NCDA&CS
Waste and Compost Analysis Guide

Plant/Waste/Solution/Media Analysis Section
Agronomic Division
N.C. Dept. of Agriculture & Consumer Services
(919) 733-2655

Michelle McGinnis, Ph.D., Agronomist
Jan Queen, Chemist
Mark Buchanan, Chemistry Supervisor
Catherine Stokes, Communication Specialist
Brenda Cleveland, Section Chief

July 2013 revision

Table of Contents

List of Tables

1. Overview of Agronomic Division

The Agronomic Division Mission is to provide N.C. residents with site-specific diagnostic and advisory services to increase agricultural productivity, promote responsible land management and safeguard environmental quality. The Agronomic Division is comprised of four sections: (1) Field Services; (2) Soil Testing; (3) Nematode Assay; and (4) Plant, Waste, Solution and Media Analysis.

The **Field Services** Section has a staff of 13 regional agronomists to advise and educate farmers, agriculture consultants, fertilizer dealers, homeowners and other state residents regarding agronomic sampling techniques, responsible and cost-effective fertilization practices, interpretation of agronomic lab results and the implementation of agronomic recommendations. For further information, see www.ncagr.gov/agronomi/rahome.htm.

Soil Testing provides soil nutrient indexes as well as weight per volume, pH, acidity, percent humic matter, soil class and soluble salt levels as described in Crop Fertilization Based on North Carolina Soil Tests. The Soil Test Report provides precise lime and fertilizer recommendations for specific crops and soil classes. For further information, see www.ncagr.gov/agronomi/sthome.htm.

Nematode Assay identifies plant-parasitic nematodes and estimates population size and relative hazard to the crop. The Nematode Assay Report provides recommendations for control of plant-parasitic nematodes. For further information, see www.ncagr.gov/agronomi/nemhome.htm.

Plant Tissue Analysis measures nutrient levels within crop tissue and identifies nutrient deficiencies and toxicities. The Plant Analysis Report provides recommendations for adjustment of crop fertilization programs. For further information, see www.ncagr.gov/agronomi/uyrplant.htm.

Waste Analysis determines nutrient levels in farm (such as animal manure), industrial, municipal and composted waste materials. The Waste Analysis Report provides estimates of first-crop nutrient availability and recommendations for the environmentally sound use of waste material as a plant nutrient source. For further information, see www.ncagr.gov/agronomi/uyrwaste.htm.

Solution Analysis measures nutrient concentrations as well as pH, electrical conductivity (soluble salts) and total alkalinity levels of water used in agricultural production, such as irrigation water, nutrient solutions and livestock drinking water. The Solution Analysis Report provides an assessment of potential problems and recommendations for their management. For further information, see www.ncagr.gov/agronomi/uyrsoln.htm.

Media Analysis measures nutrient concentrations as well as pH and electrical conductivity (soluble salts) of soilless media used for containerized crop production. The Media Analysis Report helps growers troubleshoot problems and fine-tune fertilization programs. For further information, see www.ncagr.gov/agronomi/uyrmedia.htm.

2. Overview of Waste Analysis and Nutrient Management

The Agronomic Division's Waste Analysis Lab analyzes liquid and solid waste samples from farm, municipal and industrial sources to assess their use in agriculture. Analyses of animal waste from liquid management systems for total Kjeldahl nitrogen (TKN), total phosphorus, copper and zinc are certified by the N.C. Department of Environment and Natural Resources (NCDENR) Division of Water Quality.

The Waste Analysis Lab also analyzes compost samples. Commercial composters of waste products may be required to test the chemical properties of the compost in order to comply with NCDENR regulations. Compost samples are also submitted by compost users to determine how chemical properties might limit use or impact application rates in gardens or landscapes.

The Waste Analysis Report provides total nutrient concentrations (nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, zinc, copper, boron) as well as estimates of first-year, plant-available nutrient concentrations (nutrients available to the first crop grown in units of lb/ton or lb/1000 gal). Additional chemical measures may also be provided on the waste report, such as levels of sodium; pH; electrical conductivity (soluble salts); carbon; carbon-to-nitrogen ratio (C:N); calcium carbonate equivalence (CCE%); agricultural lime equivalent (ALE); heavy metals (lead, nickel, cadmium); chloride; and inorganic nitrogen (ammonium and nitrate nitrogen).

Nutrients-available-for-first-crop values are based on estimates of mineralization rates for the specific waste type (e.g., anaerobic lagoon liquid) and source (e.g., swine) as well as application method (e.g., irrigation). These estimated values are influenced by factors such as the specific nature of the waste material, soil physical properties (i.e., texture, soil moisture), soil chemical properties (i.e., pH, cation exchange capacity), soil and air temperature, and weather. Mineralization rates used to calculate nutrient availability are reviewed and revised periodically using current scientific literature.

Knowledge of available nutrients and other chemical properties associated with waste applied to land, in conjunction with site-specific factors, is the basis for efficient nutrient management and responsible land stewardship. Waste application rates are usually limited by levels of nitrogen, phosphorus, zinc, copper, boron, sodium or CCE% as discussed below.

Waste application rate-limiting factors

Nitrogen (N)

Generally, the available N in the waste determines the rate of application, unless another element or chemical property is more restrictive. N can be applied at rates determined by the realistic yield expectation (RYE) of a specific crop by soil type. Rates using the RYE approach are available online at nutrients.soil.ncsu.edu/yields/. Contact the N.C. Interagency Nutrient Management Committee for guidelines when a specific RYE is not available.

Phosphorus (P)

Rates of waste application should be based on estimated available P when the site is vulnerable to off-site P movement. The N.C. Phosphorus Loss Assessment Tool (PLAT) is used to assess the potential for P transport from fields to surface water. When animal manure or organic by-products are used in crop production, this software tool can identify whether N or P is the application-rate-determining nutrient. PLAT ratings are

interpreted as follows: low or medium, the manure or organic by-product can be applied based on the crop's N requirement; high, application rate is limited to P removal from the site; very high, no additional P should be applied.

Zinc (Zn) and copper (Cu)

For sites receiving animal waste, monitoring soil Zn and Cu levels is required by Animal Waste Management Rules (15A NCAC 2T). Application rates should be limited when soil Zn and/or Cu levels are excessively high and/or the waste product has a high Zn and/or Cu concentration. Under these conditions, it is also advisable to monitor crop nutrient concentrations with tissue analysis. These practices will help prevent excess Zn and/or Cu accumulation in the soil.

For all crops except peanuts, the NCDA&CS soil-test Zn-index (Zn-I) and Cu-index (Cu-I) caution level is 2000 (~142 lb Zn/acre and ~72 lb Cu/acre) and the critical toxic level is 3000 (~214 lb Zn/acre and ~108 Cu lb/acre). NCDENR requires that a technical specialist be contacted to discuss options for future manure applications when Zn and/or Cu are at the caution or critical toxic level. At the caution level, growers should monitor crop growth and appearance and maintain a soil pH of at least 6.0 while searching for alternative fields better suited for application of animal manure. At the critical toxic level, all application of animal manure or organic by-products should cease and a pH of at least 6.0 should be maintained. Peanuts are much more sensitive to Zn than other crops: the caution level is 300 (~21 lb/acre) and the critical toxic level is 500 (~35 lb/acre).

Sodium (Na)

Waste that contains high sodium in relation to calcium and/or magnesium can cause problems. A high level of sodium in the soil can degrade soil structure (reduced infiltration and permeability) and/or become toxic to crops. Sodium may also damage foliage when liquid waste is applied in an overhead irrigation system to a growing crop. Regular soil testing is recommended to monitor sodium accumulation where the waste is routinely applied. Safe application rates of sodium depend on many factors, including soil texture, soil calcium and magnesium levels, rainfall, irrigation volumes and crop.

Boron (B)

Although B is an essential nutrient, the level required by a crop and the B toxicity level of that crop are very narrow. Therefore, consider the waste B level and limit B application to no more than 1-3 lb B per acre per year. Since B is not measured in NCDA&CS soil analysis, monitor B status in crops with tissue analysis.

Calcium carbonate equivalence (CCE%) and agricultural liming equivalent (ALE)

CCE% represents the acid-neutralizing capacity of a material expressed as weight percentage of calcium carbonate. For waste materials with liming potential (e.g., lime-stabilized biosolids, poultry layer litter), the application rate may be limited by a high CCE%. Waste with a high CCE% should only be applied at rates needed to increase soil pH to the desired target. Overapplication can lead to high soil pH, which may limit micronutrient availability. When CCE% is measured, ALE is also calculated. ALE indicates the amount (tons or gallons) of waste required to equal the neutralizing value of one ton of agricultural grade limestone.

Additional resources

Crop Fertilization Based on North Carolina Soil Tests

Nutrient Management in North Carolina—http://nutrients.soil.ncsu.edu/

Sampling for Waste Analysis

Understanding the Waste Analysis Report

Waste Analysis — Improving Agricultural Productivity & Environmental Quality

Waste Sample Information form (AD-9)

3. Analytes, Measures & Calculations on Waste Analysis Report

Standard analysis:
Tests included for the basic fee ($5)

Concentrations of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B) and sodium (Na) are provided for all waste samples submitted to the lab (Table 1). Units are parts per million (ppm) or, more specifically, milligrams per liter (mg/L) for liquid and milligrams per kilogram (mg/kg) (dry-weight basis) for solid waste samples. With the exception of liquid waste N, all measures are of total nutrients. Liquid waste N is measured as total Kjeldahl nitrogen (TKN). TKN does not include nitrate nitrogen.

Standard analysis may include measurements of pH, electrical conductivity (EC) [a measure of soluble salts (SS)], percent solids or dry matter percent (DM%) and carbon (C) for certain types of waste samples (particularly composted materials), according to the code specified by the client on the *Waste Sample Information* form (AD-9). Table 2 indicates the specific tests performed automatically based on each waste code. Upon request, these measures, as well as chloride, can be provided at no additional charge for any waste sample, with the following exception: carbon can only be measured for solid waste samples.

Units for EC (or SS) are 10^{-5} S/cm, and units for C are ppm or mg/kg (dry-mass basis) (Table 1). Dry matter percent (DM%) is determined for all solid waste samples according to Eq. [1]. When C is analyzed, the C-to-N ratio (C:N) is calculated according to Eq. [2].

[1] $DM\% = (\text{dry wt.} \div \text{fresh wt.}) \times 100$

[2] $C{:}N = C\ (mg/kg) \div N\ (mg/kg)$

Additional analysis upon request:
Tests conducted for additional fee ($10)

'Special tests' (heavy metals, inorganic nitrogen and/or calcium carbonate equivalence) can be performed upon request (Table 1). Each test costs an additional $10 per sample.

Heavy metals (HM): Analysis of HM includes cadmium (Cd), lead (Pb) and nickel (Ni). Units are ppm or mg/L for liquid and ppm or mg/kg (dry-weight basis) for solid samples.

Inorganic nitrogen (IN-N): The IN-N value represents the sum of measurements of nitrate nitrogen (NO_3-N) and ammonium nitrogen (NH_4-N), as shown in Eq. [3]. Measurement of NO_3-N includes any nitrite nitrogen (NO_2-N) in the sample. When analyzed, NO_3-N is added to liquid waste TKN to report total N, as shown in Eq. [4]. Organic nitrogen (OR-N) is calculated according to Eq. [5]. All units are ppm [mg/L for liquid and mg/kg (dry-weight basis) for solid samples].

[3] $IN\text{-}N = NO_3\text{-}N + NH_4\text{-}N$

[4] $\text{Total } N = TKN + NO_3\text{-}N \text{ (liquid)}$

[5] $OR\text{-}N = \text{Total } N - IN\text{-}N$

Percent calcium carbonate equivalence (CCE%) and agricultural lime equivalent (ALE): CCE% is a measure of the acid-neutralizing capacity of a waste material and is expressed as a percentage of pure calcium carbonate (on a dry-weight basis for solid waste samples). The ALE is calculated according to Eqs. [6] and Eq. [7] for solid and liquid waste samples, respectively. The assumption is made that one gallon of liquid waste weighs 8.34 pounds.

The ALE indicates the quantity of waste material that will provide a liming effect equivalent to one ton of agricultural grade limestone (90% $CaCO_3$). ALE is reported in units of tons for solid waste samples and 1000 gallons for liquid waste samples.

[6] ALE (tons) = 1800 ÷ [(DM% ÷ 100) × (CCE% ÷ 100) × 2000]

[7] ALE (1000 gallons) = 1800 ÷ [(CCE% ÷ 100) × 8340]

Nutrients available for first crop

Estimates of nutrients available for the first crop (or first-year, plant-available nutrients) are provided on the Waste Analysis Report. The Waste Analysis Lab's calculations are based on mineralization rate estimates for specific waste sources (Table 2) and anticipated nutrient loss associated with the proposed waste application method. The four application methods are

- broadcast (BR) — waste broadcast on soil surface and left uncovered for one week or longer;
- injection (IN) — waste injected directly into the soil and covered immediately;
- irrigation (IR) — waste applied through the irrigation system and left uncovered for one week or longer; and
- soil incorporation (SI) — waste broadcast on soil surface and plowed or disked into soil within two days.

The first-year-nutrient-availability coefficients for each waste source and application method are included in Table 3. All values for first-year, plant-available nutrients are calculated according to Eqs. [8] and [9] for solid and liquid wastes, respectively, where NAC = nutrient availability coefficient (listed in Table 3), NM = nutrient multiplier and DM% = dry matter percent. The NM is only relevant for P and K to allow expression of P as phosphate (P_2O_5) and K as potash (K_2O). The NM for P is 2.29 and the NM for K is 1.20. For all other nutrients and elements, the NM is 1.

[8] Nutrient available (lb/ton) = [nutrient concentration (mg/kg) ÷ 1,000,000] × NAC × NM × 2000 × (DM% ÷ 100)

[9] Nutrient available (lb/1000 gal) = [nutrient concentration (mg/L) ÷ 1,000,000] × NAC × NM × 8340

Unless the inorganic nitrogen (IN-N) test was conducted, the available nitrogen calculations are based on total nitrogen (solid waste) or TKN (liquid waste). When clients request measurement of IN-N, available nitrogen (N) is determined as the sum of available organic nitrogen (OR-N) and available IN-N, as shown in Eq. [10].

[10] Available N = available IN-N + available OR-N

Conversion of units

If the lab analyzed samples as solid waste but the client plans to apply the waste in liquid form, Eqs. [11] and [12] can be used to convert from solid waste application units (tons) to liquid waste application units (1000 gallons), and vice versa. These conversions assume that one gallon of liquid waste weighs 8.34 pounds.

[11] lb/ton × 4.17 = lb/1000 gal.

[12] lb/1000 gal. × 0.24 = lb/ton

For some applications, such as use of compost on gardens or landscapes, it is useful to plan for application of pounds to an area of 100 or 1000 ft^2 rather than tons per acre. Refer to Eqs. [13] and [14] for these conversions.

[13] tons/acre × 45.9 = pounds/1000 ft^2

[14] tons/1000 ft^2 × 4.6 = pounds/100 ft^2

Table 1. Analytes & measures included with standard and additional lab analysis

Category & waste codes[1]	Analyte / Measure	Abbreviation	Units
Standard analysis Measured for ALL waste samples (all waste codes)	Nitrogen[2]	N	ppm[3]
	Phosphorus	P	ppm
	Potassium	K	ppm
	Calcium	Ca	ppm
	Magnesium	Mg	ppm
	Sulfur	S	ppm
	Iron	Fe	ppm
	Manganese	Mn	ppm
	Zinc	Zn	ppm
	Copper	Cu	ppm
	Boron	B	ppm
	Sodium	Na	ppm
Standard analysis Measured for SOME waste samples (as indicated by waste code in Table 2)	pH	--	--
	Dry matter percent	DM%	percentage
	Electrical conductivity (soluble salts)	EC (SS)	10^{-5} S/cm
	Carbon	C	ppm
Additional analysis ('Special Tests') Included UPON REQUEST for any Waste Code ($10 per test)	Inorganic nitrogen (nitrate & ammonium nitrogen)[4]	IN-N as NO_3-N & NH_4-N	ppm
	Heavy metals: Cadmium, lead, nickel	HM: Cd, Pb, Ni	ppm
	Calcium carbonate equivalence[5] (agricultural liming equivalent[6])	CCE% (ALE)	percentage (tons or 1000 gallons)

[1] Waste code descriptions are listed on Table 2 and on page 2 of *Waste Sample Information* form (AD9).
[2] Liquid waste N is measured as Total Kjeldahl Nitrogen (TKN); solid waste N is measured as total N.
[3] Units of parts per million (ppm) are milligrams per liter (mg/L) for liquid waste and milligrams per kilogram (mg/kg) (dry-weight basis) for solid waste.
[4] NO_3-N results also include any nitrite nitrogen (NO_2-N) in the sample.
[5] CCE% is defined as the acid-neutralizing capacity of a sample expressed as a percentage of pure calcium carbonate.
[6] ALE is the calculated quantity (tons or 1000 gallons) of material that will provide the equivalent liming effect of one ton of agricultural grade limestone.

Table 2. Lab tests associated with standard analysis by waste code

Waste Type	Waste Source[2]	Waste Code[2]	Tests conducted with standard waste analysis [1]				
			Mineral nutrients [3]	DM% [4]	pH	EC (SS) [5]	C [6]
Lagoon Liquid – Anaerobic	Poultry	ALP	X	--	X	--	--
	Swine (farrow to wean)	ALF	X	--	X	--	--
	Swine (except farrow to wean)	ALS	X	--	X	--	--
	Other	ALO	X	--	X	--	--
Lagoon Sludge – Anaerobic	Poultry	ASP	X	?	--	--	--
	Swine	ASS	X	?	--	--	--
	Other	ASO	X	?	--	--	--
Manure – Liquid Slurry	Beef	LSB	X	?	--	--	--
	Dairy	LSD	X	?	--	--	--
	Poultry	LSP	X	?	--	--	--
	Other	LSO	X	?	--	--	--
Manure – Surface Scraped or Stockpiled	Beef	SSB	X	X	--	--	--
	Dairy	SSD	X	X	--	--	--
	Horse	SSH	X	X	--	--	--
	Swine	SSS	X	X	--	--	--
	Other	SSO	X	X	--	--	--
Poultry – House Litter	Broiler Breeder	HBB	X	X	--	--	--
	Broiler Pullet	HBP	X	X	--	--	--
	Broiler	HLB	X	X	--	--	--
	Layer	HLL	X	X	--	--	--
	Layer Pullet	HLP	X	X	--	--	--
	Turkey	HLT	X	X	--	--	--
	Other	HLO	X	X	--	--	--
Waste – Composted	Beef	FCB	X	X	X	X	X
	Crop Residue	FCC	X	X	X	X	X
	Dairy	FCD	X	X	X	X	X
	Sheep	FCE	X	X	X	X	X
	Goat	FCG	X	X	X	X	X
	Horse	FCH	X	X	X	X	X
	Poultry	FCP	X	X	X	X	X
	Swine	FCS	X	X	X	X	X
	Veg. Residue	FCV	X	X	X	X	X
	Other	FCW	X	X	X	X	X
	Poultry Mort.	FPM	X	X	X	X	X
	Swine Mort.	FSM	X	X	X	X	X

Table 2. (*continued*)

Waste Type	Waste Source[2]	Waste Code[2]	Tests conducted with standard waste analysis [1]				
			Mineral nutrients [3]	DM% [4]	pH	EC (SS) [5]	C [6]
Waste – Noncomposted	Bark/Sawdust	NBS	X	X	X	X	X
	Crop Residue	NCR	X	X	X	X	X
	Veg. Residue	NVR	X	X	X	X	X
	Other	NCW	X	X	X	X	X
Industrial – Miscellaneous	Composted	IOC	X	X	X	X	X
	Aerobic	IOE	X	?	--	--	--
	Lime Stabilized	IOL	X	?	--	--	--
	Anaerobic	ION	X	?	--	--	--
	Raw	IOR	X	?	--	--	--
	Chem Ox (Cl)	IOX	X	?	--	--	--
	Other	IOO	X	?	--	--	--
Industrial – Pharmaceutical	Composted	PHC	X	X	X	X	X
	Aerobic	PHA	X	?	--	--	--
	Lime Stab.	PHL	X	?	--	--	--
	Anaerobic.	PHN	X	?	--	--	--
	Raw	PHR	X	?	--	--	--
	Chem Ox (Cl)	PHX	X	?	--	--	--
	Other	PHO	X	?	--	--	--
Industrial – Poultry	Raw	PLR	X	?	--	--	--
	Aerobic	PAE	X	?	--	--	--
	Anaerobic	PAN	X	?	--	--	--
	Lime Stabilized	PLS	X	?	--	--	--
	Chem Ox (Cl)	POX	X	?	--	--	--
	Composted	PCW	X	X	X	X	X
	Other	PLO	X	?	--	--	--
Industrial – Stack Dust/Ash	Composted	SAC	X	X	X	X	X
	Raw	SAR	X	?	X	--	--
	Other	SAO	X	?	X	--	--
Industrial – Textile	Aerobic	TAE	X	?	--	--	--
	Anaerobic	TAN	X	?	--	--	--
	Composted	TCW	X	X	X	X	X
	Lime Stabilized	TLS	X	?	--	--	--
	Chem Ox (Cl)	TOX	X	?	--	--	--
	Raw	TXR	X	?	--	--	--
	Other	TXO	X	?	--	--	--

Table 2. (*continued*)

Waste Type	Waste Source[2]	Waste Code[2]	Tests conducted with standard waste analysis [1]				
			Mineral nutrients [3]	DM% [4]	pH	EC (SS) [5]	C [6]
Municipal	Aerobic	MAE	X	?	--	--	--
	Anaerobic	MAN	X	?	--	--	--
	Comp. Sludge	MCS	X	X	X	X	X
	Comp. Yard W.	MCY	X	X	X	X	X
	Lime Stabilized	MLS	X	?	--	--	--
	Chem Ox (Cl)	MOX	X	?	--	--	--
	Other	MWO	X	?	--	--	--

[1] Standard waste analysis is conducted for $5 per sample. "X" indicates the test is automatic; "--" indicates the test is NOT automatically included with the specific waste code. If requested, pH, EC and/or carbon can be measured for samples with other waste codes at no additional cost. Carbon is measured for solid waste samples only. The "?" symbol indicates the test may or may not be included and will be determined upon receipt at the lab.

[2] Waste code descriptions are listed in Table 2 and on page 2 of *Waste Sample Information* form (AD9).

[3] Mineral nutrients include concentrations (ppm) of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B) and sodium (Na). With the exception of liquid waste N, all measures are total nutrient concentrations; liquid waste N is measured as Total Kjeldahl Nitrogen (TKN).

[4] DM% = dry matter percent; DM% is measured for solid waste samples only. For codes in which **"?"** is indicated, the determination of the sample as solid or liquid waste is made the by lab personnel based on visual inspection. Generally, samples with DM% > 8–10% (as determined by visual inspection) are categorized as solid waste; samples with DM% < 8–10 are categorized as liquid waste.

[5] EC = electrical conductivity [a measure of soluble salts (SS)] and is reported in units of 10^{-5} S/cm.

[6] C = carbon; C is measured on solid waste samples only and is reported in units of ppm or mg/kg.

Table 3. First-year-nutrient-availability coefficients

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Lagoon Liquid Anaerobic	Poultry	ALP	BR/IR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Swine (farrow to wean)	ALF	BR/IR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Swine (except farrow to wean)	ALS	BR/IR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Other	ALO	BR/IR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lagoon Sludge Anaerobic	Poultry	ASP	BR/IR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Swine	ASS	BR/IR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Other	ASO	BR/IR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Manure Liquid Slurry	Beef	LSB	BR/IR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Dairy (storage pond)	LSD	BR/IR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Swine	LSS	BR/IR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Other	LSO	BR/IR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			IN/SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Table 3. (*continued*)

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Manure Surface Scraped or Stockpiled	Beef	SSB	BR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Dairy	SSD	BR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Horse	SSH	BR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Swine	SSS	BR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Other	SSO	BR	0.4	1.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Poultry House Litter	Broiler Breeder	HBB	BR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Broiler Pullet	HBP	BR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Broiler	HLB	BR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Layer	HLL	BR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Layer Pullet	HLP	BR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Turkey	HLT	BR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Other	HLO	BR	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
			SI	0.6	1.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Table 3. (*continued*)

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Waste Composted	Beef	FCB	BR	0.40	0.75	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Crop Residue	FCC	BR	0.40	0.75	0.40	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Dairy	FCD	BR	0.40	0.75	0.40	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Goat	FCG	BR	0.40	0.75	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Horse	FCH	BR	0.40	0.75	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Poultry	FCP	BR	0.40	0.75	0.40	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Sheep	FCE	BR	0.40	0.75	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Swine	FCS	BR	0.40	0.75	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Vegetable Residue	FCV	BR	0.40	0.70	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Other	FCW	BR	0.40	0.75	0.40	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Poultry Mortality	FPM	BR	0.40	0.75	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Swine Mortality	FSM	BR	0.40	0.75	0.40	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0

Table 3. (*continued*)

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Waste Noncomposted	Bark / Sawdust	NBS	BR	BR	0.20	0.25	0.20	0.30	0.80	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.80	1.0	1.0	1.0
			SI	SI	0.40	0.75	0.40	0.50	0.90	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.90	1.0	1.0	1.0
	Crop Residue	NCR	BR	0.20	0.25	0.20	0.40	0.80	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.75	0.40	0.60	0.90	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.90	1.0	1.0	1.0	1.0
	Veg. Residue	NVR	SI	0.60	0.75	0.60	0.60	0.90	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.90	1.0	0.60	1.0	1.0
	Other	NCW	BR	0.20	0.25	0.20	0.40	0.80	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.75	0.40	0.60	0.90	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.90	1.0	1.0	1.0	1.0
Industrial Miscellaneous	Composted	IOC	BR	0.30	0.75	0.30	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Aerobic	IOE	BR	0.40	0.25	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.50	0.95	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.40	0.75	--	0.60	0.60	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.75	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Lime Stabilized	IOL	BR	0.40	0.25	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.75	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Anaerobic	ION	BR	0.40	0.25	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.75	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Raw	IOR	BR	0.30	0.25	0.50	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.50	0.75	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			SI	0.50	0.75	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Chem Ox (Cl)	IOX	BR	0.40	0.25	--	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.75	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Other	IOO	BR	0.30	0.25	0.50	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.50	0.95	0.50	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
			IR	0.25	0.25	0.50	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			SI	0.40	0.75	--	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0

Table 3. (*continued*)

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Industrial Pharmaceutical	Aerobic	PHA	BR	0.21	0.80	0.21	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.30	0.95	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.21	0.75	0.21	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.30	0.90	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Composted	PHC	BR	0.20	0.80	0.20	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.30	0.90	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Lime Stabilized	PHL	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.28	0.75	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Anaerobic	PHN	BR	0.17	0.80	0.17	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.20	0.95	0.20	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.17	0.75	0.17	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.20	0.90	0.20	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Raw	PHR	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.28	0.75	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Chem Ox (Cl)	PHX	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.28	0.75	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Other	PHO	BR	0.20	0.80	0.20	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.30	0.90	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0

Table 3. (*continued*)

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Industrial Poultry	Aerobic	PAE	BR	0.21	0.80	0.21	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			IN	0.30	0.95	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
			SI	0.30	0.80	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
	Anaerobic	PAN	BR	0.17	0.80	0.17	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			IN	0.20	0.95	0.20	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
			IR	0.25	0.75	0.25	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			SI	0.20	0.80	0.20	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
	Composted	PCW	BR	0.30	0.75	0.30	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			SI	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
	Raw	PLR	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
			IR	0.25	0.75	0.25	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
	Lime Stabilized	PLS	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
	Chem Ox (Cl)	POX	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
	Other	PLO	BR	0.20	0.80	0.20	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			SI	0.30	0.90	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
Industrial Stack Dust/Ash	Composted	SAC	BR	0.50	0.75	0.50	0.70	0.80	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.80	1.0	1.0	1.0	1.0
			SI	0.60	0.95	0.50	0.80	0.90	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.90	1.0	1.0	1.0	1.0
	Raw	SAR	BR	0.50	0.75	0.50	0.70	0.80	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.80	1.0	1.0	1.0	1.0
			SI	0.60	0.95	0.50	0.80	0.90	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.90	1.0	1.0	1.0	1.0
	Other	SAO	BR	0.40	0.75	0.40	0.70	0.80	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.80	1.0	1.0	1.0	1.0
			SI	0.50	0.95	0.50	0.80	0.90	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.90	1.0	1.0	1.0	1.0

Table 3. (*continued*)

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Industrial Textile	Composted	TCW	BR	0.20	0.75	0.20	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.30	0.90	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Aerobic	TAE	BR	0.25	0.80	0.25	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.35	0.95	0.35	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			SI	0.35	0.90	0.35	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Anaerobic	TAN	BR	0.20	0.80	0.20	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.30	0.95	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			SI	0.30	0.95	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Lime Stabilized	TLS	BR	0.33	0.75	0.33	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.47	0.95	0.47	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			SI	0.47	0.95	0.47	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Chem Ox (Cl)	TOX	BR	0.33	0.75	0.33	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.47	0.95	0.47	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			SI	0.47	0.95	0.47	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Raw	TXR	BR	0.33	0.75	0.30	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.47	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			SI	0.47	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Other	TXO	BR	0.20	0.75	0.20	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.30	0.95	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0

Table 3. (*continued*)

Waste Type	Waste Source[1]	Waste Code [1]	Appl. Method [2]	Nutrient or Heavy Metal [3]																	
				N	IN-N[4]	OR-N[5]	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B	Mo	Cl	Na	Ni	Cd	Pb
Municipal	Aerobic	MAE	BR	0.21	0.80	0.21	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.30	0.95	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.25	0.75	0.25	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.30	0.90	0.30	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Anaerobic	MAN	BR	0.17	0.80	0.17	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.20	0.95	0.20	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.17	0.75	0.17	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.20	0.90	0.20	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Composted Sludge	MCS	BR	0.30	0.75	0.30	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Composted Yard Waste	MCY	BR	0.50	0.75	0.50	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			SI	0.60	0.95	0.60	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0
	Lime Stabilized	MLS	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Chem Ox (Cl)	MOX	BR	0.28	0.80	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			IN	0.40	0.95	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
			IR	0.28	0.75	0.28	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.80	1.0	1.0	1.0	1.0
			SI	0.40	0.90	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.90	1.0	1.0	1.0	1.0
	Other	MWO	BR	0.30	0.25	0.30	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.0	1.0	1.0	1.0
			SI	0.40	0.75	0.40	0.75	0.90	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0	1.0

[1] Waste code descriptions are also listed on page 2 of *Waste Sample Information* form (AD-9).

[2] BR= waste broadcast on soil surface and left uncovered for one week or longer; SI = waste broadcast on soil surface and plowed or disked into the soil within two days; IN = waste injected directly into the soil and covered immediately; IR = waste applied through irrigation system and left uncovered for one week or longer.

[3] N=nitrogen, P=phosphorus, K=potassium, Ca=calcium, Mg=magnesium, S=sulfur, Fe=iron, Mn=manganese, Zn=zinc, Cu=copper, B=boron, Mo=molybdenum, Cl^- =chloride, Na=sodium, Ni=nickel, Cd=cadmium, Pb=lead; First-year availability coefficients for animal waste codes were developed through research and extensive review of the data/literature by the 2013 N.C. Interagency Nutrient Management Committee.

[4] IN-N = inorganic nitrogen (ammonium-nitrogen + nitrite/nitrate-nitrogen)

[5] OR-N = organic nitrogen (total nitrogen – inorganic nitrogen)

4. Methods for Waste Analysis

Solid Waste Analysis Methodology

Sample handling

Prior to analysis, a subsample (~250 cm^3) is weighed (Mettler PM4800; Mettler-Toledo, Hightstown, NJ), dried overnight (12–24 hr) at 80 ^oC, reweighed, and ground with a stainless steel grinder (Intermediate Wiley Mill; Arthur H. Thomas Co.; Philadelphia, PA) to pass through a 20-mesh (1-mm) screen (adapted from Hoskins et al., 2003). Percent solids, or dry matter percent (DM%), is calculated by the following equation: DM% = (dry weight ÷ fresh weight) × 100.

Nitrogen (N) and carbon (C)

Total N and C concentrations are determined by oxygen combustion gas chromatography with an elemental analyzer (NA1500; CE Elantech Instruments; Lakewood, NJ) (AOAC 1990b; Campbell 1992) on a 5– to 10–mg aliquot of the dried/ground sample. Results are expressed in parts per million (ppm) [equivalent to mg/kg] on a dry-weight basis.

Inorganic nitrogen (IN-N) fraction concentrations include nitrate nitrogen + nitrite nitrogen (NO_3-N + NO_2-N) (reported as NO_3-N on the Waste Analysis Report) and ammonium nitrogen (NH_3-N + NH_4-N) (reported as NH_4-N on the Waste Analysis Report). NO_3-N is determined by nitrate-hydrazine reduction (Kempers 1988; Skalar Analytical 1995b) and NH_4-N is determined modified Berthelot reaction (adapted from Krom 1980; Skalar Analytical 1995a) with an auto-flow spectrophotometric analyzer (San^{++} Segmented Flow Auto-Analyzer, Skalar Instruments; Breda, The Netherlands) following a deionized water (1 g / 25 mL) 30-minute extraction on a reciprocating shaker (Wrist Action Model 75; Burrell Corp. Pittsburgh, PA). Results are expressed in parts per million (ppm) [equivalent to mg/kg] on a dry-weight basis.

Organic N (OR-N) is calculated as the difference between total N and IN-N concentrations. Results are expressed in parts per million (ppm) [equivalent to mg/kg] on a dry-weight basis.

Phosphorus (P), potassium (K), calcium (Ca), sulfur (S), magnesium (Mg), boron (B), copper (Cu), iron (Fe), manganese (Mn), zinc (Zn), sodium (Na), nickel (Ni), cadmium (Cd), lead (Pb)

Total concentrations of P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, B, Na, Ni, Cd and Pb are determined with an inductively coupled plasma (ICP) spectrophotometer (Optima 3300 DV ICP emission spectrophotometer; Perkin Elmer Corporation; Shelton, CT) (Donohue and Aho 1992; adapted USEPA 2001), after open-vessel HNO_3 digestion in a microwave digestion system (MARS & MDS2100 microwaves; CEM Corp.; Matthews, NC) (Campbell and Plank 1992). A 0.5-g, dried/ground aliquot of sample (1.0 g when nickel, cadmium or lead is analyzed) is digested in 10 mL 15.6N HNO_3 for 5–30 minutes in a microwave, and the prepared sample volume is brought to 50 mL with deionized water prior to measurement. Elements are measured at wavelengths listed in Table 4. Results are expressed in parts per million (ppm) [equivalent to mg/kg] on a dry-weight basis.

pH and electrical conductivity (EC)

The pH measurement is taken with a hydrogen electrode (Orion 920A; Thermo Fisher Scientific; Beverly, MA) on a 1:1 (v/v) slurry of sample to deionized water [10 cm^3 of sample in 10 cm^3 (mL) water] that has been allowed to stand for 60 minutes (Eaton and others 2005;

Wolf 2003b). Following pH measurement, an additional 10 cm^3 of deionized water is added to the slurry, and the sample is filtered using a Whatman #1 filter (Whatman, Inc., Florham Park, NJ). Electrical conductivity (EC) (a measure of soluble salts) is measured on this 1:2 (v/v) filtrate using a conductivity meter (Orion 550A; Thermo Fisher Scientific; Beverly, MA) (USEPA 1983; Wolf 2003a). Results of EC are expressed in 10^{-5} S/cm.

Calcium carbonate equivalence (CCE%)

CCE% is a measure of the acid-neutralizing capacity of a waste material. The process involves dissolving a 1-g aliquot of dried sample in 50 mL 0.5N HCl (with heat) and back-titrating to pH 7 with 0.25N NaOH, according to the potentiometric titration method (AOAC, 1990a). Results are expressed as percentage of pure calcium carbonate.

Agricultural lime equivalent (ALE)

ALE indicates the amount of waste that provides a liming effect equivalent to one ton of agricultural grade limestone (assuming 90% calcium carbonate). This value is calculated as follows: ALE = 1800 ÷ [(DM% ÷ 100) × (CCE% ÷ 100) × 2000]. Results are expressed in tons. The factor 1800 represents 90% of one ton (in units of pounds).

Chloride (Cl^-)

Cl^- concentration is determined by the thiocyanate displacement method (Zall et al., 1956; Skalar Analytical 1995b) with an auto-flow spectrophotometric analyzer (San^{++} Segmented Flow Auto-Analyzer, Skalar Instruments; Breda, The Netherlands) following a deionized water (1 g / 25 mL), 30-minute extraction on a reciprocating shaker (Wrist Action Model 75; Burrell Corp. Pittsburgh, PA). Results are expressed in parts per million (ppm) [equivalent to mg/kg] on a dry-weight basis.

Table 4. ICP wavelengths used to quantify total elemental concentrations

Element	Wavelength (nm)
Boron (B)	249.772
Cadmium (Cd)	214.440
Calcium (Ca)	317.933
Copper (Cu)	324.752
Iron (Fe)	259.939
Lead (Pb)	220.353
Magnesium (Mg)	285.213
Manganese (Mn)	257.610
Nickel (Ni)	231.604
Phosphorus (P)	178.221
Potassium (K)	766.490
Sodium (Na)	589.592
Sulfur (S)	181.975
Zinc (Zn)	213.857

Liquid Waste Analysis Methodology

Sample handling

Prior to analysis, samples are homogenized by shaking.

Nitrogen (N)

Total Kjeldahl Nitrogen (TKN) is determined by modified EPA Method 351.2 using an auto-flow spectrophotometric analyzer (San^{++} Segmented Flow Auto-Analyzer; Skalar Instruments; Breda, The Netherlands) (Skalar Analytical 1995c; USEPA 1993). A 10-mL aliquot of homogenized sample is digested in 10 mL concentrated H_2SO_4 for 45–60 minutes on a digestion block, and the volume is brought to 100 mL with deionized water prior to measurement. Results are expressed in parts per million (ppm) [equivalent to mg/L].

Inorganic nitrogen (IN-N) fraction concentrations include nitrate + nitrite nitrogen (NO_3-N + NO_2-N) (reported as NO_3-N on the Waste Analysis Report) and ammonium nitrogen (NH_4-N). NO_3-N is determined on a homogenized sample (~20mL) by nitrate-hydrazine reduction (Kempers 1988; Skalar Analytical 1995b) and NH_4-N is determined by a modified Berthelot reaction (adapted from Krom 1980; Skalar Analytical 1995a), with an auto-flow spectrophotometric analyzer (San^{++} Segmented Flow Auto-Analyzer, Skalar Instruments; Breda, The Netherlands). Results are expressed in parts per million (ppm) [equivalent to mg/L].

Phosphorus (P), potassium (K), calcium (Ca), sulfur (S), magnesium (Mg), boron (B), copper (Cu), iron (Fe), manganese (Mn), zinc (Zn), sodium (Na), nickel (Ni), cadmium (Cd), lead (Pb)

Total concentrations of P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, B, Na, Ni, Cd and Pb are determined with an inductively coupled plasma (ICP) spectrophotometer (Donohue and Aho 1992; adapted from USEPA 2001) (Optima 3300 DV ICP emission spectrophotometer; Perkin Elmer Corporation; Shelton, CT), after open-vessel HNO_3 digestion in a microwave digestion system (MARS & MDS2100 microwaves; CEM Corp.; Matthews, NC) (Campbell and Plank 1992). A 5-mL aliquot of homogenized sample is digested in 10 mL 15.6N HNO_3 for 5–30 minutes in a microwave, and the volume is brought to 50 mL with deionized water prior to measurement. Elements are measured at wavelengths listed in Table 4. Results are expressed in parts per million (ppm) [equivalent to mg/L].

pH and electrical conductivity (EC)

The pH and electrical conductivity (EC) (a measure of soluble salts) values are measured directly on homogenized samples. The pH is measured using a hydrogen electrode (Orion 920A; Thermo Fisher Scientific; Beverly, MA) (Eaton and others 2005; Wolf 2003b). Electrical conductivity is measured using a conductivity meter (Orion 550A; Thermo Fisher Scientific; Beverly, MA) (USEPA 1983; (Wolf 2003a). Results of EC are expressed in 10^{-5} S/cm.

Calcium carbonate equivalence (CCE%)

CCE% is a measure of the acid-neutralizing capacity of a waste material. The process involves dissolving a 10-mL, homogenized aliquot in 50 mL 0.5N HCl (with heat) and back-titrating to pH 7 with 0.25N NaOH, according to the potentiometric titration method (AOAC, 1990a). Results are expressed as percentage of pure calcium carbonate.

Agricultural lime equivalent (ALE)

ALE indicates the amount of waste that provides a liming effect equivalent to one ton of agricultural grade limestone (assuming 90% calcium carbonate). This value is calculated as follows (assuming 1 gal. of liquid waste weighs 8.34 lb): ALE = 1800 ÷ [(CCE% ÷ 100) × 8340]. Results are expressed in 1000 gal.

Chloride (Cl^-)

Cl^- concentration is determined on a homogenized sample (~20mL)by the thiocyanate displacement method (Zall et al., 1956; Skalar Analytical 1995b) with an auto-flow spectrophotometric analyzer (San^{++} Segmented Flow Auto-Analyzer, Skalar Instruments; Breda, The Netherlands). Results are expressed in parts per million (ppm) [equivalent to mg/L].

References for Waste Analysis Methodology

[AOAC] Association of Official Analytical Chemists. 1990a. AOAC official method 955.01: neutralizing value for liming materials. In: Official methods of analysis. Volume 1. 15th ed. Arlington (VA): AOAC International. p 1–2.

[AOAC] Association of Official Analytical Chemists. 1990b. AOAC official method 972.43: microchemical determination of carbon, hydrogen, and nitrogen. In: Official methods of analysis. Volume 1. 15th ed. Arlington (VA): AOAC International. p 341.

Campbell CR. 1992. Determination of total nitrogen in plant tissue by combustion. In: Plank CO, editor. Plant analysis reference procedures for the southern region of the United States. Athens (GA): Georgia Cooperative Extension Service. Southern Cooperative Series Bulletin 368. p 20–2. Available at www.ncagr.gov/agronomi/pdffiles/sera368.pdf (accessed 2011 Jan 31).

Campbell CR, Plank CO. 1992. Sample preparation. In: Plank CO, editor. Plant analysis reference procedures for the southern region of the United States. Athens (GA): Georgia Cooperative Extension Service. Southern Cooperative Series Bulletin 368. p 1–12. Available at www.ncagr.gov/agronomi/pdffiles/sera368.pdf (accessed 2011 Jan 31).

Donohue SJ, Aho DW. 1992. Determination of P, K, Ca, Mg, Mn, Fe, Al, B, Cu, and Zn in plant tissue by inductively coupled plasma (ICP) emission spectroscopy. In: Plank CO, editor. Plant analysis reference procedures for the southern region of the United States. Athens (GA): Georgia Cooperative Extension Service. Southern Cooperative Series Bulletin 368. p 34–7. Available at www.ncagr.gov/agronomi/pdffiles/sera368.pdf (accessed 2011 Jan 31).

Eaton AD, Clesceri LS, Rice EW, Greenberg AE, editors. 2005. SM 4500 H^+B: pH value in water by potentiometry using a standard hydrogen electrode. In: Standard methods for the examination of water and wastewater. 21st ed. Washington (DC): Public Health Association, Water Environment Federation, and American Water Works Association. 1368 p.

Wolf N. 2003a. Determination of manure electrical conductivity. In: Peters J, editor. Recommended methods of manure analysis. Madison (WI): University of Wisconsin Cooperative Extension. Publication A3769. p 50–1. Available at uwlab.soils.wisc.edu/pubs/A3769.pdf (accessed 2011 Jan 31).

Wolf N. 2003b. Determination of manure pH. In: Peters J, editor. Recommended methods of manure analysis. Madison (WI): University of Wisconsin Cooperative Extension. Publication A3769. p 48–9. Available at uwlab.soils.wisc.edu/pubs/A3769.pdf (accessed 2011 Jan 31).

Hoskins B, Wolf A, Wolf N. 2003. Laboratory procedures, dry matter analysis. In: Peters J, editor. Recommended methods of manure analysis. Madison (WI): University of Wisconsin Cooperative Extension. Publication A3769. p 14–7. Available at uwlab.soils.wisc.edu/pubs/A3769.pdf (accessed 2011 Jan 31).

Kempers AJ, Luft AG. 1988. Re-examination of the determination of environmental nitrate by reduction with hydrazine. Analyst 113:1117–20.

Krom M. 1980. Spectrophotometric determination of ammonia: a study of modified Berthelot reaction using salicylate and dichloroisocyanurate. Analyst 105:305–16.

Skalar Analytical B.V. 1995a. Ammonia. In: The SAN^{++} segmented flow analyzer — water analysis. Breda (The Netherlands): Skalar Analytical B.V. p 73–5.

Skalar Analytical B.V. 1995b. Nitrate + Nitrite. In: The SAN^{++} segmented flow analyzer — water analysis. Breda (The Netherlands): Skalar Analytical B.V. p 190–2.

Skalar Analytical B.V. 1995c. Nitrogen (total). In: The SAN^{++} segmented flow analyzer — water analysis. Breda (The Netherlands): Skalar Analytical B.V. p 198–200.

[USEPA] United States Environmental Protection Agency.1983. Method 120.1. Conductance (specific conductance, µmhos/cm at 25 °C). In: Methods for chemical analysis of water and wastes. Cincinnati (OH): USEPA Office of Research and Development. EPA/600/4-79-020.

[USEPA] United States Environmental Protection Agency. 1993. Method 351.2. Determination of total Kjeldahl nitrogen by semi-automated colorimetry, revision 2. In: Methods for chemical analysis of water and wastes. Cincinnati (OH): USEPA Office of Research and Development. EPA-600/4-79-020. Available at www.epa.gov/waterscience/methods/method/files/351_2.pdf (accessed 2011 Jan 31).

[USEPA] United States Environmental Protection Agency. 2001. Method 200.7. Trace elements in water, solids, and biosolids by inductively coupled plasma–atomic spectrometry, revision 5.0. Cincinnati (OH): USEPA Office of Research and Development. EPA-821-R-01-010. Available at h2o.enr.state.nc.us/lab/qa/epamethods/200_7.pdf (accessed 2011 Jan 31).