Nevada Division of Environmental Protection

Bureau of Water Pollution Control

NITROGEN BUDGET DETERMINATIONS for LAND APPLICATION SITES

WTS-1D

April 2021

a. Introduction:

This guidance document provides a general overview of the determination of nitrogen loading (e.g. lbs. Nitrogen/acre-year) at permitted, agricultural land application sites, which beneficially reclaim domestic septage, grease trap waste (commercial kitchen grease interceptors), and portable toilet fluids (including holding tank greywater). The Permittee is required to submit an annual nitrogen balance report in the end-of-year report to NDEP to demonstrate that an agronomic uptake balance was maintained and leaching of excess nitrogen into the groundwater and storm runoff conveyances was minimized. Refer to your permit's conditions for the required submission schedule, which is typically due every January 28th (4th Quarter, Annual End-Of-Year Report).

Fig. 1 – Septage injection (sub-surface)

Fig. 2 – Septage application (surface)

b. Domestic Septage & Grease Trap Waste:

Septage & Grease:

The Allowable Application Rate (AAR), in gallons of septage and grease trap waste per acre per year, shall be based on the amount of Nitrogen (pounds) required by the planned crop and the crop yield. The Allowable Application Rate (AAR) shall be determined by the formula:

$$AAR = N/0.0026$$

Where:

AAR = Allowable Application Rate in gallons per acre per 365-day period. N = Amount of nitrogen in pounds per acre per 365-day period needed by the forage crop or other vegetation grown on the land.

Sample Calculation (Septage & Grease):

Calculate the AAR of septage and grease trap waste for a one (1) acre field where a three (3) ton per acre crop of Orchard grass was harvested in last year's growing season. For this example, the Nitrogen removed from the soil is estimated at 50 lbs. N per ton of Orchard grass.

AAR = N/0.0026

AAR = (3 tons/year x 50 lbs. N/ton) / 0.0026

AAR = 57,700 gallons/acre-year (rounded to nearest 100 gallons)

Additional note: Grease trap material shall be mixed with the domestic septage at a rate of one (1) part grease interceptor material to a minimum of three (3) parts domestic septage, by volume, prior to land application.

c. Portable Toilet Fluids (and other holding tank wastes):

For the application of Portable Toilet Fluids (e.g. Sani-Hut® or Porta-Potty® wastes) or other non-digested, holding tank wastes, including greywater, the Allowable Application Rate for septage shall be reduced (divided) by a factor of six (6) to account for the higher-strength (Nitrogen) content of non-digested, holding tank wastes.

Fig. 3 – Delivery of Portable Toilets

Fig. 4 – Pumping a Vault Holding Tank

Portable Toilet Fluids & Greywater:

The Allowable Application Rate (AAR), in gallons of Portable Toilet Fluids and Greywater per acre per year, shall be based on the amount of Nitrogen (pounds) required by the planned crop and the crop yield. The Allowable Application Rate (AAR) shall be determined by the formula:

$$AAR = N/0.0156$$

Where:

AAR = Allowable Application Rate in gallons per acre per 365-day period. N = Amount of nitrogen in pounds per acre per 365-day period needed by the forage crop or other vegetation grown on the land.

Sample Calculation (Portable Toilet Fluids & Greywater):

Calculate the AAR of Portable Toilet Fluids and Greywater for a one (1) acre field where a three (3) ton per acre crop of Orchard grass was harvested in last year's growing season. For this example, the Nitrogen removed from the soil is estimated at 50 lbs. N per ton of Orchard grass.

AAR = N/0.0156

AAR = (3 tons/year x 50 lbs. N/ton) / 0.0156

AAR = 9,600 gallons/acre-year (rounded to nearest 100 gallons)

d. Supplemental Fertilization:

The annual Nitrogen balance should also include the supplemental fertilizer addition applied from commercial fertilizer and animal manure.

i. The following equation can be used to determine the nitrogen added from a commercial spreader broadcasting a solid fertilizer product.

lbs. N (Fertilizer) = (lbs. Fertilizer applied) × (% by Weight Total-Nitrogen)

Sample Calculation (Solid Fertilizer):

Calculate the lbs. of Nitrogen added onto a one (1) acre field where 500 lbs. of solid fertilizer product were broadcast onto the soil in last year's growing season. Per the product's label, the fertilizer's nitrogen content is listed at 10% by weight.

lbs. N (Fertilizer) = (lbs. Fertilizer applied) × (% by Weight Total-Nitrogen)

lbs. N (Fertilizer) = (500 lbs. Fertilizer applied) × (10% by Weight Total-Nitrogen)

= 50 lbs. N (per acre).

ii. The following equation can be used to determine the nitrogen added from a liquid tanker injecting/spraying a liquid fertilizer product.

lbs. N (Fertilizer) = (Product weight, lbs. per gallon) × (Gallons of product applied) × (% by Weight Total-Nitrogen)

Sample Calculation (Liquid Fertilizer):

Calculate the lbs. of Nitrogen added onto a one (1) acre field where 100 gals. of liquid fertilizer product were injected into the soil in last year's growing season. Per the product's label, the total nitrogen content is listed at 5% by weight, and the weight of one gallon of the fertilizer solution is indicated at 10 lbs./gallon.

lbs. N (Fertilizer) = (Product weight, lbs. per gallon) × (Gallons of product applied) × (% by Weight Total-Nitrogen)

lbs. N (Fertilizer) = (10 lbs. per gallon) × (100 Gallons) × (5% by Weight Total-Nitrogen)

= 50 lbs. N (per acre).

iii. The following equation can be used to determine the nitrogen added from animal manure when the manure's nutrient analysis is provided on an "as received" or wet basis.

lbs. N (Manure) = (lbs. Manure applied, wet basis) × (% by Weight Total-Nitrogen, as received basis)

Sample Calculation (Manure, "as-is" or wet analysis):

Calculate the lbs. of Nitrogen added onto a one (1) acre field where 2,000 lbs. of wet manure were tilled into the soil in last year's growing season. Per the lab's analysis of the manure ("as-is" or wet basis), the manure's total nitrogen content is listed at 0.5% by weight.

lbs. N (Manure) = (lbs. Manure applied, wet basis) × (% by Weight Total-Nitrogen, wet basis)

lbs. N (Manure) = (2,000 lbs. Manure applied) × (0.5% by Weight Total-Nitrogen)

= 10 lbs. N (per acre).

iv. The following equation can be used to determine the nitrogen added from animal manure when the manure analysis is provided on a "dry" basis.

lbs. N (Manure) = (lbs. Manure applied, wet weight) × (1 - % Moisture Content) × (% by Weight Total-Nitrogen, dry basis)

Sample Calculation (Manure, dry wt. analysis):

Calculate the lbs. of Nitrogen added onto a one (1) acre field where 2,000 lbs. of wet manure were tilled into the soil in last year's growing season. Per the lab's analysis of the manure (dry basis), the manure's total nitrogen content is listed at 2.0%. In addition, the dry matter (D.M.) analysis indicated 25% dry matter (i.e., 75% moisture content of the manure).

lbs. N (Manure) = (lbs. Manure applied, wet basis) × (1 – % Moisture Content) × (% by Weight Total-Nitrogen, dry basis)

lbs. N (Manure) = (2,000 lbs. Manure applied, wet) × (1 – 0.75) × (2% by Weight Total-Nitrogen, dry basis)

= 10 lbs. N (per acre).

e. Nitrogen Uptake Data:

Published data is readily available from the internet, agricultural publications or your local cooperative extension office to determine an end-of-year Nitrogen balance based on site recordkeeping including farm records of harvested crops and yields. Below is an example listing of forage crops grown in Nevada, which are fertilized with septage, grease trap waste, portable toilet fluids and/or reclaimed water.

EXAMPLE AGRONOMIC UPTAKE RATES (Nitrogen)	
Forage Crop	**Nitrogen Uptake (lbs. N/ton crop)**
Alfalfa	56
Alkar (tall) wheatgrass	22½
Bermuda grass	25
Clover	50
Corn (silage)	8¼
Crested wheatgrass	28¼
Fescue	40
Oats (silage)	45
Orchard grass	50
Pasture grass	40
Ryegrass	26
Sudan grass (sorghum)	8
Timothy	33
Triticale (silage)	52
Wheat (silage)	50

f. References:

i. *A Guide to the Federal EPA Rule for Land Application of Domestic Septage to Non-Public Contact Sites*, U.S. EPA (1993).

ii. *A Plain English Guide to the EPA Part 503 Biosolids Rule*, U.S. EPA (1994).

iii. *Crop Nutrient Tool,* United States Dept. of Agriculture (2020).

iv. *Domestic Septage Regulatory Guidance – A Guide to the EPA 503 Rule*, U.S. EPA (1993).

v. *Nutrient Uptake and Removal by Field Crops*, Canadian Fertilizer Institute (1998).

vi. *Western Fertilizer Handbook (Ninth Edition)*, Western Plant Health Association (2002).

Fig. 5 – Pasture grass fertilized with sewage sludge & reclaimed H_2O

g. Sample Nitrogen Balance:

Attached is a sample nitrogen budget for a 10-acre field, land applied with screened septage (90%) and portable toilet fluids (10%). In the spring, the farmer added a one-time, annual supplement of manure. In this example spreadsheet table, the lbs. Nitrogen/acre-yr. (applied) vs. lbs. Nitrogen/acre-yr. (uptake or removed) are in balance.

SAMPLE NITROGEN BALANCE

Month	Septage (gals)	PTF (gals)	Fertilizer (#'s N)	#'s Nitrogen	Acres	#'s N/ac. (Applied)	Crop	Yield (tons)	#'s N/ac. (Uptake)
Jan	27,000	3,000	0	117	10	11.7	---	---	---
Feb	27,000	3,000	0	117	10	11.7	---	---	---
Mar	27,000	3,000	100	217	10	21.7	---	---	---
Apr	27,000	3,000	0	117	10	11.7	---	---	---
May	27,000	3,000	0	117	10	11.7	---	---	---
June	27,000	3,000	0	117	10	11.7	Hay	10	50
Jul	27,000	3,000	0	117	10	11.7	---	---	---
Aug	27,000	3,000	0	117	10	11.7	Hay	10	50
Sep	27,000	3,000	0	117	10	11.7	---	---	---
Oct	27,000	3,000	0	117	10	11.7	Hay	10	50
Nov	27,000	3,000	0	117	10	11.7	---	---	---
Dec	27,000	3,000	0	117	10	11.7	---	---	---
∑ YTD	324,000	36,000	100	1,500	10	150	---	---	150