-to Finish capacity	per head	50	220	135	270	200	70	33	.0012	N	.44	658	292	.36	
											.70	1419	993	1.2	
											.70	179	126	.15	
Gilt Developmt capacity	per head	50	250	150	300	225	75	38	.0014	N	.44	658	292	.41	
											.70	1419	993	1.4	
											.70	179	126	.17	
Boar stud capacity	per head	250	550	400	500	375	125	54	.0020	N	.44	658	292	.58	
											.70	1419	993	2.0	
											.70	179	126	.25	
Farrow-to Weanling active sow	per active sow			433	650	435	215	78	.0029	N	.44	658	292	.84	
											.70	1419	993	2.8	
											.70	179	126	.36	
Farrow-to Feeder active sow	per active sow			522	783	523	260	94	.0035	N	.44	658	292	1.0	
											.70	1419	993	3.4	
											.70	179	126	.43	
Farrow-to Finish active sow	per active sow			1417	2833	2125	708	382	.014	N	.44	658	292	4.1	
											.70	1419	993	14	
											.70	179	126	1.8	

* References: Depts of Biological and Agricultural Engineering, Animal Science; North Carolina State University; Jan 1993
Agronomic Division, North Carolina Department of Agriculture

** Assumes 400-lb sow and boar on limited feed, 3-wk old weanling, 50-lb feeder pig, 220-lb market hog and 20 pigs/sow/yr

*** No manure solids removal prior to lagoon input.

**** Irrigated: sprinkler irrigated sludge uncovered for 1 month or longer.

Table 19C. LAND APPLICATION OF SWINE ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Animal Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **							Minimum Land Area for Sludge Application **									
			-----irrigated-----							-----irrigated-----									
			lbs/acre/year							lbs/acre/year									
			50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Weanling-to Feeder capacity	per head	N	.17	.34	.51	.69	.86	1.0	1.2	1.4	.0014	.0007	.0005	.0004	.0003	.0002	.0002	.0002	
			P205	.020	.040	.060	.081	.10	.12	.14	.16	.012	.0061	.0041	.0031	.0025	.0020	.0018	.0015
			K20	.40	.80	1.2	1.6	2.0	2.4	2.8	3.2	.0006	.0003	.0002	.0002	.0001	.0001	.0001	.0001
Feeder-to Finish capacity	per head	N	.17	.34	.51	.69	.86	1.0	1.2	1.4	.0071	.0036	.0024	.0018	.0014	.0012	.0010	.0009	
			P205	.020	.040	.060	.081	.10	.12	.14	.16	.061	.030	.020	.015	.012	.010	.0087	.0076
			K20	.40	.80	1.2	1.6	2.0	2.4	2.8	3.2	.0031	.0015	.0010	.0008	.0006	.0005	.0004	.0004
Gilt Developmt capacity	per head	N	.17	.34	.51	.69	.86	1.0	1.2	1.4	.0081	.0041	.0027	.0020	.0016	.0014	.0012	.0010	
			P205	.020	.040	.060	.081	.10	.12	.14	.16	.069	.034	.023	.017	.014	.011	.0098	.0086
			K20	.40	.80	1.2	1.6	2.0	2.4	2.8	3.2	.0035	.0017	.0012	.0009	.0007	.0006	.0005	.0004
Boar Stud capacity	per head	N	.17	.34	.51	.69	.86	1.0	1.2	1.4	.012	.0058	.0039	.0029	.0023	.0019	.0017	.0014	
			P205	.020	.040	.060	.081	.10	.12	.14	.16	.098	.049	.033	.025	.020	.016	.014	.012
			K20	.40	.80	1.2	1.6	2.0	2.4	2.8	3.2	.0050	.0025	.0017	.0012	.0010	.0008	.0007	.0006
Farrow-to Weanling active sow	per active sow	N	.17	.34	.51	.69	.86	1.0	1.2	1.4	.017	.0084	.0056	.0042	.0033	.0028	.0024	.0021	
			P205	.020	.040	.060	.081	.10	.12	.14	.16	.14	.071	.047	.036	.028	.024	.020	.018
			K20	.40	.80	1.2	1.6	2.0	2.4	2.8	3.2	.0072	.0036	.0024	.0018	.0014	.0012	.0010	.0009
Farrow-to Feeder active sow	per active sow	N	.17	.34	.51	.69	.86	1.0	1.2	1.4	.020	.010	.0067	.0050	.0040	.0034	.0029	.0025	
			P205	.020	.040	.060	.081	.10	.12	.14	.16	.17	.086	.057	.043	.034	.029	.024	.021
			K20	.40	.80	1.2	1.6	2.0	2.4	2.8	3.2	.0087	.0043	.0029	.0022	.0017	.0014	.0012	.001
Farrow-to Finish active sow	per active sow	N	.17	.34	.51	.69	.86	1.0	1.2	1.4	.082	.041	.027	.021	.016	.014	.012	.01	
			P205	.020	.040	.060	.081	.10	.12	.14	.16	.70	.35	.23	.17	.14	.12	.10	
			K20	.40	.80	1.2	1.6	2.0	2.4	2.8	3.2	.035	.018	.012	.0088	.0071	.0059	.0050	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1993

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Paved Surface Scraped Manure Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated layer paved surface scraped manure. Values in cells I25-K51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F51 are typical values which may be used if more specific information is not available. If actual manure nutrient analyses are used, then a corresponding change in manure volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual manure volumes to be land applied.

	Typical			Actual			
	Pullet nonlay	Pullet laying	Layer laying	Pullet nonlay	Pullet laying	Layer laying	
	-per bird capacity-			-per bird capacity-			
Bird live weight:	initial:	3.0	4.0	3.0	4.0	4.0	lbs
	final:	3.0	4.0	3.0	4.0	4.0	lbs
	average:	1.5	3.5	4.0	1.5	3.5	4.0
Flocks per year:	2	1	1	2	1	1	flocks/year
Days per flock:	140	365	365	140	365	365	days/flock
Manure accumulation:	.057	.13	.15	.057	.13	.15	lbs/bird/day
Manure density:	62	62	62	62	62	62	lbs/ft ³
Manure storage period:	91	91	91	91	91	91	days
Manure total nutrient analysis:							
	Tot N:	28	28	28	28	28	lbs/ton
	NH ₃ N:	50	50	50	50	50	% tot N or tbn
	P ₂ O ₅ :	31	31	31	31	31	lbs/ton
	K ₂ O:	20	20	20	20	20	lbs/ton
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
	N:	.62	.62	.62	.62	.62	
	P ₂ O ₅ :	.75	.75	.75	.75	.75	
	K ₂ O:	.75	.75	.75	.75	.75	

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH₃N</td> <td colspan="3">-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil incorp:</td> <td style="text-align: center;">.75</td> <td style="text-align: center;">.62</td> <td style="text-align: center;">.62</td> <td style="text-align: center;">.62</td> <td style="text-align: center;">.75</td> </tr> <tr> <td>broadcast:</td> <td style="text-align: center;">.25</td> <td style="text-align: center;">.38</td> <td style="text-align: center;">.38</td> <td style="text-align: center;">.38</td> <td style="text-align: center;">.70</td> </tr> </table>	Application method:	NH ₃ N	-----N-----			P&K	soil incorp:	.75	.62	.62	.62	.75	broadcast:	.25	.38	.38	.38	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">%</td> <td style="text-align: center;">x</td> <td style="text-align: center;">20</td> <td style="text-align: center;">= lbs/ton</td> </tr> <tr> <td style="text-align: center;">mg/kg (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.002</td> <td style="text-align: center;">= lbs/ton</td> </tr> </table>	%	x	20	= lbs/ton	mg/kg (ppm)	x	0.002	= lbs/ton
Application method:	NH ₃ N	-----N-----			P&K																						
soil incorp:	.75	.62	.62	.62	.75																						
broadcast:	.25	.38	.38	.38	.70																						
%	x	20	= lbs/ton																								
mg/kg (ppm)	x	0.002	= lbs/ton																								

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 26B. LAYER PAVED SURFACE SCRAPED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Scraped Manure, ***	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients	Plant Available Nutrient soil incorporated					
		init	final	mean							lbs/1000-bd capacity/year	lbs/1000-bd capacity/year				
	weeks	-----lbs-----			ft ² /bird	ft ³ /1000-bd capacity	tons/1000-bd capacity/year		soil incorporated ****	lbs/ton	lbs/ton	lbs/1000-bd capacity/year				
Pullet nonlaying	0 - 20	3.0	1.5	0.33	85	9.7	N	.62	28	17	16					
												P205	.75	31	24	22
												K20	.75	20	15	14
Pullet laying	20 - 52	4.0	3.5	0.50	197	24	N	.62	28	17	42					
												P205	.75	31	24	57
												K20	.75	20	15	36
Layer	52 -	4.0	4.0	0.50	225	28	N	.62	28	17	42					
												P205	.75	31	24	65
												K20	.75	20	15	41

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1991
 Agronomic Division, North Carolina Department of Agriculture
 ** 3-month manure accumulation with liquid drainage.
 *** Manure collected within 2 days.
 **** Soil incorporated: surface spread manure plowed or disked into soil within 2 days.

Table 26C. LAND APPLICATION OF LAYER PAVED SURFACE SCRAPED MANURE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application							
		-----soil incorporated-----									-----soil incorporated-----							
		lbs/acre/year									lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Pullet nonlaying	N	2.9	5.7	8.6	11	14	17	20	23	3.4	1.7	1.1	.85	.63	.56	.48	.4	
	P205	.85	1.7	2.5	3.4	4.2	5.1	5.9	6.8	11	5.7	3.8	2.9	2.3	1.9	1.6	1.3	
	K20	3.4	6.7	10	13	17	20	24	27	2.9	1.4	.96	.72	.58	.48	.41	.31	
Pullet laying	N	2.9	5.7	8.6	11	14	17	20	23	8.5	4.2	2.8	2.1	1.7	1.4	1.2	1.	
	P205	.85	1.7	2.5	3.4	4.2	5.1	5.9	6.8	29	14	9.5	7.1	5.7	4.8	4.1	3.	
	K20	3.4	6.7	10	13	17	20	24	27	7.2	3.6	2.4	1.8	1.4	1.2	1.0	.9	
Layer	N	2.9	5.7	8.6	11	14	17	20	23	9.7	4.8	3.2	2.4	1.9	1.6	1.4	1.	
	P205	.85	1.7	2.5	3.4	4.2	5.1	5.9	6.8	33	16	11	8.2	6.5	5.4	4.7	4.	
	K20	3.4	6.7	10	13	17	20	24	27	8.2	4.1	2.7	2.1	1.6	1.4	1.2	1.	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Paved Surface Scraped Manure Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast layer paved surface scraped manure. Values in cells I25-K51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F51 are typical values which may be used if more specific information is not available. If actual manure nutrient analyses are used, then a corresponding change in manure volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual manure volumes to be land applied.

	Typical			Actual			
	Pullet nonlay -per bird capacity-	Pullet laying capacity-	Layer capacity-	Pullet nonlay -per bird capacity-	Pullet laying capacity-	Layer capacity-	
Bird live weight:	initial:	3.0	4.0	3.0	4.0		lbs
	final:	3.0	4.0	3.0	4.0		lbs
	average:	1.5	3.5	1.5	3.5		lb
Flocks per year:	2	1	1	2	1	1	flocks/year
Days per flock:	140	365	365	140	365	365	days/flock
Manure accumulation:	.057	.13	.15	.057	.13	.15	lbs/bird/day
Manure density:	62	62	62	62	62	62	lbs/ft ³
Manure storage period:	91	91	91	91	91	91	days
Manure total nutrient analysis:							
	Tot N:	28	28	28	28	28	lbs/ton
	NH3N:	50	50	50	50	50	% tot N or tkn
	P2O5:	31	31	31	31	31	lbs/ton
	K2O:	20	20	20	20	20	lbs/ton
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
	N:	.38	.38	.38	.38	.38	
	P2O5:	.70	.70	.70	.70	.70	
	K2O:	.70	.70	.70	.70	.70	

Application method: NH3N -----N----- P&K soil incorp: .75 .62 .62 .62 .75 broadcast: .25 .38 .38 .38 .70	$\% \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times 0.002 = \text{lbs/ton}$
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Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 266. LAYER PAVED SURFACE SCRAPED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity,**	Total Scraped Manure,***	Plant Nutrient Availability Coefficients	Plant Nutrient	Total Nutrients	Plant Availa- Nutrients ² broadcast
		init	final	mean							
		weeks	-----lbs-----								
				ft ² /bird	ft ³ /1000-bd capacity	tons/1000-bd capacity/year		broadcast	lbs/ton	lbs/ton	lbs/1000-bd capacity/year
Pullet nonlaying	0 - 20	3.0	1.5	0.33	85	9.7	N P2O5 K2O	.38 .70 .70	28 31 20	10 22 14	102 214 134
Pullet laying	20 - 52	4.0	3.5	0.50	197	24	N P2O5 K2O	.38 .70 .70	28 31 20	10 22 14	255 534 336
Layer	52 -	4.0	4.0	0.50	225	28	N P2O5 K2O	.38 .70 .70	28 31 20	10 22 14	291 610 384

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture
** 3-month manure accumulation with liquid drainage.
*** Manure collected within 2 days.
**** Broadcast: surface spread manure uncovered for 1 month or longer.

Table 26C. LAND APPLICATION OF LAYER PAVED SURFACE SCRAPED MANURE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application								
		broadcast									broadcast								
		lbs/acre/year									lbs/acre/year								
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400		
	N	4.8	9.5	14	19	24	29	33	38	2.0	1.0	.68	.51	.41	.34	.29	.25		
	P2O5	.91	1.8	2.7	3.6	4.6	5.5	6.4	7.3	11	5.3	3.6	2.7	2.1	1.8	1.5	1.3		
	K2O	3.6	7.2	11	14	18	22	25	29	2.7	1.3	.90	.67	.54	.45	.38	.34		
		-----tons/acre/year-----									-----acres/1000-bird capacity-----								
Pullet nonlaying	N	4.8	9.5	14	19	24	29	33	38	2.0	1.0	.68	.51	.41	.34	.29	.25		
	P2O5	.91	1.8	2.7	3.6	4.6	5.5	6.4	7.3	11	5.3	3.6	2.7	2.1	1.8	1.5	1.3		
	K2O	3.6	7.2	11	14	18	22	25	29	2.7	1.3	.90	.67	.54	.45	.38	.34		
Pullet laying	N	4.8	9.5	14	19	24	29	33	38	5.1	2.5	1.7	1.3	1.0	.85	.73	.64		
	P2O5	.91	1.8	2.7	3.6	4.6	5.5	6.4	7.3	27	13	8.9	6.7	5.3	4.4	3.8	3.3		
	K2O	3.6	7.2	11	14	18	22	25	29	6.7	3.4	2.2	1.7	1.3	1.1	.96	.84		
Layer	N	4.8	9.5	14	19	24	29	33	38	5.8	2.9	1.9	1.5	1.2	.97	.83	.73		
	P2O5	.91	1.8	2.7	3.6	4.6	5.5	6.4	7.3	31	15	10	7.6	6.1	5.1	4.4	3.8		
	K2O	3.6	7.2	11	14	18	22	25	29	7.7	3.8	2.6	1.9	1.5	1.3	1.1	.96		

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Layer Unpaved Deep Pit Stored Manure Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated layer unpaved deep pit stored manure. Values in cells I25-K51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F51 are typical values which may be used if more specific information is not available. If actual manure nutrient analyses are used, then a corresponding change in manure volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual manure volumes to be land applied.

	Typical			Actual				
	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying		
Bird live weight:	initial:	3.0	4.0	3.0	4.0		lbs	
	final:	3.0	4.0	3.0	4.0	4.0	lbs	
	average:	1.5	3.5	4.0	1.5	3.5	4.0	lbs
Flocks per year:		2	1	1	2	1	1	flocks/year
Days per flock:		140	365	365	140	365	365	days/flock
Manure accumulation:		.038	.088	.10	.038	.088	.10	lbs/bird/day
Manure density:		51	51	51	51	51	51	lbs/ft ³
Manure storage period:		365	365	365	365	365	365	days
Manure total nutrient analysis:								
	Tot N:	38	38	38	38	38	38	lbs/ton
	NH ₃ N:	48	48	48	48	48	48	% tot N or tbn
	P ₂ O ₅ :	56	56	56	56	56	56	lbs/ton
	K ₂ O:	30	30	30	30	30	30	lbs/ton
Organic N mineralization rate:		.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients:	(from application method box)							
	N:	.62	.62	.62	.62	.62	.62	
	P ₂ O ₅ :	.75	.75	.75	.75	.75	.75	
	K ₂ O:	.75	.75	.75	.75	.75	.75	

Application method: NH ₃ N -----N----- P&K soil incorp: .75 .62 .62 .62 .75 broadcast: .25 .38 .38 .38 .70	$\frac{\text{mg/kg (ppm)}}{1000} \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times 0.002 = \text{lbs/ton}$
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Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 27B. LAYER UNPAVED DEEP PIT STORED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight		House Floor Space ft ² /bird	Manure Storage Capacity, ^{**} ft ³ /1000-bd capacity	Total Scraped Manure, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients lbs/ton	Plant Available Nutrients: soil incorporated	
		init	final					soil incorporated ^{***}	lbs/ton		lbs/ton	lbs/1000-bd capacity/year
		weeks	lbs									
Pullet nonlaying	0 - 20	3.0	1.5	0.33	252	6.5	N	.62	38	24	152	
								.75	56	42	271	
								.75	30	22	144	
Pullet laying	20 - 52	4.0	3.5	0.50	631	16	N	.62	38	24	380	
								.75	56	42	671	
								.75	30	22	360	
Layer	52 -	4.0	4.0	0.50	721	18	N	.62	38	24	431	
								.75	56	42	771	
								.75	30	22	412	

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990 Agronomic Division, North Carolina Department of Agriculture

** Annual manure accumulation.

*** Soil incorporated: surface spread manure plowed or disked into soil within 2 days.

Table 27C. LAND APPLICATION OF LAYER UNPAVED DEEP PIT STORED MANURE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application							
		soil incorporated									soil incorporated							
		lbs/acre/year									lbs/acre/year							
Pullet nonlaying	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
			K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350
Pullet laying	N	2.1	4.2	6.4	8.5	11	13	15	17	3.0	1.5	1.0	.76	.61	.51	.43	.38	
		P205	.48	.95	1.4	1.9	2.4	2.9	3.3	3.8	14	6.8	4.5	3.4	2.7	2.3	1.9	1.7
			K20	2.2	4.5	6.7	9.0	11	13	16	18	2.9	1.4	.96	.72	.58	.48	.41
Layer	N	2.1	4.2	6.4	8.5	11	13	15	17	7.6	3.8	2.5	1.9	1.5	1.3	1.1	.95	
		P205	.48	.95	1.4	1.9	2.4	2.9	3.3	3.8	34	17	11	8.5	6.8	5.6	4.8	4.2
			K20	2.2	4.5	6.7	9.0	11	13	16	18	7.2	3.6	2.4	1.8	1.4	1.2	1.0

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Unpaved Deep Pit Stored Manure Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast layer unpaved deep pit stored manure. Values in cells I25-K51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F51 are typical values which may be used if more specific information is not available. If actual manure nutrient analyses are used, then a corresponding change in manure volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual manure volumes to be land applied.

	Typical			Actual			
	Pullet nonlay	Pullet laying	Layer	Pullet nonlay	Pullet laying	Layer	
	-per bird capacity-			-per bird capacity-			
Bird live weight:	initial:	3.0	4.0		3.0	4.0	lbs
	final:	3.0	4.0	4.0	3.0	4.0	4.0
	average:	1.5	3.5	4.0	1.5	3.5	4.0
Flocks per year:		2	1	1	2	1	1
Days per flock:		140	365	365	140	365	365
Manure accumulation:		.038	.088	.10	.038	.088	.10
Manure density:		51	51	51	51	51	51
Manure storage period:		365	365	365	365	365	365
Manure total nutrient analysis:							
	Tot N:	38	38	38	38	38	38
	NH3N:	48	48	48	48	48	48
	P2O5:	56	56	56	56	56	56
	K2O:	30	30	30	30	30	30
Organic N mineralization rate:		.50	.50	.50	.50	.50	.50
Plant nutrient availability coefficients:	(from application method box)						
	N:	.38	.38	.38	.38	.38	.38
	P2O5:	.70	.70	.70	.70	.70	.70
	K2O:	.70	.70	.70	.70	.70	.70

Application method: NH3N -----N----- P&K soil incorp: .75 .62 .62 .62 .75 broadcast: .25 .38 .38 .38 .70	$\text{mg/kg (ppm)} \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times 0.002 = \text{lbs/ton}$
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Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

roll down for results.

Table 27B. LAYER UNPAVED DEEP PIT STORED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Scraped Manure, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients	Plant Available Nutrient: broadcast			
		init	final	mean							lbs/1000-bd capacity/year	lbs/1000-bd capacity/year		
		weeks	lbs	bird							ft ² /bird	ft ³ /1000-bd capacity	lbs/ton	lbs/ton
Pullet nonlaying	0 - 20	3.0	1.5	0.33	252	6.5	N	.38	38	14	91			
										P2O5	.70	56	39	253
											K2O	.70	30	21
Pullet laying	20 - 52	4.0	3.5	0.50	651	16	N	.38	38	14	252			
										P2O5	.70	56	39	633
											K2O	.70	30	21
Layer	52 -	4.0	4.0	0.50	721	18	N	.38	38	14	267			
										P2O5	.70	56	39	723
											K2O	.70	30	21

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** Annual manure accumulation.

*** Broadcast: surface spread manure uncovered for 1 month or longer.

Table 27C. LAND APPLICATION OF LAYER UNPAVED DEEP PIT STORED MANURE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate ***								Minimum Land Area for Manure Application								
		broadcast								broadcast								
		lbs/acre/year								lbs/acre/year								
Pullet nonlaying	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
			K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350
Pullet laying	N	3.5	6.9	10.4	13.9	17	21	24	28	4.7	2.3	1.6	1.2	.93	.78	.67	.58	
		P2O5	.51	1.02	1.5	2.0	2.6	3.1	3.6	4.1	32	16	11	7.9	6.3	5.3	4.5	4.0
			K2O	2.4	4.8	7.2	9.6	12	14	17	19	6.7	3.4	2.2	1.7	1.3	1.1	.96
Layer	N	3.5	6.9	10.4	13.9	17	21	24	28	5.3	2.7	1.8	1.3	1.1	.89	.76	.67	
		P2O5	.51	1.02	1.5	2.0	2.6	3.1	3.6	4.1	36	18	12	9.0	7.2	6.0	5.2	4.5
			K2O	2.4	4.8	7.2	9.6	12	14	17	19	7.7	3.8	2.6	1.9	1.5	1.3	1.1

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

** N fertilization rate should be consistent with realistic crop yield.

*** N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Layer Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected layer liquid manure slurry. Values in cells I25-K55 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical			Actual			
	Pullet nonlay	Pullet laying	Layer per bird capacity-	Pullet nonlay	Pullet laying	Layer per bird capacity-	
Bird live weight:							
initial:		3.0	4.0	3.0	4.0		lbs
final:	3.0	4.0	4.0	3.0	4.0	4.0	lbs
average:	1.5	3.5	4.0	1.5	3.5	4.0	lb
Flocks per year:	2	1	1	2	1	1	flocks/year
Days per flock:	140	365	365	140	365	365	days/flock
Manure slurry volume:							
manure and urine:	.012	.028	.032	.012	.028	.032	gals/bird/day
excess water usage:	.005	.011	.013	.005	.011	.013	gals/bird/day
total:	.017	.039	.044	.017	.039	.044	gals/bird/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon
Manure storage period:	183	183	183	183	183	183	days
Manure slurry total nutrient analysis:							
Tot N:	62	62	62	62	62	62	lbs/1000 gals
NH3N:	68	68	68	68	68	68	% tot N or tkn
P2O5:	59	59	59	59	59	59	lb/1000 gals
K2O:	37	37	37	37	37	37	lb/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.81	.81	.81	.81	.81	.81	
P2O5:	.80	.80	.80	.80	.80	.80	
K2O:	.80	.80	.80	.80	.80	.80	

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH3N</td> <td colspan="3">-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil injection:</td> <td style="text-align: center;">.95</td> <td style="text-align: center;">.81</td> <td style="text-align: center;">.81</td> <td style="text-align: center;">.81</td> <td style="text-align: center;">.80</td> </tr> <tr> <td>soil incorp:</td> <td style="text-align: center;">.75</td> <td style="text-align: center;">.67</td> <td style="text-align: center;">.67</td> <td style="text-align: center;">.67</td> <td style="text-align: center;">.75</td> </tr> <tr> <td>broadcast:</td> <td style="text-align: center;">.35</td> <td style="text-align: center;">.40</td> <td style="text-align: center;">.40</td> <td style="text-align: center;">.40</td> <td style="text-align: center;">.70</td> </tr> <tr> <td>irrigation:</td> <td style="text-align: center;">.25</td> <td style="text-align: center;">.33</td> <td style="text-align: center;">.33</td> <td style="text-align: center;">.33</td> <td style="text-align: center;">.70</td> </tr> </table>	Application method:	NH3N	-----N-----			P&K	soil injection:	.95	.81	.81	.81	.80	soil incorp:	.75	.67	.67	.67	.75	broadcast:	.35	.40	.40	.40	.70	irrigation:	.25	.33	.33	.33	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">mg/L (ppm) x .83.5 = lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm) x .00835 = lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals x 27.154 = lbs/acre-inch</td> </tr> </table>	mg/L (ppm) x .83.5 = lbs/1000 gals	mg/L (ppm) x .00835 = lbs/1000 gals	lbs/1000 gals x 27.154 = lbs/acre-inch
Application method:	NH3N	-----N-----			P&K																													
soil injection:	.95	.81	.81	.81	.80																													
soil incorp:	.75	.67	.67	.67	.75																													
broadcast:	.35	.40	.40	.40	.70																													
irrigation:	.25	.33	.33	.33	.70																													
mg/L (ppm) x .83.5 = lbs/1000 gals																																		
mg/L (ppm) x .00835 = lbs/1000 gals																																		
lbs/1000 gals x 27.154 = lbs/acre-inch																																		

crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 288. LAYER LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Manure Slurry, gallons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrient, soil inject.	
		init	final	mean							lbs/1000-bd capacity/year	lbs/1000 gals
	weeks	-----lbs-----			ft ² /bird	ft ³ /1000-bd capacity			soil injected ***			
Pullet nonlaying	0 - 20	3.0	1.5		0.33	384	5671	N	.81	62	50	28'
								P205	.80	59	47	25'
								K20	.80	37	30	16'
Pullet laying	20 - 52	3.0	4.0	3.5	0.50	948	14177	N	.81	62	50	70'
								P205	.80	59	47	66'
								K20	.80	37	30	42'
Layer	52 -	4.0	4.0	4.0	0.50	1083	16202	N	.81	62	50	80'
								P205	.80	59	47	75'
								K20	.80	37	30	48'

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** 6-month accumulation of manure, excess water usage, storage surface rainfall surplus; does not include fresh water for flushing.
 *** Soil injected: manure slurry injected directly into the soil and covered immediately.

Table 289. LAND APPLICATION OF LAYER LIQUID MANURE SLURRY *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **								Minimum Land Area for Manure Application							
		soil injected								soil injected							
		lbs/acre/year								lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Pullet nonlaying	N	1008	2016	3024	4033	5041	6049	7057	8065	5.6	2.8	1.9	1.4	1.1	.94	.80	.71
	P205	427	855	1282	1709	2136	2564	2991	3418	13	6.6	4.4	3.3	2.7	2.2	1.9	1.7
	K20	1682	3364	5046	6728	8410	10092	11773	13455	3.4	1.7	1.1	.84	.67	.56	.48	.42
Pullet laying	N	1008	2016	3024	4033	5041	6049	7057	8065	14	7.0	4.7	3.5	2.8	2.3	2.0	1.8
	P205	427	855	1282	1709	2136	2564	2991	3418	33	17	11	8.3	6.6	5.5	4.7	4.1
	K20	1682	3364	5046	6728	8410	10092	11773	13455	8.4	4.2	2.8	2.1	1.7	1.4	1.2	1.1
Layer	N	1008	2016	3024	4033	5041	6049	7057	8065	16	8.0	5.4	4.0	3.2	2.7	2.3	2.1
	P205	427	855	1282	1709	2136	2564	2991	3418	38	19	13	9.5	7.6	6.3	5.4	4.8
	K20	1682	3364	5046	6728	8410	10092	11773	13455	9.6	4.8	3.2	2.4	1.9	1.6	1.4	1.3

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated layer liquid manure slurry. Values in cells I25-K55 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F55 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I65-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical			Actual				
	Pullet nonlay	Pullet laying	Layer laying	Pullet nonlay	Pullet laying	Layer laying		
	-per bird capacity-			-per bird capacity-				
Bird live weight:	initial:	3.0	4.0	3.0	4.0	4.0	lb	
	final:	3.0	4.0	3.0	4.0	4.0	lb	
	average:	1.5	3.5	1.5	3.5	4.0	lb	
Flocks per year:	2	1	1	2	1	1	flocks/year	
Days per flock:	140	365	365	140	365	365	days/flock	
Manure slurry volume:								
	manure and urine:	.012	.028	.032	.012	.028	.032	gals/bird/day
	excess water usage:	.005	.011	.013	.005	.011	.013	gals/bird/day
	total:	.017	.039	.044	.017	.039	.044	gals/bird/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon	
Manure storage period:	183	183	183	183	183	183	days	
Manure slurry total nutrient analysis:								
	Tot N:	62	62	62	62	62	lbs/1000 gals	
	NH3N:	68	68	68	68	68	% tot N or ton	
	P2O5:	59	59	59	59	59	lbs/1000 gals	
	K2O:	37	37	37	37	37	lbs/1000 gals	
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients: (from application method box)								
	N:	.67	.67	.67	.67	.67		
	P2O5:	.75	.75	.75	.75	.75		
	K2O:	.75	.75	.75	.75	.75		

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH3N</td> <td colspan="3">-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil injection:</td> <td>.95</td> <td>.81</td> <td>.81</td> <td>.81</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.67</td> <td>.67</td> <td>.67</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.40</td> <td>.40</td> <td>.40</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.33</td> <td>.33</td> <td>.33</td> <td>.70</td> </tr> </table>	Application method:	NH3N	-----N-----			P&K	soil injection:	.95	.81	.81	.81	.80	soil incorp:	.75	.67	.67	.67	.75	broadcast:	.35	.40	.40	.40	.70	irrigation:	.25	.33	.33	.33	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">=</td> <td style="text-align: center;">x</td> <td style="text-align: center;">83.5</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">.00835</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> </table>	=	x	83.5	=	lbs/1000 gals	mg/L (ppm)	x	.00835	=	lbs/1000 gals	lbs/1000 gals	x	27.154	=	lbs/acre-inch
Application method:	NH3N	-----N-----			P&K																																									
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lbs/1000 gals	x	27.154	=	lbs/acre-inch																																										

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 288. LAYER LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Manure Slurry, gallons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients soil incorporated						
		init	final	mean							lbs/1000-bd capacity/year	lbs/1000 gals	lbs/1000-bd capacity/year				
	weeks	-----lbs-----			ft2/ bird	ft3/ 1000-bd capacity			soil incorporated								
Pullet nonlaying	0 - 20	3.0	1.5	1.5	0.33	384	5671	N	.67	62	41	234					
													P205	.75	59	44	249
Pullet laying	20 - 52	3.0	4.0	3.5	0.50	948	14177	N	.67	62	41	585					
													P205	.75	59	44	622
Layer	52 -	4.0	4.0	4.0	0.50	1083	16202	N	.67	62	41	668					
													P205	.75	59	44	711

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** 6-month accumulation of manure, excess water usage, storage surface rainfall surplus; does not include fresh water for flushing.

*** Soil incorporated: surface spread manure plowed or disked into soil within 2 days.

Table 28C. LAND APPLICATION OF LAYER LIQUID MANURE SLURRY *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **								Minimum Land Area for Manure Application							
		soil incorporated								soil incorporated							
		lbs/acre/year								lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Pullet nonlaying	N	1213	2425	3638	4850	6063	7275	8488	9700	4.7	2.3	1.6	1.2	.94	.78	.67	.58
	P205	456	912	1367	1823	2279	2735	3190	3646	12	6.2	4.1	3.1	2.5	2.1	1.8	1.6
	K20	1794	3588	5382	7176	8970	10764	12558	14352	3.2	1.6	1.1	.79	.63	.53	.45	.40
Pullet laying	N	1213	2425	3638	4850	6063	7275	8488	9700	12	5.8	3.9	2.9	2.3	1.9	1.7	1.5
	P205	456	912	1367	1823	2279	2735	3190	3646	31	16	10	7.8	6.2	5.2	4.4	3.9
	K20	1794	3588	5382	7176	8970	10764	12558	14352	7.9	4.0	2.6	2.0	1.6	1.3	1.1	.99
Layer	N	1213	2425	3638	4850	6063	7275	8488	9700	13	6.7	4.5	3.3	2.7	2.2	1.9	1.7
	P205	456	912	1367	1823	2279	2735	3190	3646	36	18	12	8.9	7.1	5.9	5.1	4.4
	K20	1794	3588	5382	7176	8970	10764	12558	14352	9.0	4.5	3.0	2.3	1.8	1.5	1.3	1.1

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast layer liquid manure slurry. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical			Actual				
	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying		
Bird live weights:	initial:	3.0	4.0		3.0	4.0	lbs	
	final:	3.0	4.0	4.0	3.0	4.0	lbs	
	average:	1.5	3.5	4.0	1.5	3.5	4.0	
Flocks per year:		2	1	1	2	1	1	flocks/year
Days per flock:		140	365	365	140	365	365	days/flock
Manure slurry volume:								
manure and urine:	.012	.028	.032	.012	.028	.032		gals/bird/day
excess water usage:	.005	.011	.013	.005	.011	.013		gals/bird/day
total:	.017	.039	.044	.017	.039	.044		gals/bird/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4		lbs/gallon
Manure storage period:	183	183	183	183	183	183		days
Manure slurry total nutrient analysis:								
Tot N:	62	62	62	62	62	62		lbs/1000 gals
NH3N:	68	68	68	68	68	68		% tot N or tkm
P2O5:	59	59	59	59	59	59		lbk/1000 gals
K2O:	37	37	37	37	37	37		lbk/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients: (from application method box)								
N:	.40	.40	.40	.40	.40	.40		
P2O5:	.70	.70	.70	.70	.70	.70		
K2O:	.70	.70	.70	.70	.70	.70		

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: left;">NH3N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: left;">PK</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.81</td> <td>.81</td> <td>.81</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.67</td> <td>.67</td> <td>.67</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.40</td> <td>.40</td> <td>.40</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.33</td> <td>.33</td> <td>.33</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----			PK	soil injection:	.95	.81	.81	.81	.80	soil incorp:	.75	.67	.67	.67	.75	broadcast:	.35	.40	.40	.40	.70	irrigation:	.25	.33	.33	.33	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">%</td> <td style="text-align: center;">x</td> <td style="text-align: center;">23.5</td> <td>= lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">.00833</td> <td>= lbs/1000 gals</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td>= lbs/acre-inch</td> </tr> </table>	%	x	23.5	= lbs/1000 gals	mg/L (ppm)	x	.00833	= lbs/1000 gals	lbs/1000 gals	x	27.154	= lbs/acre-inch
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Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 28B. LAYER LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Manure Slurry, gallons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients broadcast		
		init	final	mean							lbs/1000 capacity/year	lbs/1000 gals	lbs/1000 capacity/year
		-----lbs-----											
Pullet nonlaying	0 - 20	3.0	1.5		0.33	384	5671	N	.40	62	25	139	
								P205	.70	59	41	232	
								K20	.70	37	26	148	
Pullet laying	20 - 52	3.0	4.0	3.5	0.50	948	14177	N	.40	62	25	348	
								P205	.70	59	41	581	
								K20	.70	37	26	365	
Layer	52 -	4.0	4.0	4.0	0.50	1083	16202	N	.40	62	25	397	
								P205	.70	59	41	664	
								K20	.70	37	26	421	

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990 Agronomic Division, North Carolina Department of Agriculture
 ** 6-month accumulation of manure, excess water usage, storage surface rainfall surplus; does not include fresh water for flushing.
 *** Broadcast: surface spread manure uncovered for 1 month or longer.

Table 28C. LAND APPLICATION OF LAYER LIQUID MANURE SLURRY *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **										Minimum Land Area for Manure Application									
		-----broadcast-----										-----broadcast-----									
		lbs/acre/year										lbs/acre/year									
	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400				
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160				
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400				
		-----gallons/acre/year-----										-----acres/1000-bird capacity-----									
Pullet nonlaying	N	2040	4079	6119	8158	10198	12238	14277	16317	2.8	1.4	.93	.70	.56	.46	.40	.35				
	P205	488	977	1465	1953	2442	2930	3418	3907	12	5.8	3.9	2.9	2.3	1.9	1.7	1.5				
	K20	1922	3844	5767	7689	9611	11533	13455	15378	3.0	1.5	.98	.74	.59	.49	.42	.37				
Pullet laying	N	2040	4079	6119	8158	10198	12238	14277	16317	7.0	3.5	2.3	1.7	1.4	1.2	.99	.81				
	P205	488	977	1465	1953	2442	2930	3418	3907	29	15	9.7	7.3	5.8	4.8	4.1	3.4				
	K20	1922	3844	5767	7689	9611	11533	13455	15378	7.4	3.7	2.5	1.8	1.5	1.2	1.1	.91				
Layer	N	2040	4079	6119	8158	10198	12238	14277	16317	7.9	4.0	2.6	2.0	1.6	1.3	1.1	.9				
	P205	488	977	1465	1953	2442	2930	3418	3907	33	17	11	8.3	6.6	5.5	4.7	4.0				
	K20	1922	3844	5767	7689	9611	11533	13455	15378	8.4	4.2	2.8	2.1	1.7	1.4	1.2	1.0				

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Liquid Manure Slurry Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated layer liquid manure slurry. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual manure slurry nutrient analyses are used, then a corresponding change in manure slurry volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual liquid manure slurry volumes to be land applied.

	Typical			Actual				
	Pullet nonlay	Pullet laying	Layer laying	Pullet nonlay	Pullet laying	Layer laying		
	-per bird capacity-			-per bird capacity-				
Bird live weight:	initial:	3.0	4.0	3.0	4.0	4.0	lbs	
	final:	3.0	4.0	3.0	4.0	4.0	lbs	
	average:	1.5	3.5	4.0	1.5	3.5	4.0	lbs
Flocks per year:	2	1	1	2	1	1	flocks/year	
Days per flock:	140	365	365	140	365	365	days/flock	
Manure slurry volume:	manure and urine:	.012	.028	.032	.012	.028	.032	gals/bird/day
	excess water usage:	.005	.011	.013	.005	.011	.013	gals/bird/day
	total:	.017	.039	.044	.017	.039	.044	gals/bird/day
Manure slurry density:	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon	
Manure storage period:	183	183	183	183	183	183	days	
Manure slurry total nutrient analysis:	Tot N:	1672	1672	1672	1672	1672	lbs/acre-inch	
	NH3N:	68	68	68	68	68	% tot N or tN	
	P2O5:	1589	1589	1589	1589	1589	lbs/acre-inch	
	K2O:	1009	1009	1009	1009	1009	lbs/acre-inch	
Organic N mineralization rate	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients: (from application method box)	N:	.33	.33	.33	.33	.33		
	P2O5:	.70	.70	.70	.70	.70		
	K2O:	.70	.70	.70	.70	.70		

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Application method:	NH3N	-----N-----	P&K																					
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lbs/1000 gals x 27.154 = lbs/acre-inch																								

Crop fertilization rate: N:	50	
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 28B. LAYER LIQUID MANURE SLURRY FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Manure Slurry, per 1000-bd cap/year	Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients	Plant Available Nutrients irrigated					
		init final mean							ft2/ bird	ft3/ 1000-bd capacity		acre- gals	inch	irrigated ***	lbs/ acre- inch	lbs/ acre- inch	lbs/ 1000-bd capacity /year
		weeks	lbs														
Pullet nonlaying	0 - 20	3.0	1.5	1.5	0.33	384	5671	.21	N	.33	1672	552	115				
									P205	.70	1589	1112	232				
									K20	.70	1009	706	148				
Pullet laying	20 - 52	3.0	4.0	3.5	0.50	948	14177	.52	N	.33	1672	552	288				
									P205	.70	1589	1112	581				
									K20	.70	1009	706	369				
Layer	52 -	4.0	4.0	4.0	0.50	1083	16202	.60	N	.33	1672	552	329				
									P205	.70	1589	1112	664				
									K20	.70	1009	706	421				

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** 6-month accumulation of manure, excess water usage, storage surface rainfall surplus; does not include fresh water for flushing.
 *** Irrigated: sprinkler irrigated manure slurry uncovered for 1 month or longer.

Table 28C. LAND APPLICATION OF LAYER LIQUID MANURE SLURRY *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application							
		Irrigated									Irrigated							
		lbs/acre/year									lbs/acre/year							
Pullet nonlaying	N	50	100	150	200	250	300	350	400		50	100	150	200	250	300	350	400
		P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
		K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Pullet laying	N	.091	.18	.27	.36	.45	.54	.63	.72		2.3	1.2	.77	.58	.46	.38	.33	.28
		P205	.018	.036	.054	.072	.090	.11	.13	.14	12	5.8	3.9	2.9	2.3	1.9	1.7	1.5
		K20	.071	.14	.21	.28	.35	.42	.50	.57	3.0	1.5	.98	.74	.59	.49	.42	.37
Layer	N	.091	.18	.27	.36	.45	.54	.63	.72		5.8	2.9	1.9	1.4	1.2	.96	.82	.71
		P205	.018	.036	.054	.072	.090	.11	.13	.14	29	15	9.7	7.3	5.8	4.8	4.1	3.4
		K20	.071	.14	.21	.28	.35	.42	.50	.57	7.4	3.7	2.5	1.8	1.5	1.2	1.1	.97
Layer	N	.091	.18	.27	.36	.45	.54	.63	.72		6.6	3.3	2.2	1.6	1.3	1.1	.94	.8
		P205	.018	.036	.054	.072	.090	.11	.13	.14	33	17	11	8.3	6.6	5.5	4.7	4.1
		K20	.071	.14	.21	.28	.35	.42	.50	.57	8.4	4.2	2.8	2.1	1.7	1.4	1.2	1.1

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 199
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected layer anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual			
	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	
Bird live weight:	initial:	3.0	4.0	3.0	4.0		lbs
	final:	3.0	4.0	3.0	4.0		lbs
	average:	1.5	3.5	1.5	3.5		lbs
Flocks per year:	2	1	1	2	1	1	flocks/year
Days per flock:	140	365	365	140	365	365	days/flock
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	3.8	8.8	10.0	3.8	8.8	10.0	ft ³ /bird cap
sludge storage:	1.3	2.9	3.3	1.3	2.9	3.3	ft ³ /bird cap
temporary storage:	.6	1.5	1.7	.6	1.5	1.7	ft ³ /bird cap
total:	5.6	13.1	15.0	5.6	13.1	15.0	ft ³ /bird cap
Lagoon liquid accumulation :							
manure and urine:	.012	.028	.032	.012	.028	.032	gals/bird/day
excess water usage:	.005	.011	.013	.005	.011	.013	gals/bird/day
lagoon surface rain surplus:	.009	.022	.025	.009	.022	.025	gals/bird/day
total:	.026	.061	.069	.026	.061	.069	gals/bird/day
Lagoon liquid total nutrient analysis:							
Tot N:	6.6	6.6	6.6	6.6	6.6	6.6	lbs/1000 gals
NH ₃ N:	.86	.86	.86	.86	.86	.86	= tot N or t _{ox}
P ₂ O ₅ :	1.7	1.7	1.7	1.7	1.7	1.7	lbs/1000 gals
K ₂ O:	9.8	9.8	9.8	9.8	9.8	9.8	lbs/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.89	.89	.89	.89	.89	.89	
P ₂ O ₅ :	.80	.80	.80	.80	.80	.80	
K ₂ O:	.80	.80	.80	.80	.80	.80	

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH₃N</td> <td>-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil injection:</td> <td>.85</td> <td>.89 .89 .89</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.85</td> <td>.80 .80 .80</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.45</td> <td>.46 .46 .46</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.50</td> <td>.50 .50 .50</td> <td>.70</td> </tr> </table>	Application method:	NH ₃ N	-----N-----	P&K	soil injection:	.85	.89 .89 .89	.80	soil incorp:	.85	.80 .80 .80	.75	broadcast:	.45	.46 .46 .46	.70	irrigation:	.50	.50 .50 .50	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>=</td> <td>x</td> <td>2266</td> <td>= lbs/acre-inch</td> </tr> <tr> <td>mg/L (ppm)</td> <td>x</td> <td>0.2266</td> <td>= lbs/acre-inch</td> </tr> <tr> <td>lbs/1000 gals</td> <td>x</td> <td>27.154</td> <td>= lbs/acre-inch</td> </tr> </table>	=	x	2266	= lbs/acre-inch	mg/L (ppm)	x	0.2266	= lbs/acre-inch	lbs/1000 gals	x	27.154	= lbs/acre-inch
Application method:	NH ₃ N	-----N-----	P&K																														
soil injection:	.85	.89 .89 .89	.80																														
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mg/L (ppm)	x	0.2266	= lbs/acre-inch																														
lbs/1000 gals	x	27.154	= lbs/acre-inch																														

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Table 29B. LAYER ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity			Total Lagoon Liquid Surplus, ** per 1000-bd capacity/yr	Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients lbs/1000 gals	Plant Available Nutrients soil injected	
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals			soil injected ***	lbs/1000 gals		lbs/1000 gals	lbs/1000-bird capacity/year
		-----lbs-----			stage	1st + 2nd	gals			inch				
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	9110	.34	N	.89	6.6	5.8	53	
									P205	.80	1.7	1.3	12	
									K20	.80	9.8	7.8	71	
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	22201	.82	N	.89	6.6	5.8	130
									P205	.80	1.7	1.3	30	
									K20	.80	9.8	7.8	174	
Layer	52 -	4.0	4.0	4.0	15	13	1.7	25373	.93	N	.89	6.6	5.8	143
									P205	.80	1.7	1.3	34	
									K20	.80	9.8	7.8	199	

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
 Agronomic Division, North Carolina Department of Agriculture
 ** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.
 *** Soil injected: lagoon liquid injected directly into soil and covered immediately.

Table 29C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **									Minimum Land Area for Liquid Application							
		soil injected									soil injected							
		lbs/acre/year									lbs/acre/year							
Pullet nonlaying	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
		K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Pullet laying	N	8550	17101	25651	34201	42751	51302	59852	68402	1.1	.53	.36	.27	.21	.18	.15	.13	
		P205	14864	29728	44592	59456	74320	89184	1.0e5	1.2e5	.61	.31	.20	.15	.12	.10	.088	.077
		K20	6385	12770	19155	25541	31926	38311	44696	51081	1.4	.71	.48	.36	.29	.24	.20	.18
Layer	N	8550	17101	25651	34201	42751	51302	59852	68402	2.6	1.3	.87	.65	.52	.43	.37	.32	
		P205	14864	29728	44592	59456	74320	89184	1.0e5	1.2e5	1.5	.75	.50	.37	.30	.25	.21	.19
		K20	6385	12770	19155	25541	31926	38311	44696	51081	3.5	1.7	1.2	.87	.70	.58	.50	.43
Layer	N	8550	17101	25651	34201	42751	51302	59852	68402	3.0	1.5	.99	.74	.59	.49	.42	.37	
		P205	14864	29728	44592	59456	74320	89184	1.0e5	1.2e5	1.7	.85	.57	.43	.34	.28	.24	.21
		K20	6385	12770	19155	25541	31926	38311	44696	51081	4.0	2.0	1.3	.99	.79	.66	.57	.50

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated layer anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual				
	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying		
Bird live weight:	initial:	3.0	4.0		3.0	4.0	lbs	
	final:	3.0	4.0	4.0	3.0	4.0	lbs	
	average:	1.5	3.5	4.0	1.5	3.5	4.0	lbs
Flocks per year:		2	1	1	2	1	1	flocks/year
Days per flock:		140	365	365	140	365	365	days/flock
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)								
	design treatment:	5.3	8.3	10.0	5.3	8.3	10.0	ft ³ /bird cap
	sludge storage:	1.3	2.9	3.3	1.3	2.9	3.3	ft ³ /bird cap
	temporary storage:	.6	1.5	1.7	.6	1.5	1.7	ft ³ /bird cap
	total:	5.6	13.1	15.0	5.6	13.1	15.0	ft ³ /bird cap
Lagoon liquid accumulation :								
	manure and urine:	.012	.022	.032	.012	.022	.032	gals/bird/day
	excess water usage:	.005	.011	.013	.005	.011	.013	gals/bird/day
	lagoon surface rain surplus:	.009	.022	.025	.009	.022	.025	gals/bird/day
	total:	.026	.061	.069	.026	.061	.069	gals/bird/day
Lagoon liquid total nutrient analysis:								
	Tot N:	6.6	6.6	6.6	6.6	6.6	6.6	lbs/1000 gals
	NH ₃ N:	86	86	86	86	86	86	mg tot N or tbn
	P ₂ O ₅ :	1.7	1.7	1.7	1.7	1.7	1.7	lbs/1000 gals
	K ₂ O:	9.3	9.3	9.3	9.3	9.3	9.3	lbs/1000 gals
Organic N mineralization rate:		.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)								
	N:	.80	.80	.80	.80	.80	.80	
	P ₂ O ₅ :	.75	.75	.75	.75	.75	.75	
	K ₂ O:	.75	.75	.75	.75	.75	.75	

Application method:	NH ₃ N	-----N-----			P&K
soil injection:	.95	.89	.39	.89	.80
soil incorp:	.85	.80	.30	.80	.75
broadcast:	.45	.46	.46	.46	.70
irrigation:	.50	.50	.50	.50	.70

=	x	2266	=	lbs/acre-inch
mg/L (ppm)	x	0.2266	=	lbs/acre-inch
lbs/1000 gals	x	27.154	=	lbs/acre-inch

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Table 29B. LAYER ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity			Total Lagoon Liquid Surplus, ** per 1000-bd capacity/yr	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrient soil incorporated		
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals					inch	lbs/1000 gals	lbs/1000 gals
		weeks	lbs	lbs	lbs	gals	gals					gals	gals	gals
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	9110	.34	N	.80	6.6	5.3	4	
									P205	.75	1.7	1.3	1	
									K20	.75	9.3	7.3	6	
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	22201	.82	.80	6.6	5.3	11	
									P205	.75	1.7	1.3	2	
									K20	.75	9.3	7.3	16	
Layer	52 -	4.0	4.0	4.0	15	13	1.7	25373	.93	.80	6.6	5.3	13	
									P205	.75	1.7	1.3	2	
									K20	.75	9.3	7.3	12	

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1995; Agronomic Division, North Carolina Department of Agriculture

** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.

*** Soil incorporated: surface spread liquid plowed or disked into the soil within 2 days.

Table 29C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **									Minimum Land Area for Liquid Application								
		soil incorporated									soil incorporated								
		lbs/acre/year									lbs/acre/year								
Pullet nonlaying	N	50	100	150	200	250	300	350	400		50	100	150	200	250	300	350	400	
		P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
		K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Pullet laying	N	9465	18931	28396	37862	47327	56793	66258	75724		.96	.48	.32	.24	.19	.16	.14	.1	
		P205	15855	31710	47565	63420	79275	95130	1.1e5	1.3e5	.57	.29	.19	.14	.11	.096	.082	.07	
		K20	6811	13622	20433	27243	34054	40865	47676	54487	1.3	.67	.45	.33	.27	.22	.19	.1	
Layer	N	9465	18931	28396	37862	47327	56793	66258	75724		2.3	1.2	.78	.59	.47	.39	.34	.2	
		P205	15855	31710	47565	63420	79275	95130	1.1e5	1.3e5	1.4	.70	.47	.35	.28	.23	.20	.1	
		K20	6811	13622	20433	27243	34054	40865	47676	54487	3.3	1.6	1.1	.81	.65	.54	.47	.4	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1995

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast layer anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual			
	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	
Bird live weight:	initial:	3.0	4.0	3.0	4.0	4.0	lbs
	final:	3.0	4.0	3.0	4.0	4.0	lbs
	average:	1.5	3.5	1.5	3.5	4.0	lbs
Flocks per year:	2	1	1	2	1	1	flocks/year
Days per flock:	140	365	365	140	365	365	days/flock
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	3.3	8.8	10.0	3.3	8.8	10.0	ft ³ /bird cap
sludge storage:	1.3	2.9	3.3	1.3	2.9	3.3	ft ³ /bird cap
temporary storage:	.6	1.5	1.7	.6	1.5	1.7	ft ³ /bird cap
total:	5.6	13.1	15.0	5.6	13.1	15.0	ft ³ /bird cap
Lagoon liquid accumulation :							
manure and urine:	.012	.028	.032	.012	.028	.032	gals/bird/day
excess water usage:	.005	.011	.013	.005	.011	.013	gals/bird/day
lagoon surface rain surplus:	.009	.022	.025	.009	.022	.025	gals/bird/day
total:	.026	.061	.069	.026	.061	.069	gals/bird/day
Lagoon liquid total nutrient analysis:							
Tot N:	6.6	6.6	6.6	6.6	6.6	6.6	lbs/1000 gals
NH3N:	86	86	86	86	86	86	% tot N or tbn
P2O5:	1.7	1.7	1.7	1.7	1.7	1.7	lbs/1000 gals
K2O:	9.3	9.3	9.3	9.3	9.3	9.3	lbs/1000 gals
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.46	.46	.46	.46	.46	.46	
P2O5:	.70	.70	.70	.70	.70	.70	
K2O:	.70	.70	.70	.70	.70	.70	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: left;">NH3N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: left;">P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.89</td> <td>.89</td> <td>.89</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.85</td> <td>.80</td> <td>.80</td> <td>.80</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.45</td> <td>.46</td> <td>.46</td> <td>.46</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.50</td> <td>.50</td> <td>.50</td> <td>.50</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----			P&K	soil injection:	.95	.89	.89	.89	.80	soil incorp:	.85	.80	.80	.80	.75	broadcast:	.45	.46	.46	.46	.70	irrigation:	.50	.50	.50	.50	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">%</td> <td style="text-align: center;">x</td> <td style="text-align: center;">2266</td> <td style="text-align: center;">= lbs/acre-inch</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.2266</td> <td style="text-align: center;">= lbs/acre-inch</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td style="text-align: center;">= lbs/acre-inch</td> </tr> </table>	%	x	2266	= lbs/acre-inch	mg/L (ppm)	x	0.2266	= lbs/acre-inch	lbs/1000 gals	x	27.154	= lbs/acre-inch
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Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 29B. LAYER ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity		Total Lagoon Liquid Surplus, ** per 1000-bd capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients broadcast lbs/1000-bird capacity/year			
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals	inch				broadcast ***	lbs/1000 gals	lbs/1000 gals	1000-bird capacity/year
		weeks	-----	lbs-----	stage	stage	gals	inch							
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	9110	.34	N	.46	6.6	3.0	28		
									P205	.70	1.7	1.2	11		
									K20	.70	9.8	6.9	62		
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	22201	.82	N	.46	6.6	3.0	67	
									P205	.70	1.7	1.2	25		
									K20	.70	9.8	6.9	152		
Layer	52 -	4.0	4.0	4.0	15	13	1.7	25375	.93	N	.46	6.6	3.0	77	
									P205	.70	1.7	1.2	30		
									K20	.70	9.8	6.9	174		

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990 Agronomic Division, North Carolina Department of Agriculture

** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.

*** Broadcast: surface spread liquid uncovered for 1 month or longer.

Table 29C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **								Minimum Land Area for Liquid Application							
		broadcast								broadcast							
		lbs/acre/year								lbs/acre/year							
Pullet nonlaying	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Pullet laying	N	16552	33104	49656	66208	82760	99312	1.2e5	1.3e5	.55	.28	.18	.14	.11	.092	.079	.069
	P205	16987	33975	50962	67950	84937	1.0e5	1.2e5	1.4e5	.54	.27	.18	.13	.11	.089	.077	.067
	K20	7297	14595	21892	29189	36487	43784	51081	58379	1.2	.62	.42	.31	.25	.21	.18	.16
Layer	N	16552	33104	49656	66208	82760	99312	1.2e5	1.3e5	1.3	.67	.45	.34	.27	.22	.19	.17
	P205	16987	33975	50962	67950	84937	1.0e5	1.2e5	1.4e5	1.3	.65	.44	.33	.26	.22	.19	.16
	K20	7297	14595	21892	29189	36487	43784	51081	58379	3.0	1.5	1.0	.76	.61	.51	.43	.38

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Liquid Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated layer anaerobic lagoon liquid. Values in cells I25-K56 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F56 are typical values which may be used if more specific information is not available. If actual lagoon liquid nutrient analyses are used, then a corresponding change in lagoon liquid volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I66-I68 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon liquid volumes to be land applied.

	Typical			Actual				
	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying		
Bird live weight:	initial:	3.0	4.0		3.0	4.0	lbs	
	final:	3.0	4.0	3.0	4.0	4.0	lbs	
	average:	1.5	3.5	4.0	1.5	3.5	4.0	
Flocks per year:		2	1	1	2	1	1	flocks/year
Days per flock:		140	365	365	140	365	365	days/flock
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)								
design treatment:	3.8	8.8	10.0	3.8	8.8	10.0	ft ³ /bird cap	
sludge storage:	1.3	2.9	3.3	1.3	2.9	3.3	ft ³ /bird cap	
temporary storage:	.6	1.5	1.7	.6	1.5	1.7	ft ³ /bird cap	
total:	5.6	13.1	15.0	5.6	13.1	15.0	ft ³ /bird cap	
Lagoon liquid accumulation :								
manure and urine:	.012	.028	.032	.012	.028	.032	gals/bird/day	
excess water usage:	.005	.011	.013	.005	.011	.013	gals/bird/day	
Lagoon surface rain surplus:	.009	.022	.025	.009	.022	.025	gals/bird/day	
total:	.026	.061	.069	.026	.061	.069	gals/bird/day	
Lagoon liquid total nutrient analysis:								
Tot N:	179	179	179	179	179	179	lbs/acre-inch	
NH ₃ N:	86	86	86	86	86	86	% tot N or tdn	
P ₂ O ₅ :	46	46	46	46	46	46	lbs/acre-inch	
K ₂ O:	266	266	266	266	266	266	lbs/acre-inch	
Organic N mineralization rate:	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients: (from application method box)								
N:	.50	.50	.50	.50	.50	.50		
P ₂ O ₅ :	.70	.70	.70	.70	.70	.70		
K ₂ O:	.70	.70	.70	.70	.70	.70		

Application method:	NH ₃ N	-----N-----			P&K
soil injection:	.95	.39	.39	.39	.80
soil incorp:	.85	.20	.20	.20	.75
broadcast:	.45	.46	.46	.46	.70
irrigation:	.50	.50	.50	.50	.70

$$\begin{aligned} & \text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch} \\ & \text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch} \end{aligned}$$

Crop fertilization rates: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Table 298. LAYER ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity		Total Lagoon Liquid Surplus, ** per 1000-bd capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Nutrients irrigated	
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals	inch		irrigated ***	lbs/acre-inch	lbs/acre-inch	1000-capacity/yr		
		-----lbs-----													
		weeks													
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	9110	.34	N	.50	179	90			
										P205	.70	46	32		
										K20	.70	266	186		
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	22201	.82	N	.50	179	90		
										P205	.70	46	32		
										K20	.70	266	186		
Layer	52 -	4.0	4.0	4.0	15	13	1.7	25373	.93	N	.50	179	90		
										P205	.70	46	32		
										K20	.70	266	186		

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan Agronomic Division, North Carolina Department of Agriculture
 ** Estimated total lagoon liquid includes total liquid manure plus average annual rainfall surplus incidental to lagoon surface; does not account for seepage.
 *** Irrigated: sprinkler irrigated liquid uncovered for 1 month or longer.

Table 29C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Rate **									Minimum Land Area for Liquid Application						
		irrigated									irrigated						
		lbs/acre/year									lbs/acre/year						
		inches/year									acres/1000-bird capacity						
Pullet nonlaying	N	50	100	150	200	250	300	350	400	.60	.30	.20	.15	.12	.10	.08	
	P205	20	40	60	80	100	120	140	160	.54	.27	.18	.13	.11	.089	.077	
	K20	50	100	150	200	250	300	350	400	1.2	.62	.42	.31	.25	.21	.18	
Pullet laying	N	50	100	150	200	250	300	350	400	1.5	.73	.49	.37	.29	.24	.21	
	P205	20	40	60	80	100	120	140	160	1.3	.65	.44	.33	.26	.22	.19	
	K20	50	100	150	200	250	300	350	400	3.0	1.5	1.0	.76	.61	.51	.43	
Layer	N	50	100	150	200	250	300	350	400	1.7	.84	.56	.42	.34	.28	.24	
	P205	20	40	60	80	100	120	140	160	1.5	.75	.50	.37	.30	.25	.21	
	K20	50	100	150	200	250	300	350	400	3.5	1.7	1.2	.87	.70	.58	.50	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil injected layer anaerobic lagoon sludge. Values in cells I25-K55 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F55 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I65-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual			
	Pullet nonlay	Pullet laying	Layer	Pullet nonlay	Pullet laying	Layer	
	-per bird capacity-			-per bird capacity-			
Bird live weight:	initial:	3.0	4.0		3.0	4.0	lbs
	final:	3.0	4.0	4.0	3.0	4.0	4.0
	average:	1.5	3.5	4.0	1.5	3.5	4.0
Flocks per year:	2	1	1		2	1	1
Days per flock:	140	365	365		140	365	365
agoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	3.8	8.3	10.0		3.8	8.3	10.0
sludge storage:	1.3	2.9	3.3		1.3	2.9	3.3
temporary storage:	.6	1.5	1.7		.6	1.5	1.7
total:	5.6	13.1	15.0		5.6	13.1	15.0
Lagoon sludge accumulation:	.005	.011	.013		.005	.011	.013
Lagoon sludge density:	8.4	8.4	8.4		8.4	8.4	8.4
Lagoon liquid total nutrient analysis:							
Tot N:	26	26	26		26	26	26
NH3N:	31	31	31		31	31	31
P2O5:	92	92	92		92	92	92
K2O:	13	13	13		13	13	13
Organic N mineralization rate	.50	.50	.50		.50	.50	.50
Plant nutrient availability coefficients: (from application method box)							
N:	.64	.64	.64		.64	.64	.64
P2O5:	.80	.80	.80		.80	.80	.80
K2O:	.80	.80	.80		.80	.80	.80

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH3N</td> <td>-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil injection:</td> <td>.95</td> <td>.64 .64 .64</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.58 .58 .58</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.45 .45 .45</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.42 .42 .42</td> <td>.70</td> </tr> </table>	Application method:	NH3N	-----N-----	P&K	soil injection:	.95	.64 .64 .64	.80	soil incorp:	.75	.58 .58 .58	.75	broadcast:	.35	.45 .45 .45	.70	irrigation:	.25	.42 .42 .42	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>=</td> <td>x</td> <td>2266</td> <td>= lbs/acre-inch</td> </tr> <tr> <td>mg/L (ppm)</td> <td>x</td> <td>0.2266</td> <td>= lbs/acre-inch</td> </tr> <tr> <td>lbs/1000 gals</td> <td>x</td> <td>27.154</td> <td>= lbs/acre-inch</td> </tr> </table>	=	x	2266	= lbs/acre-inch	mg/L (ppm)	x	0.2266	= lbs/acre-inch	lbs/1000 gals	x	27.154	= lbs/acre-inch
Application method:	NH3N	-----N-----	P&K																														
soil injection:	.95	.64 .64 .64	.80																														
soil incorp:	.75	.58 .58 .58	.75																														
broadcast:	.35	.45 .45 .45	.70																														
irrigation:	.25	.42 .42 .42	.70																														
=	x	2266	= lbs/acre-inch																														
mg/L (ppm)	x	0.2266	= lbs/acre-inch																														
lbs/1000 gals	x	27.154	= lbs/acre-inch																														

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 30B. LAYER ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity		Total Lagoon Sludge Accumulation, ** per 1000-bd capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Avail Nutrient soil injec			
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³				soil injected ***	lbs/1000 gals	lbs/1000 gals	1000 ca
		weeks			lbs										
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	1659	222	N	.64	26	17			
									P205	.80	92	74			
									K20	.80	13	10			
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	4147	554	N	.64	26	17		
										P205	.80	92	74		
										K20	.80	13	10		
Layer	52 -	4.0	4.0	4.0	15	13	1.7	4739	634	N	.64	26	17		
										P205	.80	92	74		
										K20	.80	13	10		

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; JA Agronomic Division, North Carolina Department of Agriculture

** No manure solids removal prior to lagoon input.

*** Soil injected: lagoon sludge injected directly into soil and covered immediately.

Table 30C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **								Minimum Land Area for Sludge Application							
		soil injected								soil injected							
		lbs/acre/year								lbs/acre/year							
Pullet nonlaying	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	
Pullet laying	N	2999	5999	8998	11997	14997	17996	20996	23995	.55	.28	.18	.14	.11	.092	.075	
	P205	270	541	811	1082	1352	1623	1893	2164	6.1	3.1	2.0	1.5	1.2	1.0	.83	
	K20	4975	9950	14924	19899	24874	29849	34824	39798	.33	.17	.11	.083	.067	.056	.043	
Layer	N	2999	5999	8998	11997	14997	17996	20996	23995	1.4	.69	.46	.35	.28	.23	.20	
	P205	270	541	811	1082	1352	1623	1893	2164	15	7.7	5.1	3.8	3.1	2.6	2.1	
	K20	4975	9950	14924	19899	24874	29849	34824	39798	.83	.42	.28	.21	.17	.14	.11	
		gallons/acre/year								acres/1000-bird capacity							
Pullet nonlaying	N	2999	5999	8998	11997	14997	17996	20996	23995	.55	.28	.18	.14	.11	.092	.075	
	P205	270	541	811	1082	1352	1623	1893	2164	6.1	3.1	2.0	1.5	1.2	1.0	.83	
	K20	4975	9950	14924	19899	24874	29849	34824	39798	.33	.17	.11	.083	.067	.056	.043	
Pullet laying	N	2999	5999	8998	11997	14997	17996	20996	23995	1.4	.69	.46	.35	.28	.23	.20	
	P205	270	541	811	1082	1352	1623	1893	2164	15	7.7	5.1	3.8	3.1	2.6	2.1	
	K20	4975	9950	14924	19899	24874	29849	34824	39798	.83	.42	.28	.21	.17	.14	.11	
Layer	N	2999	5999	8998	11997	14997	17996	20996	23995	1.4	.69	.46	.35	.28	.23	.20	
	P205	270	541	811	1082	1352	1623	1893	2164	15	7.7	5.1	3.8	3.1	2.6	2.1	
	K20	4975	9950	14924	19899	24874	29849	34824	39798	.83	.42	.28	.21	.17	.14	.11	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; JA

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated layer anaerobic lagoon sludge. Values in cells I25-K55 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F55 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I65-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual			
	Pullet nonlay	Pullet laying	Layer laying	Pullet nonlay	Pullet laying	Layer laying	
	-per bird capacity-			-per bird capacity-			
Bird live weight:	initial:	3.0	4.0	3.0	4.0	4.0	lbs
	final:	3.0	4.0	3.0	4.0	4.0	lbs
	average:	1.5	3.5	1.5	3.5	4.0	lb
Flocks per year:	2	1	1	2	1	1	flocks/year
Days per flock:	140	365	365	140	365	365	days/flock
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
design treatment:	3.8	8.8	10.0	3.8	8.3	10.0	ft ³ /bird cap
sludge storage:	1.3	2.9	3.3	1.3	2.9	3.3	ft ³ /bird cap
temporary storage:	.6	1.5	1.7	.6	1.5	1.7	ft ³ /bird cap
total:	5.6	13.1	15.0	5.6	13.1	15.0	ft ³ /bird cap
Lagoon sludge accumulation:	.005	.011	.013	.005	.011	.013	gals/bird/day
Lagoon sludge density:	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon
Lagoon liquid total nutrient analysis:							
Tot N:	26	26	26	26	26	26	lb/1000 gals
NH3N:	31	31	31	31	31	31	% tot N or tkn
P2O5:	92	92	92	92	92	92	lb/1000 gals
K2O:	13	13	13	13	13	13	lb/1000 gals
Organic N mineralization rate	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)							
N:	.58	.58	.58	.58	.58	.58	
P2O5:	.75	.75	.75	.75	.75	.75	
K2O:	.75	.75	.75	.75	.75	.75	

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: left;">NH3N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: left;">P&K</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.64</td> <td>.64</td> <td>.64</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.53</td> <td>.58</td> <td>.53</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.45</td> <td>.45</td> <td>.45</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.42</td> <td>.42</td> <td>.42</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----			P&K	soil injection:	.95	.64	.64	.64	.80	soil incorp:	.75	.53	.58	.53	.75	broadcast:	.35	.45	.45	.45	.70	irrigation:	.25	.42	.42	.42	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> $\% \times 2266 = \text{lbs/acre-inch}$ $\text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$ </td> </tr> </table>	$\% \times 2266 = \text{lbs/acre-inch}$ $\text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$
Application method:	NH3N	-----N-----			P&K																											
soil injection:	.95	.64	.64	.64	.80																											
soil incorp:	.75	.53	.58	.53	.75																											
broadcast:	.35	.45	.45	.45	.70																											
irrigation:	.25	.42	.42	.42	.70																											
$\% \times 2266 = \text{lbs/acre-inch}$ $\text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$																																

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 30B. LAYER ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity			Total Lagoon Sludge Accumulation, per 1000-bd capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Available Nutrients soil incorporated	
		init	final	mean	single stage	2-stage 1st + 2nd	gals	ft ³	soil incorporated ***		lbs/1000 gals	lbs/1000 gals	1000-bd capacity/yr			
		weeks	lbs	lbs	lbs	gals	ft ³	gals	ft ³		gals	gals	gals	gals	gals	
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	1659	222	N	.58	26	15				
									P205	.75	92	69				
									K20	.75	13	9.4				
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	4147	554	N	.58	26	15			
										P205	.75	92	69			
										K20	.75	13	9.4			
Layer	52 -	4.0	4.0	4.0	15	13	1.7	4739	634	N	.58	26	15			
										P205	.75	92	69			
										K20	.75	13	9.4			

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1995
 Agronomic Division, North Carolina Department of Agriculture
 ** No manure solids removal prior to lagoon input.
 *** Soil incorporated: surface spread sludge plowed or disked into the soil within 2 days.

Table 30C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **										Minimum Land Area for Sludge Application													
		soil incorporated										soil incorporated													
		lbs/acre/year										lbs/acre/year													
Pullet nonlaying	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	.50	.25	.17	.12	.10	.083	.071	.06
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	5.7	2.9	1.9	1.4	1.1	.96	.82	.7
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	.31	.16	.10	.078	.063	.052	.045	.038
Pullet laying	N	3325	6649	9974	13298	16623	19948	23272	26597	1.2	.62	.42	.31	.25	.21	.18	.16								
	P205	289	577	866	1154	1443	1731	2020	2308	14	7.2	4.8	3.6	2.9	2.4	2.1	1.8								
	K20	5306	10613	15919	21226	26532	31839	37145	42452	.78	.39	.26	.20	.16	.13	.11	.09								
Layer	N	3325	6649	9974	13298	16623	19948	23272	26597	1.4	.71	.48	.36	.29	.24	.20	.17								
	P205	289	577	866	1154	1443	1731	2020	2308	16	8.2	5.5	4.1	3.3	2.7	2.3	2.0								
	K20	5306	10613	15919	21226	26532	31839	37145	42452	.89	.45	.30	.22	.18	.15	.13	.11								

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1995
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast layer anaerobic lagoon sludge. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I65-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual			
	Pullet nonlay	Pullet laying	Layer laying	Pullet nonlay	Pullet laying	Layer laying	
	-per bird capacity-			-per bird capacity-			
Bird live weight:	initial:	3.0	4.0		3.0	4.0	lbs
	final:	3.0	4.0	4.0	3.0	4.0	4.0
	average:	1.5	3.5	4.0	1.5	3.5	4.0
Flocks per year:		2	1	1	2	1	1
Days per flock:		140	365	365	140	365	365
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)							
	design treatment:	3.8	8.8	10.0	3.8	8.8	10.0
	sludge storage:	1.3	2.9	3.3	1.3	2.9	3.3
	temporary storage:	.6	1.5	1.7	.6	1.5	1.7
	total:	5.6	13.1	15.0	5.6	13.1	15.0
Lagoon sludge accumulation:		.005	.011	.013	.005	.011	.013
Lagoon sludge density:		8.4	8.4	8.4	8.4	8.4	8.4
Lagoon liquid total nutrient analysis:							
	Tot N:	26	26	26	26	26	26
	NH3N:	31	31	31	31	31	31
	P2O5:	92	92	92	92	92	92
	K2O:	13	13	13	13	13	13
Organic N mineralization rate		.50	.50	.50	.50	.50	.50
Plant nutrient availability coefficients: (from application method box)							
	N:	.45	.45	.45	.45	.45	.45
	P2O5:	.70	.70	.70	.70	.70	.70
	K2O:	.70	.70	.70	.70	.70	.70

<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Application method:</th> <th style="text-align: left;">NH3N</th> <th colspan="3" style="text-align: center;">-----N-----</th> <th style="text-align: left;">PK</th> </tr> </thead> <tbody> <tr> <td>soil injection:</td> <td>.95</td> <td>.64</td> <td>.64</td> <td>.64</td> <td>.90</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.58</td> <td>.58</td> <td>.58</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.45</td> <td>.45</td> <td>.45</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.42</td> <td>.42</td> <td>.42</td> <td>.70</td> </tr> </tbody> </table>	Application method:	NH3N	-----N-----			PK	soil injection:	.95	.64	.64	.64	.90	soil incorp:	.75	.58	.58	.58	.75	broadcast:	.35	.45	.45	.45	.70	irrigation:	.25	.42	.42	.42	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">=</td> <td style="text-align: center;">x</td> <td style="text-align: center;">2266</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> <tr> <td style="text-align: center;">mg/L (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.2266</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> <tr> <td style="text-align: center;">lbs/1000 gals</td> <td style="text-align: center;">x</td> <td style="text-align: center;">27.154</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/acre-inch</td> </tr> </table>	=	x	2266	=	lbs/acre-inch	mg/L (ppm)	x	0.2266	=	lbs/acre-inch	lbs/1000 gals	x	27.154	=	lbs/acre-inch
Application method:	NH3N	-----N-----			PK																																									
soil injection:	.95	.64	.64	.64	.90																																									
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broadcast:	.35	.45	.45	.45	.70																																									
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=	x	2266	=	lbs/acre-inch																																										
mg/L (ppm)	x	0.2266	=	lbs/acre-inch																																										
lbs/1000 gals	x	27.154	=	lbs/acre-inch																																										

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 308. LAYER ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity			Total Lagoon Sludge Accumulation, ** per 1000-bd capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/1000 gals	Plant Available Nutrients broadcast			
		init	final	mean	single stage		2-stage	broadcast ***	lbs/1000 gals				lbs/1000 gals	lbs/1000-bird capacity /year		
		weeks			stage		1st + 2nd								gals	ft ³
		-----lbs-----														
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	1659	222	N P205 K20	.45 .70 .70	26 92 13	12 65 8.8	20 107 15			
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	4147	554	N P205 K20	.45 .70 .70	26 92 13	12 65 8.8	49 268 36		
Layer	52 -	4.0	4.0	4.0	15	13	1.7	4739	634	N P205 K20	.45 .70 .70	26 92 13	12 65 8.8	56 307 42		

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture
** No manure solids removal prior to lagoon input.
*** Broadcast: surface spread sludge uncovered for 1 month or longer.

Table 30C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **									Minimum Land Area for Sludge Application							
		broadcast									broadcast							
		lbs/acre/year									lbs/acre/year							
	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		gallons/acre/year									acres/1000-bird capacity							
Pullet nonlaying	N	4245	8491	12736	16981	21227	25472	29717	33962	.39	.20	.13	.098	.078	.065	.056	.049	
	P205	309	618	927	1237	1546	1855	2164	2473	5.4	2.7	1.8	1.3	1.1	.89	.77	.67	
	K20	5685	11371	17056	22742	28427	34113	39798	45484	.29	.15	.097	.073	.058	.049	.042	.036	
Pullet laying	N	4245	8491	12736	16981	21227	25472	29717	33962	.98	.49	.33	.24	.20	.16	.14	.12	
	P205	309	618	927	1237	1546	1855	2164	2473	13	6.7	4.5	3.4	2.7	2.2	1.9	1.7	
	K20	5685	11371	17056	22742	28427	34113	39798	45484	.73	.36	.24	.18	.15	.12	.10	.091	
Layer	N	4245	8491	12736	16981	21227	25472	29717	33962	1.1	.56	.37	.28	.22	.19	.16	.14	
	P205	309	618	927	1237	1546	1855	2164	2473	15	7.7	5.1	3.8	3.1	2.6	2.2	1.9	
	K20	5685	11371	17056	22742	28427	34113	39798	45484	.83	.42	.28	.21	.17	.14	.12	.10	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1991
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Layer Anaerobic Lagoon Sludge Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of irrigated layer anaerobic lagoon sludge. Values in cells I25-K53 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-F53 are typical values which may be used if more specific information is not available. If actual lagoon sludge nutrient analyses are used, then a corresponding change in lagoon sludge volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I63-I65 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, lagoon capacities, and estimated annual lagoon sludge volumes to be land applied.

	Typical			Actual				
	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying	Pullet nonlay -per bird capacity-	Pullet laying	Layer laying		
Bird live weight:	initial:	3.0	4.0	3.0	4.0		lbs	
	final:	3.0	4.0	3.0	4.0		lbs	
	average:	1.5	3.5	1.5	3.5		lbs	
Flocks per year:	2	1	1	2	1	1	flocks/year	
Days per flock:	140	365	365	140	365	365	days/flock	
Lagoon liquid capacity: (does not include freeboard or 25-yr storm storage)								
	design treatment:	3.8	8.8	10.0	3.8	8.8	10.0	ft ³ /bird cap
	sludge storage:	1.3	2.9	3.3	1.3	2.9	3.3	ft ³ /bird cap
	temporary storage:	.6	1.5	1.7	.6	1.5	1.7	ft ³ /bird cap
	total:	5.6	13.1	15.0	5.6	13.1	15.0	ft ³ /bird cap
Lagoon sludge accumulation:	.005	.011	.013	.005	.011	.013	gals/bird/day	
Lagoon sludge density:	8.4	8.4	8.4	8.4	8.4	8.4	lbs/gallon	
Lagoon liquid total nutrient analysis:								
	Tot N:	706	706	706	706	706	lbs/1000 gals	
	NH ₃ N:	31	31	31	31	31	≅ tot N or tKN	
	P ₂ O ₅ :	2510	2510	2510	2510	2510	lbs/1000 gals	
	K ₂ O:	341	341	341	341	341	lbs/1000 gals	
Organic N mineralization rate	.50	.50	.50	.50	.50	.50		
Plant nutrient availability coefficients: (from application method box)								
	N:	.42	.42	.42	.42	.42		
	P ₂ O ₅ :	.70	.70	.70	.70	.70		
	K ₂ O:	.70	.70	.70	.70	.70		

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH₃N</td> <td>-----N-----</td> <td>P&K</td> </tr> <tr> <td>soil injection:</td> <td>.95</td> <td>.64 .64 .64</td> <td>.80</td> </tr> <tr> <td>soil incorp:</td> <td>.75</td> <td>.58 .58 .58</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.35</td> <td>.45 .45 .45</td> <td>.70</td> </tr> <tr> <td>irrigation:</td> <td>.25</td> <td>.42 .42 .42</td> <td>.70</td> </tr> </table>	Application method:	NH ₃ N	-----N-----	P&K	soil injection:	.95	.64 .64 .64	.80	soil incorp:	.75	.58 .58 .58	.75	broadcast:	.35	.45 .45 .45	.70	irrigation:	.25	.42 .42 .42	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> $\bar{x} \times 2266 = \text{lbs/acre-inch}$ $\text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$ </td> </tr> </table>	$\bar{x} \times 2266 = \text{lbs/acre-inch}$ $\text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$
Application method:	NH ₃ N	-----N-----	P&K																			
soil injection:	.95	.64 .64 .64	.80																			
soil incorp:	.75	.58 .58 .58	.75																			
broadcast:	.35	.45 .45 .45	.70																			
irrigation:	.25	.42 .42 .42	.70																			
$\bar{x} \times 2266 = \text{lbs/acre-inch}$ $\text{mg/L (ppm)} \times 0.2266 = \text{lbs/acre-inch}$ $\text{lbs/1000 gals} \times 27.154 = \text{lbs/acre-inch}$																						

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Table 30B. LAYER ANAEROBIC LAGOON SLUDGE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft ³ /bird capacity			Total Lagoon Sludge Accumulation, ** per 1000-bd capacity/yr		Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients		Plant Available Nutrients irrigated	
		init	final	mean	single stage	2-stage 1st + 2nd	acre-gals	inch	irrigated ***		lbs/acre-inch	lbs/acre-inch	1000-bird capacity/year			
		-----			-----			-----			-----		-----			
		weeks	----- lbs-----		stage	1st + 2nd	gals	inch	***		acre-inch	acre-inch	capacity/year			
Pullet nonlaying	0 - 20	3.0	1.5	5.6	5.0	.6	1659	.061	N	.42	706	298	18			
										P205	.70	2510	1757	107		
										K20	.70	341	239	15		
Pullet laying	20 - 52	3.0	4.0	3.5	13	12	1.5	4147	.15	N	.42	706	298	45		
											P205	.70	2510	1757	258	
											K20	.70	341	239	36	
Layer	52 -	4.0	4.0	4.0	15	13	1.7	4739	.17	N	.42	706	298	52		
											P205	.70	2510	1757	307	
											K20	.70	341	239	42	

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** No manure solids removal prior to lagoon input.

*** Irrigated: sprinkler irrigated sludge uncovered for 1 month or longer.

Table 30C. LAND APPLICATION OF LAYER ANAEROBIC LAGOON SLUDGE *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Sludge Application Rate **									Minimum Land Area for Sludge Application irrigated							
		----- lbs/acre/year -----									----- lbs/acre/year -----							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
Pullet nonlaying	N	.17	.34	.50	.67	.84	1.0	1.2	1.3	.36	.18	.12	.091	.073	.061	.052	.045	
	P205	.011	.023	.034	.046	.057	.068	.080	.091	5.4	2.7	1.8	1.3	1.1	.89	.77	.67	
	K20	.21	.42	.63	.84	1.0	1.3	1.5	1.7	.29	.15	.097	.073	.058	.049	.042	.036	
Pullet laying	N	.17	.34	.50	.67	.84	1.0	1.2	1.3	.91	.45	.30	.23	.18	.15	.13	.11	
	P205	.011	.023	.034	.046	.057	.068	.080	.091	13	6.7	4.5	3.4	2.7	2.2	1.9	1.7	
	K20	.21	.42	.63	.84	1.0	1.3	1.5	1.7	.73	.36	.24	.18	.15	.12	.10	.09	
Layer	N	.17	.34	.50	.67	.84	1.0	1.2	1.3	1.0	.52	.35	.26	.21	.17	.15	.13	
	P205	.011	.023	.034	.046	.057	.068	.080	.091	15	7.7	5.1	3.8	3.1	2.6	2.2	1.9	
	K20	.21	.42	.63	.84	1.0	1.3	1.5	1.7	.83	.42	.28	.21	.17	.14	.12	.11	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 199

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P205 soil immobilization unaccounted for.

Broiler Litter Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated broiler litter. Values in cells I25-M51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H51 are typical values which may be used if more specific information is not available. If actual litter nutrient analyses are used, then a corresponding change in litter volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, litter storage capacities, and estimated annual litter volumes to be land applied.

	Typical					Actual						
	Broil house whole	Broil house cake	Broil stock piled	Roast house whole	Breed house whole	Broil house whole	Broil house cake	Broil stock piled	Roast house whole	Breed house whole		
	-----per bird capacity-----					-----per bird capacity-----						
Bird live weight:	initial:				6.0					6.0	lbs	
	final:	4.0	4.0	4.0	8.0	6.0	4.0	4.0	4.0	8.0	6.0	lbs
	average:	2.0	2.0	2.0	4.0	6.0	2.0	2.0	2.0	4.0	6.0	lbs
Flocks per year:		6	6	6	4	1	6	6	6	4	1	flocks/year
Days per flock:		53	53	53	81	365	53	53	53	81	365	days/flock
Litter accumulation:		1.0	.34	1.0	2.6	24	1.0	.34	1.0	2.6	24	tons/1000 birds sold
Litter density:		28	34	34	28	40	28	34	34	28	40	lbs/ft ³
Litter storage period:		365	365	365	365	365	365	365	365	365	365	days
Litter total nutrient analysis:												
	Tot N:	72	46	36	75	31	72	46	36	75	31	lbs/ton
	NH ₃ N:	15	26	21	15	21	15	26	21	15	21	% tot N or tdn
	P ₂ O ₅ :	78	54	80	75	54	78	54	80	75	54	lbs/ton
	K ₂ O:	46	36	34	45	31	46	36	34	45	31	lbs/ton
Organic N mineralization rate		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients:	(from application method box)											
	N:	.56	.60	.58	.56	.59	.56	.60	.58	.56	.59	
	P ₂ O ₅ :	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	
	K ₂ O:	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	

Application method: NH ₃ N -----N----- P&K soil incorp: .90 .56 .60 .58 .56 .59 .75 broadcast: .25 .46 .44 .45 .46 .45 .70	$\% \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times 0.002 = \text{lbs/ton}$
---	---

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 32B. BROILER LITTER FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Litter Storage Capacity,**	Total Litter, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/ton	Plant Available Nutrients soil incorporated					
		init	final	mean							lbs/1000-bd capacity/year	lbs/ton				
		weeks	lbs								ft2/bird	ft3/1000-bd capacity	soil incorporated***	lbs/ton		
Broiler house whole	0- 7.5	4.0	2.0	0.8	414	5.8	N	.56	72	41	237					
												P2O5	.75	73	59	344
												K2O	.75	46	34	201
Broiler house cake	0- 7.5	4.0	2.0	0.8	116	2.0	N	.60	46	28	51					
												P2O5	.75	54	40	81
												K2O	.75	36	27	53
Broiler stock-piled	0- 7.5	4.0	2.0	0.8	414	5.8	N	.58	36	21	121					
												P2O5	.75	80	60	344
												K2O	.75	34	25	143
Roaster house whole	0-11.5	8.0	4.0	1.6	733	10	N	.56	73	41	424					
												P2O5	.75	75	56	537
												K2O	.75	45	34	343
Breeder house whole		6.0	6.0	6.0	1201	24	N	.59	31	18	436					
												P2O5	.75	54	41	967
												K2O	.75	31	23	554

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan. Agronomic Division, North Carolina Department of Agriculture
 ** Annual manure and litter accumulation; typical litter base is sawdust, wood shavings or peanut hulls.
 *** Soil incorporated: surface spread litter plowed or disked into soil within 2 days.

Table 32C. LAND APPLICATION OF BROILER LITTER *

Type of Production Unit	Rate-Limiting Nutrient	Litter Application Rate **									Minimum Land Area for Litter Application **							
		soil incorporated									soil incorporated							
		lbs/acre/year									lbs/acre/year							
	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
	P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
	K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		tons/acre/year									acres/1000-bird capacity							
Broiler house whole	N	1.2	2.5	3.7	4.9	6.2	7.4	8.6	9.8	4.7	2.4	1.6	1.2	.95	.79	.68	.55	
	P2O5	.34	.68	1.0	1.4	1.7	2.0	2.4	2.7	17	8.6	5.7	4.3	3.4	2.9	2.5	2.1	
	K2O	1.5	2.9	4.4	5.8	7.3	8.7	10	12	4.0	2.0	1.3	1.0	.80	.67	.57	.51	
Broiler house cake	N	1.8	3.6	5.5	7.3	9.1	11	13	15	1.1	.55	.36	.27	.22	.18	.16	.14	
	P2O5	.50	.99	1.5	2.0	2.5	3.0	3.5	4.0	4.0	2.0	1.3	1.0	.80	.67	.57	.51	
	K2O	1.9	3.7	5.6	7.5	9.3	11	13	15	1.1	.53	.35	.27	.21	.18	.15	.11	
Broiler stock-piled	N	2.4	4.8	7.2	9.6	12	14	17	19	2.4	1.2	.80	.60	.48	.40	.34	.31	
	P2O5	.33	.67	1.0	1.3	1.7	2.0	2.3	2.7	17	8.6	5.7	4.3	3.4	2.9	2.5	2.1	
	K2O	1.9	3.9	5.8	7.7	9.7	12	14	15	3.0	1.5	.99	.74	.60	.50	.43	.3	
Roaster house whole	N	1.2	2.4	3.6	4.9	6.1	7.3	8.5	9.7	8.5	4.3	2.8	2.1	1.7	1.4	1.2	1.0	
	P2O5	.36	.71	1.1	1.4	1.8	2.1	2.5	2.9	29	15	9.7	7.3	5.8	4.8	4.1	3.5	
	K2O	1.5	3.0	4.5	5.9	7.4	8.9	10	12	7.0	3.5	2.3	1.7	1.4	1.2	1.0	.8	
Breeder house whole	N	2.7	5.5	8.2	11	14	16	19	22	8.7	4.4	2.9	2.2	1.7	1.5	1.2	1.0	
	P2O5	.49	.99	1.5	2.0	2.5	3.0	3.5	3.9	48	24	16	12	9.7	8.1	6.9	6.0	
	K2O	2.2	4.3	6.5	8.6	11	13	15	17	11	5.5	3.7	2.8	2.2	1.8	1.6	1.4	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Broiler Litter Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast broiler litter. Values in cells I25-M51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-H51 are typical values which may be used if more specific information is not available. If actual litter nutrient analyses are used, then a corresponding change in litter volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, litter storage capacities, and estimated annual litter volumes to be land applied.

	Typical					Actual						
	Broil house whole	Broil house cake	Broil stock piled	Roast house whole	Breed house whole	Broil house whole	Broil house cake	Broil stock piled	Roast house whole	Breed house whole		
	-----per bird capacity-----					-----per bird capacity-----						
Bird live weight:	initial:				6.0					6.0	lbs	
	final:	4.0	4.0	4.0	8.0	6.0	4.0	4.0	4.0	8.0	6.0	lbs
	average:	2.0	2.0	2.0	4.0	6.0	2.0	2.0	2.0	4.0	6.0	lbs
Flocks per year:		6	6	6	4	1	6	6	6	4	1	flocks/year
Days per flock:		53	53	53	81	365	53	53	53	81	365	days/flock
Litter accumulation:		1.0	.34	1.0	2.6	24	1.0	.34	1.0	2.6	24	tons/1000 birds sold
Litter density:		28	34	34	28	40	28	34	34	28	40	lbs/ft ³
Litter storage period:		365	365	365	365	365	365	365	365	365	365	days
Litter total nutrient analysis:												
	Tot N:	72	46	36	73	31	72	46	36	73	31	lbs/ton
	NH ₃ N:	15	26	21	15	21	15	26	21	15	21	% tot N or tkn
	P ₂ O ₅ :	78	54	80	75	54	78	54	80	75	54	lbs/ton
	K ₂ O:	46	36	34	45	31	46	36	34	45	31	lbs/ton
Organic N mineralization rate		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients:	(from application method box)											
	N:	.46	.44	.45	.46	.45	.46	.44	.45	.46	.45	
	P ₂ O ₅ :	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	
	K ₂ O:	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	

Application method: NH ₃ N -----N----- P&K soil incorp: .90 .56 .60 .58 .56 .59 .75 broadcast: .25 .46 .44 .45 .46 .45 .70	$\% \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times 0.002 = \text{lbs/ton}$
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Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 32B. BROILER LITTER FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space ft ² /bird	Litter Storage Capacity, ** ft ³ /1000-bd capacity	Total Litter, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients		Total Nutrients lbs/ton	Plant Available Nutrients broadcast	
		init	final	mean					broadcast ***	lbs/ton		lbs/ton	lbs/1000-bd capacity/year
		-----lbs-----											
Broiler house whole	0- 7.5	4.0	2.0	0.8	414	5.8	N P2O5 K2O	.46	72	33	195		
								.70	78	55	321		
								.70	46	32	187		
Broiler house cake	0- 7.5	4.0	2.0	0.8	116	2.0	N P2O5 K2O	.44	46	20	39		
								.70	54	38	75		
								.70	36	25	50		
Broiler stock-piled	0- 7.5	4.0	2.0	0.8	414	5.8	N P2O5 K2O	.45	36	16	92		
								.70	80	56	321		
								.70	34	24	139		
Roaster house whole	0-11.5	8.0	4.0	1.6	733	10	N P2O5 K2O	.46	73	34	350		
								.70	75	52	542		
								.70	45	31	325		
Breeder house whole		6.0	6.0	6.0	2.5	1201	24	N P2O5 K2O	.45	31	14	332	
									.70	54	38	902	
									.70	31	22	517	

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1994
 Agronomic Division, North Carolina Department of Agriculture
 ** Annual manure and litter accumulation; typical litter base is sawdust, wood shavings or peanut hulls.
 *** Broadcast: surface spread litter uncovered for 1 month or longer.

Table 32C. LAND APPLICATION OF BROILER LITTER *

Type of Production Unit	Rate-Limiting Nutrient	Litter Application Rate **									Minimum Land Area for Litter Application **							
		broadcast									broadcast							
		lbs/acre/year									lbs/acre/year							
Broiler house whole	N P2O5 K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
		20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Broiler house whole	N P2O5 K2O	1.5	3.0	4.5	6.0	7.5	9.0	10	12	3.9	2.0	1.3	.98	.78	.65	.56	.49	
		.36	.73	1.1	1.5	1.8	2.2	2.5	2.9	16	8.0	5.3	4.0	3.2	2.7	2.3	2.0	
		1.6	3.1	4.7	6.2	7.8	9.4	11	12	3.7	1.9	1.2	.94	.75	.62	.53	.47	
Broiler house cake	N P2O5 K2O	2.5	5.0	7.5	10	13	15	18	20	.79	.39	.24	.20	.16	.13	.11	.098	
		.53	1.1	1.6	2.1	2.7	3.2	3.7	4.2	3.7	1.9	1.2	.94	.75	.62	.53	.47	
		2.0	4.0	6.0	8.0	10	12	14	16	.99	.50	.33	.25	.20	.17	.14	.12	
Broiler stock-piled	N P2O5 K2O	3.1	6.3	9.4	13	16	19	22	25	1.8	.92	.61	.46	.37	.31	.26	.23	
		.36	.72	1.1	1.4	1.8	2.2	2.5	2.9	16	8.0	5.3	4.0	3.2	2.7	2.3	2.1	
		2.1	4.1	6.2	8.3	10	12	15	17	2.8	1.4	.93	.69	.56	.46	.40	.35	
Roaster house whole	N P2O5 K2O	1.5	3.0	4.4	5.9	7.4	8.9	10	12	7.0	3.5	2.3	1.8	1.4	1.2	1.0	.8	
		.38	.76	1.1	1.5	1.9	2.3	2.7	3.1	27	14	9.0	6.8	5.4	4.5	3.9	3.4	
		1.6	3.2	4.8	6.4	8.0	9.6	11	13	6.5	3.3	2.2	1.6	1.3	1.1	.93	.8	
Breeder house whole	N P2O5 K2O	3.6	7.2	11	14	18	22	25	29	6.6	3.3	2.2	1.7	1.3	1.1	.95		
		.53	1.1	1.6	2.1	2.6	3.2	3.7	4.2	45	23	15	11	9.0	7.5	6.4		
		2.3	4.6	6.9	9.2	12	14	16	18	10	5.2	3.4	2.6	2.1	1.7	1.5		

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1994
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Turkey House Whole Litter Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated turkey house whole litter. Values in cells D25-E31 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-G31 are typical values which may be used if more specific information is not available. If actual litter nutrient analyses are used, then a corresponding change in litter volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, litter storage capacities, and estimated annual litter volumes to be land applied.

	Typical				Actual				
	Poult:		Tom Breed		Poult:		Tom Breed		
	house whole	house whole	house whole	house whole	house whole	house whole	house whole	house whole	
	-----per bird capacity-----				-----per bird capacity-----				
Bird live weights:	initial:	4	5	20	4	5	20	lbs	
	final:	5.0	16	25	20	5.0	16	25	20
	average:	2.5	10	15	20	2.5	10	15	20
Flocks per year:		7	3	3	1	7	3	3	1
Days per flock:		42	98	98	365	42	98	98	365
Litter accumulation:		.75	5.0	7.5	37	.75	5.0	7.5	37
		tons/1000 birds sold							
Litter density:		25	34	34	34	25	34	34	34
		lbs/ft ³							
Litter storage periods:		365	365	365	365	365	365	365	365
		days							
Litter total nutrient analysis:									
	Tot N:	45	57	57	33	45	57	57	33
	NHEN:	19	23	23	22	19	23	23	22
	P2O5:	52	72	72	47	52	72	72	47
	K2O:	32	40	40	18	32	40	40	18
		lbs/ton							
		% tot N or ton							
Organic N mineralization rate		.50	.50	.50	.50	.50	.50	.50	.50
Plant nutrient availability coefficients: (from application method box)									
	N:	.53	.61	.61	.61	.53	.61	.61	.61
	P2O5:	.75	.75	.75	.75	.75	.75	.75	.75
	K2O:	.75	.75	.75	.75	.75	.75	.75	.75

Application method: NHEN -----N----- P3K soil incorp: .90 .53 .61 .61 .61 .75 broadcast: .25 .45 .45 .45 .45 .70	$= \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times .002 = \text{lbs/ton}$
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Crop fertilization rates: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Table 37a. TURKEY HOUSE WHOLE LITTER FERTILIZER NUTRIENTS

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Litter Storage Capacity, ^{1/} ft ³ /1000-bd capacity	Total Litter, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/ton	Plant Avail/soil incorporate					
		init	final	mean							soil incorporated	lbs/ton				
		weeks	lbs								ft ² /bird	soil incorporated	lbs/ton	lbs/1000-bd capacity/year		
Poult house whole	0 - 6	5.0	2.5	1.0	428	5.3	N	.58	45	26	137					
												P2O5	.75	52	39	205
												K2O	.75	32	24	127
Hen house whole	6 - 20	4	16	10	2.0	1005	17	N	.61	57	35					
												P2O5	.75	72	54	594
												K2O	.75	40	30	919
Tom house whole	6 - 20	5	25	15	3.0	1505	25	N	.61	57	35					
												P2O5	.75	72	54	891
												K2O	.75	40	30	1378
Breeder house whole		20	20	20		2212	37	N	.61	35	22					
												P2O5	.75	47	35	810
												K2O	.75	18	15	1319

^{1/} References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

^{2/} Annual manure and litter accumulation; typical litter base is sawdust, wood shavings or peanut hulls.

^{3/} Soil incorporated: surface spread litter plowed or disked into soil within 2 days.

Table 37c. LAND APPLICATION OF TURKEY HOUSE WHOLE LITTER

Type of Production Unit	Rate-Limiting Nutrient	Litter Application Rate ^{2/}										Minimum Land Area for Litter Application ^{3/}							
		soil incorporated										soil incorporated							
		lbs/acre/year										lbs/acre/year							
Poult house whole	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400		
		P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160	
		K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Hen house whole	N	1.9	3.3	5.3	7.7	9.6	12	13	15	2.7	1.4	.92	.69	.55	.46	.39	.34		
		P2O5	.51	1.0	1.5	2.1	2.6	3.1	3.6	4.1	10	5.1	3.4	2.6	2.1	1.7	1.5	1.3	
		K2O	2.1	4.1	6.2	8.3	10	12	15	17	2.5	1.3	.85	.64	.51	.42	.36	.32	
Tom house whole	N	1.4	2.8	4.3	5.7	7.1	8.5	10	11	12	5.9	4.0	3.0	2.4	2.0	1.7	1.5		
		P2O5	.37	.74	1.1	1.5	1.8	2.2	2.6	2.9	46	23	15	11	9.2	7.7	6.6	5.7	
		K2O	1.6	3.3	4.9	6.6	8.2	10	12	13	10	5.1	3.4	2.6	2.0	1.7	1.5	1.3	
Breeder house whole	N	1.4	2.8	4.3	5.7	7.1	8.5	10	11	18	8.9	5.9	4.5	3.6	3.0	2.5	2.2		
		P2O5	.37	.74	1.1	1.5	1.8	2.2	2.6	2.9	69	34	23	17	14	11	9.8	8.6	
		K2O	1.6	3.3	4.9	6.6	8.2	10	12	13	15	7.7	5.1	3.8	3.1	2.6	2.2	1.9	
Breeder house whole	N	2.3	4.6	6.9	9.2	12	14	16	18	16	8.1	5.4	4.1	3.2	2.7	2.3	2.0		
		P2O5	.57	1.1	1.7	2.3	2.8	3.4	4.0	4.5	66	33	22	16	13	11	9.4	8.2	
		K2O	3.7	7.4	11	15	19	22	26	30	10	5.0	3.4	2.5	2.0	1.7	1.4	1.3	

^{1/} References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

^{2/} N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P2O5 soil immobilization unaccounted for.

^{3/} Dr. James Barker, NCSU, said the values in this column are based on a very limited database and can vary with management styles. When using these values to determine volume of storage required, volumes should be verified with the local poultry specialist.

Jan. 1995

Turkey House Whole Litter Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast turkey house whole litter. Values in cells I25-L51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-G51 are typical values which may be used if more specific information is not available. If actual litter nutrient analyses are used, then a corresponding change in litter volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, litter storage capacities, and estimated annual litter volumes to be land applied.

	Typical				Actual					
	Poult house whole ----per bird capacity--	Hen house whole ----per bird capacity--	Tom house whole ----per bird capacity--	Breed house whole ----per bird capacity--	Poult house whole ----per bird capacity--	Hen house whole ----per bird capacity--	Tom house whole ----per bird capacity--	Breed house whole ----per bird capacity--		
Bird live weight:	initial:	4	5	20		4	5	20	lbs	
	final:	5.0	16	25	20	5.0	16	25	20	lbs
	average:	2.5	10	15	20	2.5	10	15	20	lbs
Flocks per year:		7	3	3	1	7	3	3	1	flocks/year
Days per flock:		42	98	98	365	42	98	98	365	days/flock
Litter accumulation:		.75	5.0	7.5	37	.75	5.0	7.5	37	tens/1000 birds sold
Litter density:		25	34	34	34	25	34	34	34	lbs/ft ³
Litter storage period:		365	365	365	365	365	365	365	365	days
Litter total nutrient analysis:										
	Tot N:	45	57	57	35	45	57	57	35	lbs/ton
	NH ₃ N:	19	28	28	28	19	28	28	28	% tot N or tdn
	P ₂ O ₅ :	52	72	72	47	52	72	72	47	lbs/ton
	K ₂ O:	32	40	40	18	32	40	40	18	lbs/ton
Organic N mineralization rate		.50	.50	.50	.50	.50	.50	.50	.50	
Plant nutrient availability coefficients:	(from application method box)									
	N:	.45	.43	.43	.43	.45	.43	.43	.43	
	P ₂ O ₅ :	.70	.70	.70	.70	.70	.70	.70	.70	
	K ₂ O:	.70	.70	.70	.70	.70	.70	.70	.70	

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">Application method:</td> <td style="width: 10%;">NH₃N</td> <td colspan="4" style="text-align: center;">-----N-----</td> <td style="width: 10%;">P&K</td> </tr> <tr> <td>soil incorp:</td> <td>.90</td> <td>.53</td> <td>.61</td> <td>.61</td> <td>.61</td> <td>.75</td> </tr> <tr> <td>broadcast:</td> <td>.25</td> <td>.45</td> <td>.45</td> <td>.43</td> <td>.43</td> <td>.70</td> </tr> </table>	Application method:	NH ₃ N	-----N-----				P&K	soil incorp:	.90	.53	.61	.61	.61	.75	broadcast:	.25	.45	.45	.43	.43	.70	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">=</td> <td style="text-align: center;">x</td> <td style="text-align: center;">20</td> <td style="text-align: center;">=</td> <td>lbs/ton</td> </tr> <tr> <td style="text-align: center;">mg/kg (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.002</td> <td style="text-align: center;">=</td> <td>lbs/ton</td> </tr> </table>	=	x	20	=	lbs/ton	mg/kg (ppm)	x	0.002	=	lbs/ton
Application method:	NH ₃ N	-----N-----				P&K																										
soil incorp:	.90	.53	.61	.61	.61	.75																										
broadcast:	.25	.45	.45	.43	.43	.70																										
=	x	20	=	lbs/ton																												
mg/kg (ppm)	x	0.002	=	lbs/ton																												

Crop fertilization rates: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 37B. TURKEY HOUSE WHOLE LITTER FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Litter Storage Capacity, **	Total Litter, tons/1000-bd capacity /year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/ton	Plant Available Nutrients broadcast	
		init	final	mean							lbs/1000-bd capacity/year	lbs/ton
		weeks	lbs	lbs							ft2/bird	ft3/1000-bd capacity
Poult house whole	0 - 6	5.0	2.5	1.0	428	5.3	N	.45	45	20	108	
							P205	.70	52	36	192	
							K20	.70	32	23	115	
Hen house whole	6 - 20	4	16	10	1003	17	N	.43	57	25	415	
							P205	.70	72	51	858	
							K20	.70	40	28	478	
Tom house whole	6 - 20	5	25	15	1505	25	N	.43	57	25	623	
							P205	.70	72	51	1288	
							K20	.70	40	28	717	
Breeder house whole	20	20	20		2212	37	N	.43	35	15	566	
							P205	.70	47	33	1231	
							K20	.70	18	13	469	

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan Agronomic Division, North Carolina Department of Agriculture
 ** Annual manure and litter accumulation; typical litter base is sawdust, wood shavings or peanut hulls.
 *** Broadcast: surface spread litter uncovered for 1 month or longer.

Table 37C. LAND APPLICATION OF TURKEY HOUSE WHOLE LITTER *

Type of Production Unit	Rate-Limiting Nutrient	Litter Application Rate **								Minimum Land Area for Litter Application ***							
		broadcast								broadcast							
		lbs/acre/year								lbs/acre/year							
Poult house whole	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
	P205	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140	160
	K20	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400
Hen house whole	N	2.4	4.9	7.3	9.8	12	15	17	20	2.2	1.1	.72	.54	.43	.36	.31	.27
	P205	.55	1.1	1.6	2.2	2.7	3.3	3.8	4.4	9.6	4.8	3.2	2.4	1.9	1.6	1.4	1.2
	K20	2.2	4.4	6.7	8.9	11	13	16	18	2.4	1.2	.79	.59	.47	.40	.34	.30
Tom house whole	N	2.0	4.1	6.1	8.1	10	12	14	16	8.3	4.2	2.8	2.1	1.7	1.4	1.2	1.1
	P205	.39	.79	1.2	1.6	2.0	2.4	2.8	3.2	43	21	14	11	8.6	7.1	6.1	5.4
	K20	1.8	3.5	5.3	7.1	8.8	11	12	14	9.6	4.8	3.2	2.4	1.9	1.6	1.4	1.2
Breeder house whole	N	2.0	4.1	6.1	8.1	10	12	14	16	12	6.2	4.2	3.1	2.5	2.1	1.8	1.6
	P205	.39	.79	1.2	1.6	2.0	2.4	2.8	3.2	64	32	21	16	13	11	9.2	8.1
	K20	1.8	3.5	5.3	7.1	8.8	11	12	14	14	7.2	4.8	3.6	2.9	2.4	2.0	1.8
Breeder house whole	N	3.3	6.6	9.9	13	16	20	23	26	11	5.7	3.8	2.8	2.3	1.9	1.6	1.5
	P205	.61	1.2	1.8	2.4	3.0	3.6	4.2	4.8	62	31	21	15	12	10	8.8	8.1
	K20	4.0	7.9	12	16	20	24	28	32	9.4	4.7	3.1	2.3	1.9	1.6	1.3	1.3

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan
 ** N fertilization rate should be consistent with realistic crop yield.
 *** N leaching and denitrification and P205 soil immobilization unaccounted for.

REV. Jan. 1995

Turkey House Manure Cake Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated turkey house manure cake. Values in cells I25-J51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-E51 are typical values which may be used if more specific information is not available. If actual manure cake nutrient analyses are used, then a corresponding change in manure cake volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual manure cake volumes to be land applied.

	Typical		Actual																		
	Hen house cake -per bd cap-	Tom house cake -per bd cap-	Hen house cake -per bd cap-	Tom house cake -per bd cap-																	
Bird live weight:	initial:	4	5	4	5	lb															
	final:	16	25	16	25	lb															
	average:	10	15	10	15	lb															
Flocks per year:		3	3	3	3	flocks/year															
Days per flock:		98	98	98	98	days/flock															
Manure cake accumulation:		1.7	2.6	1.7	2.6	tons/1000 birds sold															
Manure cake density:		34	34	34	34	lb/ft ³															
Manure storage period:		365	365	365	365	days															
Manure cake total nutrient analysis:																					
	Tot N:	45	45	45	45	lb/ton															
	NH3N:	45	45	45	45	N tot N or tkn															
	P2O5:	47	47	47	47	lb/ton															
	K2O:	30	30	30	30	lb/ton															
Organic N mineralization rate		.50	.50	.50	.50																
Plant nutrient availability coefficients:	(from application method box)																				
	N:	.68	.68	.68	.68																
	P2O5:	.75	.75	.75	.75																
	K2O:	.75	.75	.75	.75																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Application method:</td> <td>NH3N</td> <td>----N----</td> <td>P&K</td> </tr> <tr> <td>soil incorp:</td> <td>.90</td> <td>.68</td> <td>.68</td> </tr> <tr> <td>broadcast:</td> <td>.25</td> <td>.39</td> <td>.39</td> </tr> <tr> <td></td> <td></td> <td></td> <td>.70</td> </tr> </table>						Application method:	NH3N	----N----	P&K	soil incorp:	.90	.68	.68	broadcast:	.25	.39	.39				.70
Application method:	NH3N	----N----	P&K																		
soil incorp:	.90	.68	.68																		
broadcast:	.25	.39	.39																		
			.70																		
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">mg/kg (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">20</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/ton</td> </tr> <tr> <td style="text-align: center;">mg/kg (ppm)</td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.002</td> <td style="text-align: center;">=</td> <td style="text-align: center;">lbs/ton</td> </tr> </table>						mg/kg (ppm)	x	20	=	lbs/ton	mg/kg (ppm)	x	0.002	=	lbs/ton						
mg/kg (ppm)	x	20	=	lbs/ton																	
mg/kg (ppm)	x	0.002	=	lbs/ton																	
Crop fertilization rate:	N:			50		lbs/ac/yr															
	P2O5:			20		lbs/ac/yr															
	K2O:			50		lbs/ac/yr															

Scroll down for results.

Table 37b. TURKEY HOUSE MANURE CAKE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Manure Cake, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/ton	Plant Available Nutrients soil incorporated	
		init	final	mean							lbs/1000-bd capacity/year	lbs/ton
Hen house cake	6 - 20 weeks	16	10	10	1.0	337	5.8	N	.68	45	30	174
								P205	.75	47	35	203
								K20	.75	30	23	150
Tom house cake	6 - 20 weeks	5	25	15	2.0	505	8.7	N	.68	45	30	264
								P205	.75	47	35	304
								K20	.75	30	23	196

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture
** Annual manure cake accumulation removed from house after each flock.
*** Soil incorporated: surface spread manure plowed or disked into the soil within 2 days.

Table 37c. LAND APPLICATION OF TURKEY HOUSE MANURE CAKE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **									Minimum Land Area for Manure Application							
		soil incorporated									soil incorporated							
		lbs/acre/year									lbs/acre/year							
		50	100	150	200	250	300	350	400	50	100	150	200	250	300	350	400	
Hen house cake	N	1.6	3.3	4.9	6.6	8.2	9.8	11	13	3.5	1.8	1.2	.88	.70	.59	.50	.44	
	P205	.57	1.1	1.7	2.3	2.8	3.4	4.0	4.6	10	5.1	3.4	2.5	2.0	1.7	1.4	1.3	
	K20	2.2	4.4	6.7	8.9	11	13	16	18	2.6	1.3	.87	.65	.52	.43	.37	.33	
Tom house cake	N	1.6	3.3	4.9	6.6	8.2	9.8	11	13	5.3	2.6	1.8	1.3	1.1	.88	.75	.66	
	P205	.57	1.1	1.7	2.3	2.8	3.4	4.0	4.6	15	7.6	5.1	3.8	3.0	2.5	2.2	1.9	
	K20	2.2	4.4	6.7	8.9	11	13	16	18	3.9	2.0	1.3	.98	.78	.65	.56	.49	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990
** N fertilization rate should be consistent with realistic crop yield.
N leaching and denitrification and P205 soil immobilization unaccounted for.

Jan. 1995

Turkey House Manure Cake Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast turkey house manure cake. Values in cells I25-J51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-E51 are typical values which may be used if more specific information is not available. If actual manure cake nutrient analyses are used, then a corresponding change in manure cake volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, manure storage capacities, and estimated annual manure cake volumes to be land applied.

	Typical		Actual		
	Hen house cake -per bd cap	Tom house cake -per bd cap	Hen house cake -per bd cap	Tom house cake -per bd cap	
Bird live weight:	initial: 4	5	4	5	lbs
	final: 16	25	16	25	lbs
	average: 10	15	10	15	lbs
Flocks per year:	3	3	3	3	flocks/year
Days per flock:	98	98	98	98	days/flock
Manure cake accumulation:	1.7	2.6	1.7	2.6	tons/1000 birds sold
Manure cake density:	34	34	34	34	lbs/ft ³
Manure storage period:	365	365	365	365	days
Manure cake total nutrient analysis:			45	45	lbs/ton
	Tot N: 45	45	45	45	% tot N or tkn
	NH3N: 45	45	47	47	lbs/ton
	P2O5: 47	47	30	30	lbs/ton
	K2O: 30	30			
Organic N mineralization rate:	.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)			.39	.39	
	N: .39	.39	.70	.70	
	P2O5: .70	.70	.70	.70	
	K2O: .70	.70			

Application method:	NH3N	----	P&K
soil incorp:	.90	.68	.75
broadcast:	.25	.39	.70

$\frac{\text{mg}}{\text{kg}}$ (ppm) \times 20 = lbs/ton
$\frac{\text{mg}}{\text{kg}}$ (ppm) \times 0.002 = lbs/ton

Crop fertilization rate: N:	50	lbs/ac/yr
P2O5:	20	lbs/ac/yr
K2O:	50	lbs/ac/yr

Scroll down for results.

Table 37b. TURKEY HOUSE MANURE CAKE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Manure Storage Capacity, **	Total Manure Cake, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients
		init final mean								
		weeks	lbs							
Hen house cake	6 - 20		16	10	1.0	337	5.8	N	.39	45
								P2O5	.70	47
								K2O	.70	30
Tom house cake	6 - 20	5	25	15	2.0	505	8.7	N	.39	45
								P2O5	.70	47
								K2O	.70	30

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University Agronomic Division, North Carolina Department of Agriculture
 ** Annual manure cake accumulation removed from house after each flock.
 *** Broadcast: surface spread manure uncovered for 1 month or longer.

Table 37c. LAND APPLICATION OF TURKEY HOUSE MANURE CAKE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Rate **										Minimum Land Area for Manure App					
		broadcast										broadcast					
		lbs/acre/year										lbs/acre/year					
Hen house cake	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300		
	P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120		
	K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300		
Tom house cake	N	2.9	5.7	8.6	11	14	17	20	23	2.0	1.0	.67	.50	.40	.34		
	P2O5	.61	1.2	1.8	2.4	3.1	3.7	4.3	4.9	9.5	4.7	3.2	2.4	1.9	1.6		
	K2O	2.4	4.8	7.1	9.5	12	14	17	19	2.4	1.2	.81	.61	.49	.41		
Tom house cake	N	2.9	5.7	8.6	11	14	17	20	23	3.0	1.5	1.0	.75	.60	.50		
	P2O5	.61	1.2	1.8	2.4	3.1	3.7	4.3	4.9	14	7.1	4.7	3.4	2.8	2.4		
	K2O	2.4	4.8	7.1	9.5	12	14	17	19	3.6	1.8	1.2	.91	.73	.61		

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Turkey Stockpiled Litter Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of soil incorporated turkey stockpiled litter. Values in cells I25-J51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-E51 are typical values which may be used if more specific information is not available. If actual litter nutrient analyses are used, then a corresponding change in litter volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, litter storage capacities, and estimated annual litter volumes to be land applied.

		Typical		Actual		
		Hen	Tom	Hen	Tom	
		-stockpiled-		-stockpiled-		
		-per bd cap-		-per bd cap-		
Bird live weight:	initial:	4	5	4	5	lb
	final:	16	25	16	25	lb
	average:	10	15	10	15	lb
Flocks per year:		3	3	3	3	flocks/year
Days per flock:		98	98	98	98	days/flock
Litter accumulation:		4.4	6.6	4.4	6.6	tons/1000 birds sold
Litter density:		24	24	24	24	lbs/ft ³
Litter storage period:		365	365	365	365	days
Litter total nutrient analysis:						
	Tot N:	36	36	36	36	lbs/ton
	NH ₃ N:	17	17	17	17	% tot N on ton
	P ₂ O ₅ :	72	72	72	72	lbs/ton
	K ₂ O:	33	33	33	33	lbs/ton
Organic N mineralization rate		.50	.50	.50	.50	
Plant nutrient availability coefficients: (from application method box)						
	N:	.57	.57	.57	.57	
	P ₂ O ₅ :	.75	.75	.75	.75	
	K ₂ O:	.75	.75	.75	.75	

<table style="width: 100%;"> <tr> <td>Application method:</td> <td>NH₃N</td> <td>----</td> <td>N</td> <td>----</td> <td>P&K</td> </tr> <tr> <td>soil incorp:</td> <td style="text-align: center;">.90</td> <td style="text-align: center;">.57</td> <td style="text-align: center;">.57</td> <td></td> <td style="text-align: center;">.75</td> </tr> <tr> <td>broadcast:</td> <td style="text-align: center;">.25</td> <td style="text-align: center;">.46</td> <td style="text-align: center;">.46</td> <td></td> <td style="text-align: center;">.70</td> </tr> </table>	Application method:	NH ₃ N	----	N	----	P&K	soil incorp:	.90	.57	.57		.75	broadcast:	.25	.46	.46		.70	$\% \times 20 = \text{lbs/ton}$ $\text{mg/kg (ppm)} \times 0.002 = \text{lbs/ton}$
Application method:	NH ₃ N	----	N	----	P&K														
soil incorp:	.90	.57	.57		.75														
broadcast:	.25	.46	.46		.70														

Crop fertilization rate: N:	50	lbs/ac/yr
P ₂ O ₅ :	20	lbs/ac/yr
K ₂ O:	50	lbs/ac/yr

Scroll down for results.

Table 425. TURKEY STOCKPILED LITTER FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Litter Storage Capacity, **	Total Litter, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients	Plant Available Nutrients soil incorp
		init final mean									
		weeks	lbs								
Hen stock-piled	6 - 20	4	16	10	1.0	1003	15	N	.57	36	20
								P2O5	.75	72	54
								K2O	.75	33	25
Tom stock-piled	6 - 20	5	25	15	2.0	1505	22	N	.57	36	20
								P2O5	.75	72	54
								K2O	.75	33	25

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan Agronomic Division, North Carolina Department of Agriculture
 ** Annual house manure and litter accumulation removed to uncovered stockpile to be spread within 6 months; typical lit base is sawdust, wood shavings or peanut hulls.
 *** Soil incorporated: surface spread litter plowed or disked into the soil within 2 days.

Table 426. LAND APPLICATION OF TURKEY STOCKPILED LITTER *

Type of Production Unit	Rate-Limiting Nutrient	Litter Application Rate **										Minimum Land Area for Litter Appli							
		soil incorporated										soil incorporated							
		lbs/acre/year										lbs/acre/year							
Hen stock-piled	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350			
	P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140			
	K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350			
Tom stock-piled	N	2.5	4.9	7.4	9.8	12	15	17	20	6.1	3.0	2.0	1.5	1.2	1.0	.87			
	P2O5	.37	.74	1.1	1.5	1.3	2.2	2.6	3.0	40	20	13	10	8.1	6.7	5.3			
	K2O	2.0	4.0	6.1	8.1	10	12	14	16	7.4	3.7	2.5	1.8	1.5	1.2	1.1			

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 19
 ** N fertilization rate should be consistent with realistic crop yield.
 N leaching and denitrification and P2O5 soil immobilization unaccounted for.

Turkey Stockpiled Litter Land Application Spreadsheet

This spreadsheet uses values from existing NCSU/NCDA data bases to calculate the fertilizer nutrients, application rates and land areas needed for agronomic usage of broadcast turkey stockpiled litter. Values in cells I25-J51 represent inputs which need to be entered to use this spreadsheet. Values in cells D25-E51 are typical values which may be used if more specific information is not available. If actual litter nutrient analyses are used, then a corresponding change in litter volumes should also be entered. Application rates and land areas are calculated for a range of fertilization rates. Actual fertilization rates based on crop yield may be entered into cells I59-I61 with the results calculated in columns C and K in Table C. The spreadsheet also computes bird live weight equivalents, litter storage capacities, and estimated annual litter volumes to be land applied.

	Typical		Actual													
	Hen -stockpiled- -per bd cap-	Tom -stockpiled- -per bd cap-	Hen -stockpiled- -per bd cap-	Tom -stockpiled- -per bd cap-												
Bird live weight:	initial:	4	5	4	5	lbs										
	final:	16	25	16	25	lbs										
	average:	10	15	10	15	lbs										
Flocks per year:	3	3	3	3		flocks/year										
Days per flock:	98	98	98	98		days/flock										
Litter accumulation:	4.4	6.6	4.4	6.6		tens/1000 birds sold										
Litter density:	24	24	24	24		lbs/ft ³										
Litter storage period:	365	365	365	365		days										
Litter total nutrient analysis:																
	Tot N:	36	36	36	36	lbs/ton										
	NH ₃ N:	17	17	17	17	% tot N or tkn										
	P ₂ O ₅ :	72	72	72	72	lbs/ton										
	K ₂ O:	33	33	33	33	lbs/ton										
Organic N mineralization rate	.50	.50	.50	.50												
Plant nutrient availability coefficients: (from application method box)																
	N:	.46	.46	.46	.46											
	P ₂ O ₅ :	.70	.70	.70	.70											
	K ₂ O:	.70	.70	.70	.70											
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"> Application method: NH₃N ----N---- soil incorp: .90 .57 .57 broadcast: .25 .46 .46 </td> <td style="width: 10%; text-align: center;">P&K</td> <td style="width: 40%;"></td> </tr> <tr> <td></td> <td style="text-align: center;">.75</td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">.70</td> <td></td> </tr> </table>							Application method: NH ₃ N ----N---- soil incorp: .90 .57 .57 broadcast: .25 .46 .46	P&K			.75			.70		
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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="width: 10%; text-align: center;">mg/kg (ppm)</td> <td style="width: 10%; text-align: center;">x</td> <td style="width: 10%; text-align: center;">20</td> <td style="width: 10%; text-align: center;">= lbs/ton</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">x</td> <td style="text-align: center;">0.002</td> <td style="text-align: center;">= lbs/ton</td> </tr> </table>								mg/kg (ppm)	x	20	= lbs/ton			x	0.002	= lbs/ton
	mg/kg (ppm)	x	20	= lbs/ton												
		x	0.002	= lbs/ton												
Crop fertilization rate: N:				50		lbs/ac/yr										
	P ₂ O ₅ :			20		lbs/ac/yr										
	K ₂ O:			50		lbs/ac/yr										

Scroll down for results.

Table 42B. TURKEY STOCKPILED LITTER FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			House Floor Space	Litter Storage Capacity, **	Total Litter, tons/1000-bd capacity/year	Plant Nutrient	Plant Nutrient Availability Coefficients	Total Nutrients lbs/ton	Plant Available Nutrients broadcast	
		init	final	mean							lbs/1000-bd capacity/year	Lbs/ton
		-----lbs-----										
Hen stock-piled	6 - 20 weeks	4	16	10	1.0	1003	15	N	.46	36	16	2
								P2O5	.70	72	51	7
								K2O	.70	53	23	34
Tom stock-piled	6 - 20 weeks	5	25	15	2.0	1505	22	N	.46	36	16	36
								P2O5	.70	72	51	113
								K2O	.70	53	23	51

* References: Depts of Biological and Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990
Agronomic Division, North Carolina Department of Agriculture

** Annual house manure and litter accumulation removed to uncovered stockpile to be spread within 6 months; typical litter base is sawdust, wood shavings or peanut hulls.

*** Broadcast: surface spread litter uncovered for 1 month or longer.

Table 42C. LAND APPLICATION OF TURKEY STOCKPILED LITTER *

Type of Production Unit	Rate-Limiting Nutrient	Litter Application Rate **									Minimum Land Area for Litter Application							
		-----broadcast-----									-----broadcast-----							
		lbs/acre/year									lbs/acre/year							
Hen stock-piled	N	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350		
	P2O5	20	40	60	80	100	120	140	160	20	40	60	80	100	120	140		
	K2O	50	100	150	200	250	300	350	400	50	100	150	200	250	300	350		
Tom stock-piled	N	3.1	6.1	9.2	12	15	18	21	25	4.9	2.4	1.6	1.2	.97	.81	.69	.61	
	P2O5	.40	.79	1.2	1.6	2.0	2.4	2.8	3.2	38	19	13	9.4	7.5	6.3	5.4	4.7	
	K2O	2.2	4.3	6.5	8.6	11	13	15	17	6.9	3.4	2.3	1.7	1.4	1.1	.98	.84	

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Science; North Carolina St Univ; Jan 1990

** N fertilization rate should be consistent with realistic crop yield.

N leaching and denitrification and P2O5 soil immobilization unaccounted for.