TITLE 35: ENVIRONMENTAL PROTECTION

SUBTITLE C: WATER POLLUTION

CHAPTER II: ENVIRONMENTAL PROTECTION AGENCY

PART 391
DESIGN CRITERIA FOR SLUDGE APPLICATION ON LAND

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AUTHORITY: Implementing and authorized by Section 4(g) of the Environmental Protection Act (Ill. Rev. Stat. 1981, ch. 111 1/2 par. 1004(g)) and by 35 Ill. Adm. Code 309.155, 309.208(e), and 309.262.

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SUBPART A: INTRODUCTION AND DEFINITIONS

Section 391.101 Purpose

a) The purpose of this document is to present criteria for transporting, storing and applying sludge on land in an environmentally acceptable manner. This document identifies

methods of sludge transportation, handling, storage, application and monitoring to control potential environmental problems.

b) These criteria are to be used for the design and operation of sludge management plans required to obtain permits from the Division of Water Pollution Control. More specifically, these criteria apply to municipal and private domestic sewage and water treatment plants that include the land application of sludge for final disposal.

c) These criteria apply to projects for the land application of sludge that has been determined to be non-hazardous and non-toxic. Hazardous or toxic sludge disposal is regulated under either the Resource Conservation Recovery Act, 42 USC 6901 et seq. (1982 as amended) or the Toxic Substances Control Act, 15 USC 2601 et seq. (1982 as amended) respectively, as promulgated by United States Environmental Protection Agency (USEPA). These rules do not relieve sludge generators, users or distributors of compliance with Federal regulations.

Section 391.102 Definitions

"Agronomic Rates for Sludge Application": An application rate of sludge sufficient to supply that quantity of plant nutrients that can reasonably be expected to be utilized by agricultural crops as determined pursuant to Section 391.410.
"Application": The placement of sludge on or under the land surface.

"Cation Exchange Capacity": The sum of exchangeable cations a soil can absorb expressed in milli-equivalents per 100 grams of soil as determined by the summation method for distinctly acid soils or the sodium acetate method for neutral, calcareous or saline soils.

"Digested Sludge": Sludge digested under either aerobic or anaerobic conditions until the volatile content has been reduced to the point at which the solids are relatively nonputrescible and inoffensive.

"Dried Sludge": Sludge that has been dewatered by a mechanical device, drying beds or other means such that it can be transported and handled as a solid material. Normally, this will be a minimum of 15% total solids.

"Heavy Metals": Metals with a high specific gravity, including but not limited to cadmium (Cd), copper (Cu), lead (Pb), zinc

(Zn), chromium (Cr), mercury (Hg), nickel (Ni).

"Incorporation": To mix sludge with the soil, concurrent with application, in the upper horizon by such means as injection, discing, or plowing.

"Liquid Sludge": Sludge that is readily pumpable and must be transported by a closed vessel. Normally, this will be a maximum of 8% total solids.

"Management Scheme or Management Plan": A program devised by a sludge generator or user that specifies how they will properly transport, store and dispose of sludge for which they are responsible. This would include but not be limited to on-site or off-site storage, seasonal operation, with all proposed disposal techniques and criteria to be followed.

"Natric Soils": Soils having 15% or more millequivalents of exchangeable sodium within the solum.

"Off-Site Interim Storage": The storage of sludge off the treatment plant site from where it was generated but does not include sludge in the transporting vehicle.

"Plant Nutrients": Those forms of nitrogen, phosphorus, potassium and micro-nutrients which are absorbed by agricultural crops and provide the necessary food for the plant's maintenance and growth.

"Public Distribution": A program by a sludge generator that allows the general public to obtain sludge for individual use but does not include sludge users who may be under contract with the sludge generator or persons receiving sludge for commercial agricultural use.

"Reclamation": The improvement of disturbed soils by addition of sludge materials which would allow the establishment and maintenance of vegetation.

"Sludge Distributor": A sludge user who is not a sludge generator but who sells or gives away sludge regardless of its origin.

"Sludge Generator": A person who produces sludge by treating water or wastewater by a treatment works or pretreatment works.

"Sludge User": A person who obtains sludge from a sludge

generator for application on his land or land under his control.

"Stabilized Sludge": The product of biological, chemical, heat or other type of sludge treatment that results in a relatively nonputrescible and inoffensive material.

"Utilization": The application of sludge on land for agriculatural, horticultural, silvicultural, or other beneficial purposes at such rates that the nutrients can be expected to be utilized by plant growth.

SUBPART B: PERMIT REQUIREMENTS FOR SLUDGE GENERATORS, DISTRIBUTORS AND USERS

Section 391.201 Persons Requiring Permits

a) Persons applying sludge on land are required to obtain a permit unless exempted by 35 Ill. Adm. Code 309.208.
b) Persons that have not been exempted include the following:
   1) All sludge generators intending to apply sludge on land including but not limited to agricultural land, treatment plant grounds, disturbed soils, sod farms or have a public distribution program are required to obtain an Agency permit, either in a separate construction and/or operating state permit pursuant to Subpart B of 35 Ill. Adm. Code 309 for new or existing treatment works, or as part of a National Pollutant Discharge Elimination System (NPDES) permit;
   2) Sludge distributors who sell or give away sludge at a rate exceeding the equivalent of 1500 dry tons per year are required to obtain an Agency permit or be included as part of a sludge management plan in a sludge generator's permit;
   3) Sludge users who apply sludge to sites greater than 300 acres under common ownership or control in any year or apply more than 1500 dry tons of sludge per year are required to obtain an Agency permit unless the site is specifically identified in an Agency permitted sludge generator management plan;
   4) Sludge users are required to obtain an Agency permit if special circumstances exist such that a permit is required to protect the environment or public health;
   5) Sludge generators or users constructing or operating permanent sludge transfer or receiving stations, permanent liquid sludge storage facilities or permanent dried sludge stockpile areas are required to obtain an Agency permit unless these facilities are approved in a sludge management

plan as part of a sludge generator permit.

Section 391.202 Permit Application Requirements

a) Sludge permit applications shall include, as a minimum, the following:
   1) Schedule WPC-PS-1
   2) Schedule G
   3) Laboratory Analysis Sheet
   4) Agronomic Calculations
   5) Sludge Management Plan Narrative
      The sludge management plan narrative shall include, as a minimum, the following items:
      A) method of application such as liquid or dry sludge, incorporation or surface application and the equipment used;
      B) sludge application site characteristics such as proximity to streams, wells and groundwater, soil types, slopes, runoff control, distance to dwellings and roads, crops and yields;
      C) contingencies such as differences in seasonal operations, method of sludge handling or storage, supporting calcuations for storage facility operation during periods when sludge cannot be land applied, and name, location and permit numbers of landfills used during contingency periods;
      D) copy of sludge user information sheet(s) containing information outlined in Appendix G, H or I;
      E) heavy metal loadings at proposed sludge application rate.
   6) If a specific utilization site has been chosen, then a letter of acceptance by the site owner (if different than the sludge generator) shall be included in the application for permit. User sheets may be signed by the site owner in lieu of a separate letter. If sites are specifically identified in a permit application by the generator, the following minimum information shall be submitted:
      A) the location and acreage of the sludge application site shown on a United States Geological Survey (USGS) map or plat map (or clear reproduction of one of these maps);
      B) a soil survey map with a description of the soils as provided by a published soil survey;
      C) previous and expected crop yields for crops to be grown;
      D) slope of application site;
      E) depth to mean annual water table;

F) soil pH and cation exchange capacity; and
G) special considerations for sludge application rates and operating techniques for the specific site.

b) All permit renewal applications shall identify sludge application sites and include the information required in Subsection (a)(6) above, unless a generator provides for sludge disposal by contract. If a generator has developed a sludge utilization program with numerous users, the generator shall identify the 10 largest users and provide the information in Subsection (a)(6) in the permit renewal application.

Section 391.203 Permit Requirements

a) A sludge generator is responsible for complying with the sludge management plan set forth in its permit. If sludge is transferred to any person who requires off-site interim storage, or is applied by a person other than the generator, the user shall also be responsible for its utilization in full compliance with the generator's sludge management plan and its permit. Sludge generators shall be responsible for informing all the sludge users of the sludge quality and shall recommend application rates for the user's specific needs.

b) In order to minimize odor potential and reduce pathogen organism content, wastewater sludges must be digested or stablized prior to application. During situations when NPDES effluent violations may exist and no landfill is accessible, land application of partially stabilized sludge shall be allowed when approved by Agency permit.

c) Sludge generators with sludge utilization permits from the Agency may sell or give away quantities of liquid or dried sludge in excess of one equivalent semi-trailer truck load, (approximately 25 cubic yards) per year to a sludge user provided the sludge user completes and signs an information sheet. As a minimum, the information sheet must contain the items outlined in Appendix G, H or I of this Part. These signed sheets are to be retained by the sludge generator (with a copy to the user) for inspection throughout the duration of their permit and for two years following the expiration date of the permit. Sludge records shall include:
1) Date of sludge shipment or application;
2) Weather conditions when delivered;
3) Location of sludge destination;
4) Amount of sludge applied or delivered;
5) Analysis of sludge pursuant to generator's permit;

d) Sludge generators with sludge utilization permits from the Agency may sell or give away quantities of liquid or dried sludge less

than or equal to one semi-trailer truck load (approximately 25 cubic yards) per year to a sludge user without keeping records of such users as stated in (c) above. The sludge generator shall provide an information sheet as described in Appendix G, H or I to each sludge user.

e) Sludge generators and users that receive permits must monitor their sludge quality, provide soil and groundwater analyses and (when required) report to the Agency as specified in Sections 391.430, 391.440 and 391.501 or in the permit issued by the Agency. Sludge users that receive permits shall submit monthly reports to the Agency which shall include the following minimal information:
   1) Permit number and name of sludge generator;
   2) Date of sludge transfer;
   3) Volume of sludge transferred;
   4) Location of application sites;
   5) Most recent chemical analysis of the sludge applied;
   6) Application rate and metal loading rate;
   7) Method of application.

Section 391.204 Public Distribution Programs

a) General
   Public distribution programs are acceptable to the Agency under certain conditions and shall be included in a generator's sludge management plan. Sludge can be used by the general public as a soil amendment provided the public is properly informed of the nature of the material they are utilizing. Information sheets are necessary for all public distribution programs describing the constituents in the sludge, how to properly apply the sludge and must contain the items outlined in Appendix H.

b) Specific Requirements
   1) Sludge which contains more than 25 mg Cd/kg (dry weight basis) shall not be distributed to the general public.
   2) Sludge application rates for public distribution programs shall not exceed 10 dry tons per acre per year.
   3) Information sheets as described in Appendix H shall be provided to all persons receiving sludge under public distribution programs. Information sheets must be retained by the sludge generator as specified in Sections 391.203(c) and (d).
   4) The Agency does not recommend that leafy or root crop vegetables (such as lettuce, Swiss chard, spinach, potatoes, carrots, horseradish, etc.) be grown on sludge amended land.
   5) The sludge must be transported, stored and applied in

accordance with Subpart C and D.

6) Only dried sludge shall be distributed to the general public.

SUBPART C: TRANSPORT AND STORAGE DESIGN CRITERIA

Section 391.301 Sludge Transport Design

Sludge shall be transported from the treatment plant to the application site or storage facilities in accordance with the following criteria:

a) Liquid sludge shall be transported in a closed vessel which shall not allow any leakage or spillage on any public road or right of way;

b) Pipelines transporting liquid sludge shall be made of material and joints so as to eliminate leakage or spillage;

c) Open dump trucks may be utilized for transporting dewatered sludge (greater than 15% total solids) if equipped and operated so as to prevent spillage or wind-blown particles. If the travel distance exceeds 10 miles (one way), the person transporting the sludge shall consider covering or enclosing the vehicle to prevent spillage or wind-blown particles;

d) Sludge transfer or receiving stations shall be designed and constructed to prevent or contain any leakage or spillage of sludge.

Section 391.302 Sludge Storage Design

a) General

Off-site interim storage of sludge has created odors, spillage, leachate and other environmental problems. Consequently, the Agency discourages sludge management plans that require off-site interim sludge storage. Where no other feasible alternative exists, the applicant shall consider the following criteria.

b) Specific Criteria for Off-site Interim Storage of Liquid or Dried Sludge

1) Off-site interim storage of liquid or dried sludge shall not exceed 8 months.

2) Provide a fence to preclude livestock and warning signs designating the nature of the facility and advising against trespassing.

3) Reduce visibility of storage site to general public and maximize distance between site and any habitation.

4) Use topographic features or wind breaks to take advantage of wind effects of dispersion and/or reducing the movement of odorants away from the source.

5) Use wind breaks to prevent wave action in lagoons.
6) Reduce exposed surface area by designing the deepest practical and acceptable storage facility.
7) Provide mixing equipment to maximize ease of removal of liquid sludge from the storage facility and provide a homogeneous mixture. Such equipment should not generate aerosols.
8) Only sludge that is stabilized so that odor production will not occur may be placed in off-site interim storage facilities.
9) In the event unexpected odor conditions do occur, the responsible party managing the off-site storage facilities shall be prepared to install and/or operate acceptable emergency odor control measures.
10) Off-site interim storage facilities shall not be located proximate to potable water supplies and other facilities subject to contamination. Facilities should not be located in areas of porous soils and fissured rock formations. If such location is necessary the facility shall be designed and constructed to protect groundwater and groundwater monitoring in accordance with Section 391.440 shall be provided.

Section 391.303 Off-Site Interim Storage of Liquid Anaerobic Sludge

The Agency will not issue a permit for the off-site interim open storage of liquid anaerobic sludge unless the applicant submits proof that the storage facility will not cause or threaten to allow air or water pollution. In addition to the general criteria under Section 391.302(b), the following items shall be addressed by the applicant in the design of closed storage facilities.

a) Closed storage facilities shall have an air breather vent pipe(s) capped to preclude the entrance of precipitation. Minimum height from top of vent to ground level shall be 10 feet.
b) Appropriate signs shall be posted in the immediate vicinity of the storage facility, which as a minimum must state, "Danger - No Smoking."
c) Closed storage facilities shall incorporate into the vent system adsorptive devices to minimize emissions of odorants.
d) An alarm system shall be installed in the storage container vapor space to actuate should an explosive situation be produced in the storage facility.
e) Electrical equipment in, on or in the immediate vicinity of the closed storage facility shall comply with the National Electric Code requirements adopted by the National Fire Protection Association, 1981 for Class 1, Group D, Division 1 locations. Any

forced air ventilation equipment shall be fabricated from nonsparking material.

f) Operating personnel access shall be provided for all closed liquid storage facilities. Self-contained oxygen-supplying equipment shall be available for use upon entrance into such facilities.

g) Closed liquid storage facilities must be constructed with relatively impermeable materials such as clay, concrete, synthetic liner or equivalent.

Section 391.304 Off-Site Interim Storage of Liquid Aerobic Sludge

In addition to the general criteria under Section 391.302(b), the following items shall be addressed by the applicant in the design.

a) The site is isolated from residential and commercial developments.

b) The storage facility must be constructed with relatively impermeable materials such as clay, concrete, synthetic liner or equivalent.

c) Aeration equipment is provided and maintains a measurable amount of dissolved oxygen.

Section 391.305 Off-Site Interim Storage of Dried Sludge

Off-site interim storage of dried sludge less than 2 months are considered temporary storage facilities and do not require an Agency permit. Off-site interim storage of dried sludge equal to or greater than 2 months are considered permanent storage facilities and do require an Agency permit. In addition to the general criteria under Section 391.302(b), the following items shall be addressed by the applicant in the design.

a) The stockpiles are contained and runoff is controlled.

b) Leachate shall be contained and provisions made to protect groundwater.

c) The stockpiles are not subject to flooding.

d) Sludge storage is isolated from commercial and residential developments.

SUBPART D: SLUDGE APPLICATION DESIGN CRITERIA

Section 391.401 Introduction

Sludge shall be applied to land in accordance with the following criteria, except as approved otherwise in a specific permit issued pursuant to Ill. Adm. Code 309.208(f).

Section 391.402 General Criteria

a) Sludge shall be applied as soon as possible after transport to the application site, unless storage is provided in compliance with the sludge storage criteria.

b) Sludge shall not be applied on land:
   1) During precipitation;
   2) Which is saturated or with ponded water.

c) It is not recommended that sludge be applied on land:
   1) When precipitation is imminent;
   2) Which has received greater than 1/4 inch rainfall within the 24 hour period preceding the intended application time.

d) Sludge applied to natric soils shall be incorporated.

e) Sludge shall be applied at or below the annual nitrogen or phosphorus agronomic rate as calculated using the nutrient loading criteria pursuant to Section 391.410 for the crops grown or the heavy metal loading criteria pursuant to Section 391.420.

f) Unless surface application is allowed by Section 391.404(a) or specified in a permit, sludge shall be incorporated as soon as possible after application to prevent odor emission and runoff potential. Sludge shall be incorporated within 48 hours or prior to any rainfall after application whichever is more restrictive.

g) Sludge shall not be applied to sites used for growing of commercial truck gardening fruits and vegetables that are grown and sold for direct human consumption. For public distribution programs, it is not recommended that sludge be applied to sites for individual use that may grow leafy (lettuce, spinach, Swiss chard, etc.) or root (potatoes, carrots, horseradish, etc.) vegetables unless the following conditions are met:
   1) The application rate does not exceed 10 dry tons/acre per year;
   2) The sludge does not contain more than 10 mg Cd/Kg (dry weight basis);
   3) The sludge has been aged for approximately 3 years after digestion or stabilization;
   4) All vegetables are thoroughly washed or cooked prior to consumption;
   5) Comply with Subsection 391.402 (a), (b), (c), (d), (f), (i), (j), (k), 391.403(d) and 301.404(d) as listed herein.

h) Liquid sludge shall not be applied by spray irrigation facilities unless specifically permitted by the Agency. Spray irrigation operations will be considered for permits if the applicant demonstrates the environmental acceptability of the project with particular attention to the following items:
   1) Type of sludge digestion utilized;
   2) Isolation from habitation;

3) Buffer areas from application sites;
4) Water balance and storage requirements;
5) Spray irrigation equipment design and operational procedures;
6) Sludge characteristics pursuant to Subpart E in this rule;
7) Compliance with other criteria listed in this rule.

i) Wind direction and velocity, humidity and the day of the week shall also be considered prior to sludge transport and applications with respect to neighboring activities.

j) Polychlorinated Biphenyls and Hazardous Waste
1) Sludge containing concentrations of Polychlorinated Biphenyls (PCBs) equal to or greater than 10 mg/kg (dry weight basis) must be incorporated into the soil when applied to land used for producing animal feed, including pasture crops for animals raised for milk. Incorporation of the sludge into the soil is not required if it is assured that the PCB content is less than 0.2 mg/kg (actual weight) in animal feed or less than 1.5 mg/kg (fat basis) in milk.
2) Sludge containing concentrations of PCBs equal to or greater than 50 mg/kg (dry weight basis) shall not be land applied and are subject to the Toxic Substances Control Act (15 U.S.C. 2601 et seq. (1982)).
3) Sludge which exhibits the characteristics of a hazardous waste defined in 40 CFR 261.20 (1983) shall not be land applied unless it is performed in accordance with 40 CFR 264 Subpart M (1983) and Illinois Pollution Control Board (IPCB) rules under Title 35, Subtitle G, Chapter I. It is the generator's responsibility to make this determination.

k) Sludge must be properly stabilized or digested to reduce odor potential and pathogen content of the sludge prior to land application. Acceptable methods include but are not limited to aerobic digestion, anaerobic digestion, composting and lime stabilization.
1) If the treatment plant sludge digestion process units are designed and operated within the requirements set forth in Illinois Recommended Standards for Sewage Works, the sludge will normally be assumed to be stablized for land application.
2) If the sludge is to be composted or lime stabilized, the process must be designed and operated in accordance with the definitions of composting and lime stabilization specified in 40 CFR 257 Appendix II, Section A (1983).
3) For facilities not meeting the above requirements or for other methods not mentioned, the Agency will require that sludge analysis and engineering data be submitted by the applicant to prove that stabilization and pathogen kill is

obtained.

l) If the sludge is disposed of by burial on the treatment plant grounds, the site must be designed and operated in accordance with the regulations adopted pursuant to Title V of the Environmental Protection Act.

Section 391.403 Application Buffer Area

a) Sludge application with immediate incorporation or injection shall not be done closer than 20 feet from any occupied dwelling or 10 feet from the closest edge of traveled portions of a public road or outside roadway fence lines.

b) Sludge application with no immediate incorporation shall not be done closer than 200 feet from any occupied dwelling or 20 feet from the closet edge of traveled portions of a primary and secondary public roads or 10 feet from the closest edge of lesser utilized public roads or outside roadway fence lines.

c) Sludge application by ridge and furrow shall not be done closer than 200 feet from any occupied dwelling or the closest edge of traveled portions of a public road or outside roadway fence lines.

d) Sludge shall not be applied on land which lies within 150 feet from wells used to supply potable water or other potable water supplies and 200 feet from surface waters or intermittent streams; or within one-fourth of a mile of any potable water supply wells located in consolidated bedrock such as limestone or sinkhole areas unless a 50 foot depth of non-sandy or non-gravelly unconsolidated material exists.

e) Sludge shall not be applied or discharged to streams, waterways which are grassed or otherwise, or those flood plains having a return frequency mor often than a 10 year frequency.

f) Sludge application by low pressure spray irrigation systems (less than 50 psi) shall not be done closer than 200 feet from any occupied dwelling, closest edge of traveled portion of public road, surface waters, waterways or floodplains as measured from the outer boundary of the spray pattern. The wind velocity shall be less than 15 mph during spray irrigation periods.

g) Sludge application by high pressure spray irrigation systems (greater than 50 psi) shall not be done closer than 1000 feet from any occupied dwelling, closest edge of traveled portion of public road, surface waters, waterways or floodplains as measured from the outer boundary of the spray pattern. The wind velocity shall be less than 15 mph during spray irrigation periods.

Section 391.404 Site Characteristics

a) Sludge shall not be surface applied without incorporation to farm

land having greater than 5% slope. If the slope does exceed 5%, surface application can be used providing the annual soil loss does not exceed 5 tons/acre as calculated by the Universal Soil Loss Equation found in the University of Illinois Cooperative Extension Service Circular, "Estimating your soil erosion losses with USLE", revised May 1980 or in USDA Agricultural Handbook #537, "Predicting Rainfall Erosion Losses", December 1978.

b) Sludge may be incorporated on lands having slopes up to eight percent, irrespective of soil loss. If the slope exceeds eight percent, incorporation methods may be used providing the annual soil loss does not exceed five tons per acre as calculated by the Universal Soil Loss Equation.

c) For sludge applied soils having the following infiltration rates as determined by standard percolation tests or from information contained in soil surveys, the listed minimum soil depth to the mean annual water table shall be adhered to:
   1) Greater than 2 inches/hour -- 10 feet;
   2) Less than or equal to 2 inches/hour -- 5 feet.

d) Unless otherwise allowed by Section 391.450, sludge applied land must have a background soil pH of 6.5 or greater or liming of the land is required prior to sludge application to raise the soil pH to a minimum of 6.5. Note that some liming techniques of the soil do not immediately raise the soil pH. Considerable time is usually required. Water treatment plant lime softening sludge may be used to raise the soil pH.

e) Pasture or hay ground that has received surface applied sludge shall not be harvested or used for livestock grazing for a period of at least one month after sludge application or until precipitation of sufficient duration and intensity has occurred and washed all sludge from the area of the plant which can be injested by an animal, whichever time period is greater.

f) Frozen ground which is not ice or snow covered and has a slope of 5% or less may be used for winter spreading providing a 200 feet grassy area exists between the sludge applied land and any surface water or potable water supply well.

g) In general, sludge application shall not be applied on ice or snow covered ground. Sludge may be applied on ice or snow covered ground during emergency situations pursuant to an Agency permit only under the following conditions:
   1) The treatment plant site does not have adequate storage facilities or sufficient springtime application period and the effluent may cause violations of their NPDES limits;
   2) Sludge application site shall not be fall plowed by mold board plow unless a 200 foot grassy area exists between the application site and any swale, waterway, surface water, or

potable water supply well;

3) Slope of the application site does not exceed 5%;
4) Runoff control measures such as vegetative fence rows around the site, contour farming, terracing, catchment basins and buffer areas in the direction of surface runoff;
5) Site is isolated from habitation;
6) No landfill is accessible;
7) No feasible alternative is available;
8) Other alternatives will be pursued by the generator, as appropriate.

h) Sludge amended land shall have a crop grown and harvested according to normal agricultural practice. Normal agricultural practices may include fallow land, set-aside programs, pasture land or other similar agricultural uses. Application rates shall be based upon the nitrogen or phosphorus requirements for the crops grown taking into account the soil nutrient level determined by soil testing.

i) Horticultural, silvicultural, nursery, sod farm, highway median or right-of-way or other beneficial uses of sludge on land will be reviewed on a case-by-case determination. Conformance with other criteria contained in this Part shall be evaluated and incorporated in a management plan by the generator or user as appropriate for their particular case.

j) The following numbers correspond to soil type numbers identified on soil survey maps complied by the United States Department of Agriculture - Soil Conservation Service. These numbers identify soils which have characteristics such as steep slopes, shallow soil depth, saline content or a texture that may constrain their use for sludge application projects. Additional precautions such as incorporation, lower application rates or groundwater monitoring may be necessary for sludge application on these types of soils. This list may not include every soil type in the state that may constrain a sludge application project. The descriptions of all soil types identified on a soil survey map should be evaluated along with field observation and verification for determining the acceptability of certain sludge application areas. The following soil type numbers warrant additional consideration for determining what constraints are required for sludge application of these soil types:

5	93	271	472	620	956
7	98	282	501	660	977
8	100	312	504	731	
25	103	316	511	741	
34	120	354	513	761	
49	210	389	551	768	

53	224	397	581	777
54	241	417	584	779
85	250	425	585	786
88	253	427	605	903
92	264	471	606	955

Section 391.405 Water Treatment Plant Sludge

a) Lime sludge shall be applied at rates calculated using soil type, soil pH, and type of crops grown as determined using Appendix E.
b) Water treatment plant sludge, other than lime sludge, may be land applied provided the applicant can demonstrate, through field testing on plots of up to 1 acre in size, that the sludge applied will not have an adverse impact on the land for agricultural purposes.
c) Water treatment plant sludge application projects must comply with Section 391.301; 391.302; 391.402 (a), (b), (c), (d), (f), (h), (j); 391.403; 391.404 (a), (b), (c), (f), (g); and 391.420.

Section 391.410 Nutrient Loading

Sludge utilization permit applications must include agronomic calculations which specify the application rates (dry tons per acre) to be utilized by sludge users. Unless site specific information on crop yields is available, the applicants must use the average county crop yields shown in Appendix C in conjunction with the fertilizer requirements specified in Appendix B. The applicant must determine whether the sludge application site is to be used on a short term (less than 5 years) or long term (greater than 5 years) period and calculate the necessary nitrogen or phosphorus agronomic rate. The applicants shall use Sections 391.411, 391.412 and 391.413 for determining the nutrient loading.

Section 391.411 Nitrogen

In the short range (five years), nitrogen in the sludge is usually considered to be the limiting factor. The maximum loading rates of sludge applied to the land is based on the nitrogen required for growing a crop. Projects that apply sludge in excess of the nitrogen agronomic rate must show what additional precautions or circumstances are present to prevent potential surface or groundwater pollution or violations of the Act. The following figures for nitrogen availability to plants shall be utilized in the agronomic calculations unless additional research and site specific information is provided:

a) Ammonia Nitrogen
    1) Surface application without incorporation

A) Sandy and non-sandy soil -- 50% NH availability
B) Tight clay soil -- 25% NH availability

2) Surface application with chisel plowing, disking or equivalent
A) Sandy soil -- 50% NH availability
B) Non-sandy soil -- 80% NH availability

3) Subsurface application (injection)
A) Sandy soil -- 50% NH availability
B) Non-sandy soil -- 100% NH availability

4) Due to additional losses such as volatilization, nitrification, denitrification, etc., no carry over of available ammonia nitrogen is expected. The above figures are to be used for that particular year's application rate calculations.

b) Organic Nitrogen

Table I
Organic Nitrogen Availability for Crops
(read down for that particular year of sludge application)

Sludge Application Year	1st	2nd	3rd	4th	5th
1st	20%	10%	5%	2.5%	1.25%
2nd	20%	10%	5%	2.5%	
3rd	20%	10%	5%		
4th	20%	10%			
5th	20%				

After the 5th year crop, additional organic nitrogen is not expected to be available to the crops from the sludge which was applied more than 5 years past.

Section 391.412 Phosphorus

a) The phosphorus content of the soil may govern loading rates for the sludge. It is recommended that the available phosphorus content in soils and total phosphorus in the sludge be analyzed every 2 years.

b) After five years of sludge application the phosphorus level in the soil shall be monitored and sludge application shall cease if the plant available phosphorus content in the soil exceeds 400 pounds per acre for sandy soils or 800 pounds for non-sandy soils.

Section 391.413 Potassium

Although most sludges will not contain sufficient potassium levels for optimum nutrient loading, the potassium concentrations in sludge shall be analyzed for the purposes of advising sludge users.

Section 391.420 Heavy Metal Loading

a) Heavy metal loading rates on sludge application projects are limited to prevent significant increases of heavy metals in the food chain, phytotoxicity and water pollution. Generators shall sample their sludge for metals in accordance with Subpart E and accordingly limit annual and total cumulative sludge application rates.

b) Sites which have a lifetime of sludge application less than 5 years due to metal loading rates in Subsection c below shall be identified in a permit application. The Agency shall not issue a permit for sludge application on such sites unless the following items are considered in the application:
   1) Groundwater monitoring;
   2) Soil monitoring;
   3) Plant tissue sampling and analyses;
   4) Additional operational controls.

c) Soil cation exchange capacity (CEC) plays a major role in enabling the soil to retain the heavy metals contained in the sludge. Soils having a CEC in the range from 5 to 15 meq/100gm are acceptable for sludge utilization providing sludge application rates do not result in heavy metals being applied to land in excess of those amounts listed in Table II below.

TABLE II

MAXIMUM ACCEPTABLE HEAVY METAL LOADING RATES OVER THE LIFE OF A PROJECT SITE
(pounds per acre)

Metal	Total	Annual
Pb	1000	--
Mn	900	--
Zn	500	--
Cu	250	--
Ni	100	--
Cd	10	2

d) There are some areas in Illinois which have low soil CEC (less than 5 meq/100g) and should be avoided for sludge application whenever possible. If a sludge management plan includes sludge application in these areas, the sludge generator or user shall apply only half of the heavy metal loading rates set forth in Table II.

e) Permits may be issued which allow application of double the

amounts listed in Table II providing it is demonstrated that the soil CEC is greater than 15 meg/100g. However, an extensive soil survey must be performed prior to and during the sludge application period to demonstrate the consistency of high soil CEC values at the sludge application site.

f) The Agency may request an applicant to analyze a sludge for elements other than those in Table II and to limit sludge application based on other elements due to potential for groundwater or surface water pollution, phytotoxicity, mammalian toxicity or other environmental concerns. If the Agency determines that metals other than those in Table II should restrict the proposed application rate, the following loading rates shall be utilized for the land application project:

Table III

Acceptable Loading Rates
(pounds per acre)

Metal	Total	Annual
Antimony	700	
Arsenic	100	
Chromium (trivalent)	3500	89
Chromium (hexavalent)	440	44
Mercury		7
Selenium	8	
Silver	178	

g) If sludge concentrations of molybdenum and/or selenium exceed 4.0 mg/kg (dry weight basis) the Agency shall restrict the crops to be grown on land receiving applications of that sludge or shall restrict the use of crops for livestock forage as necessary to prevent toxicity to livestock.

h) The Agency will consider allowing loading rates greater than those specified in this Section provided the generator or user addresses the following items:

1) Soil testing results with particular attention to plant available metals and phosphorus;
2) Groundwater monitoring results and adjacent groundwater use;
3) Plant tissue sampling and analyses and the ultimate use of the crop;
4) Availability of additional application sites;
5) Hydrogeology of the application site;
6) Operational constriants of the application site;
7) Ultimate use of the application site.

Section 391.430 Site Monitoring

a) For sludge application projects less than 5 years, and with sludge generated by treatment plants receiving minimal industrial waste load, the agronomic rate usually results in the application of heavy metals to the soil in low amounts that should not create problems from a water pollution, phytotoxic and food-chain standpoint. In general, soil testing will not be required for these types of projects.

b) For long term projects, soil testing shall be provided by the permittee. The number of soil tests and frequency of monitoring will be dependent upon the quality of the sludge, sludge application rate and continuity of soil types of the sludge application site. If more than 100 dry tons per acre of sludge are applied over the life of the site, the permittee shall perform a complete soils analysis for that particular site. The soils shall be tested for parameters including, but not limited to, CEC, heavy metals (total and/or plant available), pH, plant available phosphorus, organic carbon content, soluble salts by electrical conductivity. The collection of soil samples shall be performed in accordance with Section 391.510.

c) Except as provided in Section 391.430(a), analysis of the soil prior to any sludge application will also be required for determining background levels. Hydrogeologic data shall be required for specific sites including sites with unidentified hydrogeologic conditions.

d) The information required in Sections 391.430(b) and (c) shall be required for projects with a sludge application rate greater than the nitrogen agronomic rate.

Section 391.440 Additional Precautions

a) If the requirements of Subpart D cannot be met, additional environmental precautions such as groundwater monitoring, soil analyses, plant tissue sampling and analysis shall be included as permit conditions as necessary to assure compliance with the Environmental Protection Act and 35 Ill. Adm. Code, Subtitle C, Subchapter l.

b) If groundwater monitoring is required, a minimum of 3 saturated zone groundwater monitoring wells (1 upgradient and 2 downgradient) shall be provided at each land application site. Additional wells may be required depending upon the size of the site, hydrogeology, direction of groundwater movement, sludge quality and other considerations.

   1) The design, construction and operation of the groundwater monitoring system shall be done in accordance with the regulations adopted pursuant to Title V of the Act and

policies of the Division of Land Pollution Control.

2) The location of groundwater monitoring wells is site specific and the hydrogeology of the particular site shall be considered in the design.

3) The wells must be sampled monthly and analyzed for parameters including, but not limited to, nitrates, electrical conductivity, chlorides, pH, hardness and heavy metals.

c) Yearly plant tissue sampling and analysis may also be required to determine the uptake characteristics and heavy metal concentrations of the plant tissue and grain. Plant tissue sampling and analyses shall be the responsibility of the generator and of those utilizing the sludge.

d) The plant tissue monitoring and groundwater monitoring results of Subsections b and c will be reviewed by the Agency to determine future controls and frequency of monitoring.

Section 391.450 Land Reclamation Projects

a) Land reclamation projects are acceptable alternatives for sludge application and disposal and require an Agency permit. Reclamation would involve the retoration or improvement of land conditions to the point where vegetation can be sustained. In most cases, the application rate of sludge is much greater than agronomic application rates. The applicant's design of reclamation projects and site conditions must be comprehensive and sufficiently detailed to comply with provisions of the Act and this part.

b) The applicant shall include the following items in a permit application:

1) The applicant shall state the name(s) and addresses of the owner(s) of the site and the operator(s) of the site.

2) The applicant shall describe the site conditions including:

A) Hydrogeology;

B) Groundwater quality;

C) Soil characteristics;

D) Topography;

E) Drainage patterns;

F) Mine refuse piles.

3) The applicant shall describe the method of site preparation including an evaluation of the following alternatives:

A) Grading;

B) Diking;

C) Terraces;

D) Sediment traps;

E) Run-on control;

F) Run-off and erosion control;
G) Stream relocation.

4) The applicant shall describe the methods for transportation and storage included in the design in accordance with Subpart C.
5) The applicant shall specify the distance to habitation and potable water supplies.
6) The applicant shall specify the sludge application criteria including:
A) Application rate;
B) Equipment;
C) Methods;
D) Nutrient and heavy metal loadings;
E) Buffer areas in accordance with Section 391.403.
7) The applicant shall specify procedures for site operation and maintenance including:
A) Vegetation or crop grown and its ultimate use;
B) Existing ponded site water disposal or reuse;
C) Adjustment of soil and sludge mixture pH;
D) Monitoring networks;
i) Soil,
ii) Groundwater,
iii) Plant tissue.
8) The applicant shall describe its proposed recordkeeping procedures.
9) The applicant shall determine whether its proposed project complies with federal and state mining laws.

c) The permittee shall file an annual operating report with the Agency and shall make such other reports as required in their permit. The annual report shall include as a minimum the following information:
1) Dates of sludge application;
2) Amount of sludge applied;
3) Crops grown and their ultimate use;
4) Sludge source and analyses;
5) Groundwater monitoring results;
6) Soil monitoring results;
7) Plant tissue monitoring results;
8) Precipitation events and dates;
9) Specific operating constraints.

SUBPART E: SAMPLE COLLECTION AND ANALYSIS

Section 391.501 Sludge Sampling and Analysis

a) Permit applications, except water treatment plant sludge application projects, shall provide analyses for the following parameters;
   1) % total solids, % volatile solids, pH, volatile acids (if anaerobic digestion is used);
   2) Total Kjeldahl nitrogen, ammonia nitrogen, phosphorus and potassium;
   3) Cadmium, copper, lead, manganese, nickel and zinc.

b) All analyses for Subsections (a) (2) and (3) above must be reported in mg/kg (dry weight basis).

c) Wastewater treatment plants whose design population equivalents are less than 1000, which have sanitary sewers not subject to large inflow sources and do not receive any industrial process wastewater may request an exemption from analyzing the metals under Subsection 391.501 (a) (3) except for cadmium which must always be analyzed. These generators shall periodically analyze their sludge used for land application and make the necessary calculations for nutrient and heavy metal loadings in accordance with the following schedule:

Design Population Equivalents	Frequency of Sludge Analysis
greater than 100,000	Monthly
10,000 - 100,000	Quarterly
1000-9999	Semi-annual
less than 1000	Annual

   1) If a treatment plant sludge application project is limited by heavy metal loading more frequent sludge analysis shall be required by the Agency as necessary to assure compliance with the Act and 35 Ill. Adm. Code, Subtitle C, Subchapter l.
   2) If sludge analyses show only minor deviations in sludge quality, the applicant may request a less frequent sludge sampling and analysis program or compositing of samples with less frequent analyses of samples.

d) Water treatment plant sludge permit applications shall provide analyses for the following parameters;
   1) % total solids, pH, % calcium carbonate equivalent;
   2) Arsenic, barium, cadmium, chromium (hexavalent), chromium (total), copper, mercury, nickel, selenium, silver and zinc;
   3) The Agency shall request an applicant to analyze water treatment plant sludge for additional parameters and limit sludge application rates based on these other parameters as necessary to prevent groundwater or surface water pollution, phytotoxicity, mammalian toxicity or other environmental

concerns.

4) If raw water or sludge analyses show only negligible amounts of metals listed in (d)(2) above, the applicant may request less parameters to be analyzed.

e) All analyses for Subsection (d)(2) above must be reported in mg/kg (dry weight basis).

f) Water treatment plants shall analyze their sludge on an annual basis. For facilities that have on-site storage lagoons, analyses shall be performed at the time of lagoon cleanout.

Section 391.502 Collection of Sludge Samples

Collect samples during dry periods, and not sooner than 48 hours after the last precipitation. Do not collect samples during freezing periods or sooner than 48 hours after a thaw. Collect samples as follows:

a) Dried sludge: Collect 100 grams of dried material or a core sample (whichever is greater) from each of 6 locations which include the perimeter and inner portions of the drying bed or lagoon, then composite these samples. For mechnical dewatering facilities, collect 100 grams, 6-8 times at hourly intervals during a normal day's operating period and composite these samples.

b) Liquid sludge outside digester: At each of 6 locations equally spaced along the perimeter of the storage area collect a core sample representing the top, middle, and bottom. Composite the 6 samples and preserve according to USEPA procedures specified in "The Handbook for Sampling and Sample Preservation for Water and Wastewater," September 1982. Analyses are to be carried out on properly preserved samples within the times specified.

c) Digester Contents: If analyses are required on a quarterly or more frequent interval, samples for heavy metal analyses are to be collected weekly and composited. If analyses are required on a semi-annual interval, three two-month composites are required each 6 months. If analyses are required on an annual interval, three two-month composites are required; the first composite must be collected in the first 6 month interval. One quart of each composited sample, preserved according to USEPA procedures described in subsection (b) above, shall be collected for the analyses.

d) Sample collection for all nitrogen analyses should be done immediately before analysis and preserved according to USEPA procedures described in subsection (b) above for water and sewage sludge samples. Long-term composites are not acceptable.

Section 391.503 Analyses of Sludge Samples

a) It is recommended that the following parameters be analyzed according to the referenced sections in Standard Methods for Examination of Water and Wastewater (14th ed), or as approved in 40 CFR 136. Other analyses or methodologies are acceptable provided equivalent results are obtainable. The permittee or applicant shall demonstrate that equivalent results are obtainable based on the nature of the test methodology, the nature of the parameter and the level of statistical accuracy.
   1) Ammonia nitrogen, Part 418(D)
   2) Total Kjeldahl nitrogen, Part 421 (Macro-Kjeldahl Method in 15th Edition)
   3) pH, part 424, glass electrode method
   4) Volatile acids (total organic acids), Part 504-A, chromatographic method
   5) % total solids, Part 208-G, "Procedure", Subpart 3.a.l. "Total Residue"
   6) % volatile solids, Part 224-G, "Procedure", Subpart 3.a.2. "Volatile Residue"
   7) Phosphorus (total), Part 425-C
   8) Potassium (total), Part 317-B

b) Heavy Metals
   1) Metals Other Than Mercury
      A) Homogenize wet sludge sample in blender, ultrasonic homogenizer, or other suitable device.
      B) An aliquot of homogenized sludge suitable to provide 5-10 grams of dry material is dried at 103 C for 48 hours.
      C) Accurately weigh about 1 gram of dry sludge to the nearest 0.1 mg and place in a "Tallform" beaker containing 20 ml of reagent grade nitric acid.
      D) Place a watch glass over the mouth of the beaker, and warm the mixture on a hot plate, allowing the acid to gently reflux off the watch glass.
      E) Reflux the mixture until a clear solution is obtained (45-50 minutes). Sand and other non-digestible material present in the sample will settle out.
      F) Using quantitative technique, filter the cooled, digested sample, and make the filtrate up to 100.0 ml in a volumetric flask.
      G) Analyze according to USEPA procedures specified in "Methods for Chemical Analysis of Water and Waste," March 1979.
      H) Repeat steps (C) through (G) on two additional 1 gram samples. It is the intent that triplicate analysis be

performed.

I) Report all results.

2) Mercury: Tentative procedure
Analyze three separate portions according to USEPA procedure "Mercury in Sediment".

Section 391.510 Collection of Soil Samples

Soil sample collection shall be conducted so as to be representative of the entire sludge application site.

a) Soil Plow Zone - one soil sample shall be collected per 8 acres of sludge application site area to a depth of 12 inches. Each soil sample shall be taken a homogeneous mixture composed of at least 10 subsamples randomly collected within the 8 acre area.

b) Soil Profiles - one soil core sample per 8 acres of land application site shall be obtained to a depth of 5 feet using a soil tube or soil auger type implement. Soil cores shall be divided into 5 - one foot subsamples and each subsample shall be analyzed separately.

c) Soil sample collection pursuant to Subsections (a) and (b) may be modified by the Agency upon request by the applicant after considering the quality of the sludge, sludge application rate and continuity of soil types of the sludge application site.

Section 391.511 Analyses of Soil Samples

If the Agency requires soil sampling and analysis pursuant to Section 391.430, the method of analysis shall be performed in accordance with the following references unless equivalent results can be obtained by other methods. The permittee or applicant shall demonstrate that equivalent results are obtainable based on the nature of the test methodology, the nature of the parameter and the level of statistical accuracy.

a) Physical Testing Methods

1) Annual book of ASTM standards (1979), Part 19, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103; or

2) Methods of Soil Analysis - Part 1 (1965), Physical and Mineralogical Properties, Agronomy Series No. 9, C. A. Black (editor), American Society of Agronomy, Inc. (Publisher), 677 South Segoe Road, Madison, Wisconsin 53711.

b) Chemical Testing Methods
Methods of Soil Analysis - Part 2 (1982) 2nd edition, Chemical and Microbiological Properties, Agronomy Series No. 9, A. L. Page (editor), American Society of Agronomy, Inc. (Publisher).

Section 391.520 Groundwater Sampling and Analyses

a) Groundwater samples shall be collected by one of the following methods:
   1) Peristaltic pumps;
   2) Submersible diaphragm pumps;
   3) Bailing method using stainless steel or PVC materials;
b) Air lift or nitrogen lift pumping equipment shall not be used.
c) Groundwater samples shall be filtered at the time of collection using a 0.45 micron filter or equivalent, however laboratory filtration is acceptable provided it is performed within 15 minutes from the time of collection. Groundwater samples shall be preserved and analyzed in accordance with Standard Methods for the Examination of Water and Wastewater (14th edition).

Section 391.530 Plant Tissue Sampling and Analyses

a) Plant tissue monitoring programs are sensitive to the care and standard techniques used in the sample collection, handling and analysis. This section presents recommended guidelines intended to minimize error in a plant tissue monitoring program. It is recommended that a professional agronomist or crop scientist be consulted when developing such a program.
b) Plant tissue sampling should include as many samples as possible. The same part of each plant should be sampled and samples should not include dead tissue. Usually it is adequate to sample only the portion of the plant that will be harvested. Collection of samples is not recommended when plants are under severe moisture or temperature stress. Leaf analysis for grain crops should be done on samples collected prior to pollination, especially if macro- and/or micro-nutrients will be analyzed.
c) Sample should be washed in a 0.1 to 0.3% detergent solution followed by 2 or 3 rinsings in deionized water. Washing should be performed quickly to avoid leaching water soluble constituents. Most household detergents are suitable for washing plant tissues.
d) Plant tissue samples should be dried as rapidly as possible after collection. Place the tissue samples in a clean muslin bag or tray and place inside a forced - draft oven at 65 C for 48 hours.
e) Plant tissues samples are normally ground after drying. Mechanical grinding mills are preferred and careful consideration should be given to sample contamination especially when micro-nutrient elements are to be determined. The recommended technique is to grind the sample to about 200 mesh in an all-agate mechanical ball mill. After grinding place the powdered plant tissue sample in a clean bottle and dry for an additional 24 hours

at 65 C to remove moisture picked up during grinding.

f) After grinding and the second drying, a subsample can be weighed for analysis or the bottle sealed and stored under refrigerated conditions until the analysis can be performed.

g) It is recommended that samples be stored in sealed polyethylene bags in a refrigerator at -5 C until they can be washed and dried. Dried and ground plant tissue samples should not be stored on the shelf longer than 60 days prior to analysis. However, dried and ground samples can be stored indefinitely in a sterilized, sealed bottle in a refrigerator at -5 C.

h) There are numerous methods available for the analysis of plant tissue samples. Most procedures involve wet or dry ashing or the use of an extraction procedure followed by element analysis typically by atomic absorption, flame emission, or direct-reading emission spectroscopy. Wet ashing by the use of nitric and/or sulfuric acid is preferred to dry ashing in an oven to minimize volatile losses of metals. Boron can be determined only by dry ashing become because this element is volatilized during wet ashing.

i) For further information on this subject the Agency suggests the following reference: Soil Testing and Plant Analysis, Revised Edition, (1973). Edited by Leo M. Walsh and James D. Beaton, Soil Science Society of American, Inc., 677 South Segoe Road, Madison, Wisconsin 53711.

Section 391.APPENDIX A Applicable Board Rules From 35 Ill. Adm. Code: Subtitle C, Chapter I

Editor's Note: Appendix A is comprised of selected quotes from 35 Ill. Adm. Code 309.155 and 309.208.

Section 309.155 Terms and Conditions of NPDES Permits Concerning Sewage Sludge Disposal

In establishing the terms and conditions of each issued NPDES permit, the Agency shall apply and ensure compliance with applicable regulations promulgated under Section 405 of the CWA governing the disposal of sewage sludge from treatment works.

Section 309.208 Permits for Sites Receiving Sludge for Land Application

a) A construction and an operating permit are required under this Chapter for any site receiving sludge for land application unless:
   1) The site receives only livestock wastes; or
   2) The site receives only tank sludges generated from domestic sources; or
   3) The site is regulated under Parts 700 et seq. of the Board's regulations; or
   4) The site is specifically identified in an approved sludge

management scheme of an operating or NPDES permit issued by the Agency and receives sludge exclusively from the permittee; or

5) All of the following conditions are satisfied:

A) The site is not specifically identified in an NPDES or operating permit of any treatment works or pretreatment works but receives sludge from a treatment works or pretreatment works which has a valid operating permit issued by the Agency, or an NPDES permit with a sludge management scheme approved by the Agency. The sludge generator shall inform the user that this requirement has been met; and

B) The sludge user applies the sludge to less than 121 ha (300 acres) under common ownership or control in any year; and

C) The sludge is transported, stored and applied by the user in compliance with the approved sludge management scheme of the generator from which the user receives the sludge. Any person who intends to transport, store or apply sludge in any manner other than that described in the approved sludge management scheme must apply for a permit.

b) Notwithstanding subparagraphs (1) through (5) of paragraph (a), the Agency may require a user receiving sludge for land application to obtain a permit under this Section when the Agency determines that special circumstances exist such that a permit is required to protect the environment or the public health. In making its determination, the Agency shall consider the following factors:

1) Where the sludge will be stored;

2) The proposed rate and method of application of the sludge to the receiving site;

3) The quality (constituents and concentrations) of the sludge to be applied to the receiving site; and

4) The geological and hydrological characteristics of the receiving site, including proximity to waters of the state.

c) No permit may be required under Subsection (b) for a user receiving sludge for land application unless the owner or operator is notified in writing of the requirement to apply for a permit. That notification shall include a statement of the special circumstances requiring the site to be permitted. The requirement of a permit is reviewable only in a permit appeal proceeding.

d) Generators and haulers of municipal water or wastewater treatment plant sludge, which is to be applied to land and which is regulated under this Chapter, need not obtain a special waste

hauling permit or prepare, carry and complete a manifest under Part 706 of the Board's Special Waste Hauling regulations.

e) The Agency may establish the revise criteria in accordance with Rule 309.262 of this Chapter for the design, operation, and maintenance of facilities regulated under this Rule.

f) For purposes of permit issuance and approval of a sludge management scheme, proof of conformity with Agency criteria shall be prima facie evidence of no violation of the Act or this Chapter. However, nonconformity with Agency criteria shall not be grounds for permit denial, or for failure to approve a sludge management scheme, if the applicant submits adequate information showing that the sludge will be stored, transported and applied so as not to cause a violation of the Act or this Chapter.

Section 391.APPENDIX B Fertilizer Requirements for Illinois Crops

The Agency in reviewing a permit application for a sludge project will consider any recognized source of fertility recommendations for Illinois crops, and soils. However, Table IV was prepared for the convenience of persons planning a sludge project who do not wish to consult other information sources with regard to fertilizer requirements for Illinois crops. Table IV is general in nature and may not reflect an optimum recommendation for all areas or soil types of this state, rather the recommendation reflects the maximum rate of application consistent with current research. With respect to nutrients, the available nitrogen rate will dominate as the maximum permissible application rate. Note that with most sludges and crops if the available nitrogen crop demand is met by applying sludge as the only fertilizer, the phosphorus (P) applied with often exceed the plant requirements. Therefore, in order to make the best use of sludge resources, the P rate should be followed. However, it is environmentally acceptable to apply at the nitrogen rate if other factors so dictate. In order to obtain more accurate recommendations for fertilizer requirements, soil testing should be done.

TABLE IV

Fertilizer Requirements for Illinois Crops
(pounds of nutrient)

Crop	Avail-Table N	P	P(2)0(5)	K	K(2)0
Corn for grain	1.3/bu.	.24/bu.	.55/bu.	0.23/bu.	.28/bu.
Corn silage	7.5/T	1.4/T	3.1/T	7.9/T	9.4/T

Wheat (1)	2.3/bu.	0.3/bu.	0.68/bu.	1.7/bu.	2.0/bu.
Oats (1)	1.1/bu.	0.17/bu.	0.40/bu.	1.2/bu.	1.5/bu.
Barley (1)	1.5/bu.	0.24/bu.	0.55/bu.	0.83/bu.	1.0/bu.
Rye (1)	2.2/bu.	0.15/bu.	0.69/bu.	0.75/bu.	1.8/bu.
Sorghum for grain	2.0/100 lbs.	0.33/100 lbs.	0.75/100 lbs.	0.31/100 lbs.	0.38/100 lbs.
Grain sorghum for silage	7.5/T	1.4/T	3.1/T	7.9/T	9.4/T
Tall fescue (3)	39/T	8.1/T	19/T	44/T	53/T
Brome-grass (3)	33/T	5.7/T	13/T	42/T	51/T
Sorghum -Sudan (3)	40/T	6.7/T	15/G	49/T	59/T
Orchard Grass (3)	50/T	7.2/T	17/T	52/T	63/T
Timothy (3)	38/T	6.0/T	14/T	52/T	63/T
Reed Canary Grass (3)	55/T	5.4/T	13/T	42/T	50/T
Alfalfa (3)	(2)	4.4/T	10/T	50/T	60/T
Clovers (3)	(2)	6.5/T	15/T	50/T	60/T
Soybeans	(2)	0.47/bu.	1.1/bu.	2.0/bu.	2.4/bu.

(1) If straw is harvested.

(2) Legumes can obtain most of their nitrogen requirements from the air and are normally not fertilized with nitrogen. However, if included in a crop rotation with nitrogen using crops they will use the available nitrogen in the soil and not fix nitrogen from the air. Therefore, it can be assumed that they will remove as much nitrogen as corn for grain would remove in the same rotation.

(3) Forage crops may become toxic to livestock if high concentrations of molybdenum or selenium are present in the sludge. Refer to Section

391.420(g) for guidance.
If specific crop yield information is unavailable, consult the Illinois Agriculture Statistics Annual Summary for the current year or utilize the values shown in Appendix C. This publication is available from the Illinois Cooperative Crop Reporting Service, Post Office Box 429, Springfield, Illinois 62705. If a specific crop which you want to use in not listed in this reference contact the University of Illinois Cooperative Extension Service in your county for average yields of that crop.

Section 391.APPENDIX C Average County Crop Yields

(1978 - 1981)

COUNTY	CORN	WHEAT	SOYBEANS	HAY (dry)
Adams	105	45	34	2.9
Alexander	86	37	28	2.0
Bond	92	45	30	2.9
Boone	121	50	38	3.7
Brown	113	42	32	2.8
Bureau	123	51	41	3.5
Calhoun	101	44	33	3.2
Carroll	121	45	38	3.8
Cass	120	41	37	3.1
Champaign	123	54	38	3.3
Christian	125	49	39	2.9
Clark	111	43	36	2.7
Clay	83	40	28	2.2
Clinton	88	43	30	3.4
Coles	119	47	39	3.1
Cook	103	45	31	2.9
Crawford	105	42	33	2.4
Cumberland	109	45	35	2.5
DeKalb	132	53	40	3.6
DeWitt	115	48	38	3.2
Douglas	116	52	40	3.2
DuPage	114	47	35	2.9
Edgar	115	50	38	2.9
Edwards	91	43	30	2.0
Effingham	106	48	33	2.6
Fayette	93	44	29	2.5
Ford	108	46	37	3.3
Franklin	72	40	23	2.2
Fulton	107	41	36	2.9

COUNTY	CORN	WHEAT	SOYBEANS	HAY (dry)
Gallatin	91	42	29	2.1
Greene	105	48	37	3.2
Grundy	116	43	37	3.3
Hamilton	77	43	25	2.1
Hancock	116	43	36	2.9
Hardin	70	37	25	2.0
Henderson	125	41	38	3.3
Henry	123	49	41	3.7
Iroquois	109	50	36	3.6
Jackson	78	38	28	2.5
Jasper	106	45	34	2.6
Jefferson	79	41	25	2.1
Jersey	107	49	34	3.1
Jo Daviess	115	49	37	3.7
Johnson	76	36	23	2.0
Kane	128	53	39	3.4
Kankakee	112	47	37	3.1
Kendall	119	48	37	3.2
Knox	120	44	42	3.4
Lake	101	43	31	3.2
LaSalle	123	48	40	3.5
Lawrence	94	42	32	2.3
Lee	125	51	39	3.7
Livingston	114	47	38	3.5
Logan	114	49	39	3.2
McDonough	121	44	40	3.2
McHenry	118	49	36	3.5
McLean	119	50	40	3.4
Macon	125	53	39	3.2
Macoupin	114	51	35	3.0
Madison	105	46	34	3.0
Marion	85	43	29	2.3
Marshall	113	43	39	3.4
Mason	101	41	36	2.9
Massac	80	37	25	2.0
Menard	117	46	40	3.2
Mercer	123	50	41	3.5
Monroe	100	47	34	3.2
Montgomery	117	49	35	2.9
Morgan	129	51	41	3.2
Moultrie	128	52	40	3.2
Ogle	122	51	40	3.8
Peoria	113	46	39	3.2

Perry	75	39	28	2.5
Piatt	123	54	39	3.2
Pike	104	44	34	3.1
Pope	71	36	24	1.9
Pulaski	81	39	28	2.2
Putnam	116	44	40	3.4
Randolph	85	41	31	2.9
Richland	92	43	30	2.3
Rock Island	121	46	39	3.6
St. Clair	101	49	34	2.9
Saline	75	40	24	2.1
Sangamon	128	50	41	3.2
Schuyler	106	42	34	2.8
Scott	114	46	36	3.2
Shelby	118	49	36	3.0
Stark	123	47	42	3.3
Stephenson	118	50	38	3.9
COUNTY	CORN	WHEAT	SOYBEANS	HAY (dry)
Tazewell	114	46	40	3.3
Union	82	38	27	2.1
Vermilion	118	50	37	3.2
Wabash	96	42	31	2.1
Warren	128	44	42	3.2
Washington	83	45	29	2.9
Wayne	83	40	26	1.9
White	83	43	27	2.2
Whiteside	122	48	40	3.8
Will	108	49	34	3.2
Williamson	71	37	23	2.1
Winnebago	116	47	36	3.7
Woodford	118	45	41	3.3
Illinois (State)	115	45	36	3.1

Note that all crop yields are expressed in bushels per acre except for hay which is expressed in tons/acre.

Section 391.APPENDIX D Sample Calculations of Sewage Sludge Application Rates

I. Units and Conversions
Laboratory analyses are reported on either a wet weight ("as-received") basis or on a dry weight basis. The units for a

wet weight basis are millgrams per liter (mg/l - weight per volume). The units for a dry weight basis are milligrams per kilogram of solids (mg/kg - weight per weight).

Sludge represents a material in which most of the solid matter is undissolved and the dissolved fraction is of minor importance. It is generally simpler to perform sludge calculations by using dry weight units. Furthermore, some calculations must ultimately be expressed in dry weight units to be correct. For these reasons all the sample calculations are worked on a dry weight basis. However, since may laboratories report results on a wet weight basis, conversion relationships are provided below. Be aware that some laboratories report results in mg/kg on an "as-received" basis. You should consult the laboratory to confirm this and then convert the units to a dry weight basis. Finally, note that the specific gravity of liquid and most dry sludges can be assumed to be 1.0 (equal to water) and sufficient accuracy in the calculations will be obtained.

A) The decimal equivalent (DE) of the percent total solids equals the percentage divided by 100.

% TS = DE of Total Solids
100

Example: 5% TS > > = 0.05 DE
100

B) Wet Weight to Dry Weight Basis

mg/1 = mg/kg (dry wt. basis)
DE

Example: 1.5 mg/l Cadmium = 30 mg/kg Cadmium (dwb)
0.05 DE

C) Dry Weight to Wet Weight Basis

(mg/kg) x (DE) = mg/l (wet wt. basis)

Example: (30,000 mg/kg TKN) x (0.05) = 1500 mg/1 TKN (wwb)

D) Other useful conversions

1) ppm (wet) x 100 = ppm (dry)
%TS
2) ppm x 0.002 = 1b/ton
3) 10,000 ppm (or mg/l or mg/kg) = 1%
4) 1 acre = 43,560 square feet
5) (dry tons sludge) x 100 = wet tons sludge
%TS
6) Wet tons > > x 2000 > > = gallons/acre
acre 8.345

7) 1 cubic yard of drying bed sludge is approximately equal to 0.45 dry tons.
8) 1 mg/kg = 0.002 lb/ton

II. Assumptions for Sludge Calculations

A) Sludge will be surface applied with incorporation by disking or chisel plowing.
B) Soils are non-sandy at the application sites.
C) The sludge has been well stabilized by heat anaerobic digestion.
D) Laboratory analysis of sludge (dwb):

5% TS
Total Kjeldahl Nitrogen (TKN) = 30,000 mg/kg
Ammonia Nitrogen = 10,000 mg/kg
Phosphorus = 8,000 mg/kg
Potassium = 3,500 mg/kg
Cadmium = 30 mg/kg
Copper = 2000 mg/kg
Manganese = 1000 mg/kg
Nickel = 400 mg/kg
Lead = 1000 mg/kg
Zinc = 4000 mg/kg

E) Corn for grain is grown and the average yield is 110 bushels per acre per year.

III. Calculating Agronomic Nitrogen Application Rates of Sludge

A) Determine the availability of nitrogen forms by referring to Section 391.411.
1) Ammonia nitrogen plant availability is 80%.
2) Organic nitrogen plant availability is 20% for the first year and decreases as shown in Table I.

B) First Year Application Rate
1) Organic nitrogen is not a laboratory test. It is a calculated value as shown below.
Organic N = Total Kjeldahl N - Ammonia N
Organic N = 30,000 - 10,000 = 20,000 mg/kg
2) Calculate the plant available nitrogen (PAN) in the sludge as follows:
Ammonia Nitrogen: 10,000 x 0.8 = 8,000 mg/kg
Organic Nitrogen: 20,000 x 0.2 = 4,000 mg/kg
PAN = 8,000 + 4,000 = 12,000 mg/kg

$$(12{,}000 \text{ mg/kg PAN}) \times (0.002) = 24 \frac{\text{lb PAN}}{\text{dry ton sludge}}$$

This means that each dry ton of sludge solids will have 24 pounds of nitrogen available for utilization by plants when the sludge has been disked into the soil.

Note that if the sludge has been injected into the soil there would have been 28 pounds of plant available nitrogen provided. If the sludge had been surface applied without incorporation there would have been only 18 pounds of plant available nitrogen provided.

3) Calculate the agronomic nitrogen requirement for the corn grain crop using the yield and the values from Appendix B - Table IV:

$$\frac{110 \text{ bushels}}{\text{acre}} \times \frac{1.3 \text{ lb. PAN}}{\text{bushel}} = \frac{143 \text{ lb. PAN}}{\text{acre}}$$

This means that each acre of corn with the stated yield requires 143 pounds of plant available nitrogen for proper growth.

4) Calculate the sludge application rate needed to provide the required plant available nitrogen.

$$\frac{143}{24} = \frac{5.96 \text{ dry tons sludge}}{\text{acre}}$$

5) For convenience during the actual sludge application it is usually helpful to convert the application rate into gallons per acre.

$$\frac{5.96 \text{ d T}}{\text{acre}} \times \frac{2000}{8.345} \times \frac{1}{0.05 \text{ DE}} = \frac{28{,}570 \text{ gallons}}{\text{acre}}$$

C) Second Year Application Rate

1) To simplify your calculations, assume that the laboratory analysis remains the same as used for the first year application rate calculations. However, note that nutrients and metal concentrations in sludge will vary, often considerably.

2) Determine the amount of organic nitrogen (O.N.) applied during the first year that is remaining for plant uptake during the second year by using Table I values and the first year application of organic nitrogen.

$$(20{,}000 \text{ mg/kg O.N.}) \times (0.20) = 4{,}000 \text{ mg/kg O.N. use up first year}$$

$$20{,}000 - 4{,}000 = 16{,}000 \text{mg/kg Organic N remains for second year use}$$

$$(16{,}000 \text{ mg/kg}) \times (10\%) = 1600 \text{ mg/kg O.N. available during second year}$$

$$(16{,}000 \text{ mg/kg}) \times (0.002) = 3.2 \text{ lb Organic N available}$$

dry ton
sludge

This Represents:

3.2 lb. x 5.96 dT = 19 lb. PAN
dT acre acre

Therefore, the second year crop will need:

143 - 19 = 124 lb. PAN of additional
acre nitrogen is needed.

3) Calculate the second year sludge application rate.

124 > > = 5.17 dry tons sludge
24 acre

5.17 dT x 2000 x 1 = 24,780 gallons
acre 8.345 0.05 DE acre

D) Third year application rate

1) In the third year some organic nitrogen applied during the first and second years will become available for plant utilization ; 5% and 10% respectively from Table I.

2) Determine the amount of organic nitrogen applied during previous years that is available to plants during the third year.

a) From the first year application:

(16,000 mg/kg O.N.) x (0.10) = 1600 mg/kg
O.N. used
the second
year

16,000 - 1600 = 14,400 mg/kg O.N. remaining from the first year sludge application.

(14,400 mg/kg O.N.) x (5%) = 720 mg/kg O.N. is available during the third year.

This represents:

(720 mg/kg) x (0.002) x (5.96dT) = 8.58 lb. O.N.
acre acre

b) From the second year application:

(20,000 mg/kg O.N.) x (0.20) = 4,000 mg/kg O.N. used

20,000 - 4,000 = 16,000 mg/kg O.N. remains

(16,000 mg/kg) x (0.10) = 1600 mg/kg O.N. available

(1600 mg/kg) x (0.002) = 3.2lb. O.N. available
dry ton

3.2 lb O.N. x 5.17 dT = 16.5 lb. O.N. available.
dT acre acre

c) Sum the available organic nitrogen from previous years application of sludge and subtract that sum from the

crop nitrogen requirements.

143 - (8.58 + 16.5) = 118 lb. PAN of additional nitrogen is needed.

d) Calculate the third year application rate.

$$\frac{118}{24} = 4.92 \text{ dry tons sludge per acre}$$

$$4.92 \frac{dT}{acre} \times \frac{2000}{8.345} \times \frac{1}{0.05 \text{ DE}} = 23{,}580 \frac{\text{gallons}}{\text{acre}}$$

E) Fourth year application rate

1) In the fourth year some organic nitrogen applied during the previous three years will become available for plant utilization; 2.5%, 5%, and 10% respectively from Table I.

2) Determine the amount of organic nitrogen applied during previous years that is available to plants during the fourth year.

a) From the first year application:

(14,400 mg/kg O.N.) x (0.05) = 720 mg/kg used during the third year.

14,400 - 720 = 13,680 mg/kg O.N. remaining

(13,680 mg/kg) x (2.5%) = 342 mg/kg O.N. available

$$(342 \text{ mg/kg}) \times (0.002) \times (5.96 \text{ dT}) = \frac{4 \text{ lb. O.N. available}}{\text{acre}}$$

b) From the second year application:

(16,000 mg/kg O.N.) x (0.10) = 1600 mg/kg O.N. used

16,000 - 1600 = 14,400 mg/kg O.N. remains

(14,400 mg/kg) x (0.05) = 720 mg/kg O.N. available

$$(720 \text{ mg/kg}) \times (0.002) \times (5.17 \text{ dT}) = \frac{7.4 \text{ lb. O.N. available}}{\text{acre}}$$

c) From the third year application:

(20,000 mg/kg O.N.) x (0.20) = 4,000 mg/kg O.N. used

20,000 - 4,000 = 16,000 mg/kg O.N. remains

(16,000 mg/kg) x (0.10) = 1600 mg/kg O.N. available

$$(1600 \text{ mg/kg}) \times (0.002) \times (4.92 \text{ dT}) = \frac{15.7 \text{ lb. O.N. available}}{\text{acre}}$$

d) Sum the available organic nitrogen from previous years application of sludge and subtract that sum from the crop nitrogen requirements.

143 - (4 + 7.4 + 15.7) = 116 lb. PAN of
acre
additional nitrogen is needed.

e) Calculate the fourth year application rate.

$$116 = \frac{4.83 \text{ dry tons sludge}}{24 \quad \text{acre}}$$

$$4.83 \frac{dT}{acre} \times \frac{2000}{8.345} \times \frac{1}{0.05 \text{ DE}} = 23{,}150 \frac{\text{gallons}}{\text{acre}}$$

F. Fifth year application rate

1) In the fifth year some of the organic nitrogen applied during the previous four years will become available for plant utilization; 1.25%, 2.5%, 5%, and 10% respectively from Table I.

2) Determine the amount of organic nitrogen applied during previous years that is available to plants during the fifth year.

a) From the first year application:

(13,680 mg/kg) x (0.025) = 342 mg/kg used during the fourth year.

13,680 - 342 = 13,338 mg/kg O.N. remaining

(13,338 mg/kg) x (0.0125) = 167 mg/kg O.N. available

(167 mg/kg) x (0.002) x (5.96 dT) =
acre

2 lb. O.N. available
acre

b) From the second year application:

(14,400 mg/kg) x (0.05) = 720 mg/kg O.N. used

14,400 - 720 = 13,680 mg/kg O.N. remaining

(13,680 mg/kg) x (0.025) = 342 mg/kg O.N. available

(342 mg/kg) x (0.002) x (5.17 dT) =
acre

3.5 lb. O.N. available
acre

c) From the third year application:

(16,000 mg/kg) x (0.10) = 1600 mg/kg O.N. used

16,000 - 1600 = 14,400 mg/kg O.N. remaining

(14,400 mg/kg) x (0.05) = 720 mg/kg O.N. available

(720 mg/kg) x (0.002) x (4.92 dT) =
acre

7 lb. O.N available

acre

d) From the fourth year application:
(20,000 mg/kg O.N. x (0.20) = 4,000 mg/kg O.N. used
20,000 - 4,000 = 16,000 mg/kg O.N. remaining
(16,000 mg/kg) x (0.10) = 1600 mg/kg O.N. available
(1600 mg/kg) x (0.002) x (4.83 dT) = acre
15.5 lb. O.N. available
acre

e) Sum the available organic nitrogen from previous years application of sludge and subtract that sum from the crop nitrogen requirements.
143 - (2 + 3.5 + 7 15.5) = 115 lb. PAN of acre
additional nitrogen is needed.

f) Calculate the fifth year application rate.
115 = 4.79 dry tons sludge
24 acre
4.79 dT x 2000 x 1 = 22,960 gallons
acre 8.345 0.05 DE acre

G) During and after the sixth year there will not be any significant amount of organic nitrogen available to the crop from sludge applied during the first year. An equilibrium situation was reached in this sample problem during the fourth year since there is practically no difference between the fourth and fifth year application rates.
A conservative operating plan would be to apply sludge at approximately 4.8 dry tons per acre per year. Note, however, that this would mean that additional nitrogen would be needed from fertilizers during the first, second, and third years of sludge application to meet the nitrogen requirement for the crop grown.

IV. Metal Loading Rate Calculations

A) It is useful to estimate the lifetime of a site receiving sludge on the basis of metal loadings. The method for performing this estimation is given below assuming the sludge chemical analysis provided the following quantities.
Percent Solids = 5% (0.05 decimal equivalent)

Cadmium	30 mg/kg
Copper	2000 mg/kg
Nickel	400 mg/kg
Lead	1000 mg/kg
Zinc	4000 mg/kg

Manganese 1000 mg/kg
Application rate 4.8 dry tons/acre/year

B) Set up and complete a table as follows:

Metal	Sludge Analysis	Loading Factor	Annual Metal Loading (lb/acre/year)	Maximum Metal Loading (lb/acre)	Site Life (Years)
Cadmium	30 mg/kg	0.0096	0.29	10	34
Nickel	400 mg/kg	0.0096	3.84	100	26
Copper	2000 mg/kg	0.0096	19.2	250	13
Zinc	4000 mg/kg	0.0096	38.4	500	13
Manganese	2000 mg/kg	0.0096	19.2	900	46
Lead	1000 mg/kg	0.0096	9.6	1000	104

C) The loading factor column will be the same for each metal and is calculated as follows:
0.002 #/dry ton > > x (dry tons/acre/year) = mg/kg
0.002 x 4.8 = 0.0096

D) Multiply the metal analysis value by the loading factor value (0.0096) to obtain the Annual Metal Loading (lb/acre/year) column.
Divide the maximum metal loading for each metal (from Table II, Section 391.420) by the annual metal loading rate (pounds/acre/year) to obtain the site lifetime.

E) This example indicates that the zinc and copper loading is the most restrictive to the site lifetime. Therefore a site should be used for no more than 13 years, however updated sludge analyses and different application rates may change these site lifetimes. Records should be kept on each site that sludge is applied to for each year's metal loading.

Section 391.APPENDIX E Sample Calculations of Water Treatment Plant Lime Sludge Application Rates

I. Laboratory analysis of sludge (dwb):

% Calcium Carbonate Equivalent	94.34
% Total Solids	24
pH	10.4
Arsenic	0.83 mg/kg
Barium	8.3 mg/kg
Cadmium	0.6 mg/kg
Chromium (hexavalent)	0.008 mg/kg

Chromium (total)	1.2 mg/kg
Copper	3.3 mg/kg
Mercury	0.0008 mg/kg
Nickel	8.75 mg/kg
Selenium	0.4 mg/kg
Silver	0.83 mg/kg
Zinc	6.6 mg/kg
Effective Neutralizing Value (ENV) as calculated below	94.34

$$ENV = \frac{\text{Total fineness efficiency} \times \% \text{ calcium carbonate equivalent}}{100}$$

total fineness efficiency assumed to be 100

Therefore: $ENV = \frac{100 \times 94.34}{100} = 94.34$

II. Compare ENV of water treatment plant lime sludge to ENV of agricultural limestone.

Given: 1. ENV of typical agricultural limestone = 46.35

2. ENV of water plant lime sludge from (I.) above = 94.34

$$\text{Correction factor} = \frac{\text{ENV of typical limestone}}{\text{ENV of water plant sludge}}$$

$$= \frac{46.35}{94.34} = 0.49 \text{ or } 0.5$$

This means that 0.5 tons of water treatment plant lime sludge is approximately equivalent to 1.0 tons of typical agricultural lime.

III. Lime sludge will be applied to a light-colored silty clay loam soil having a pH of 5.0.

IV. The soil will be used for grain farming.

V. The following list of soil types are to be used with the corresponding letters shown on Charts I and II for the respective cropping systems:

A) Dark-colored silty clays and silty clay loams.

B) Light-and medium-colored silty clays and silty clay loams; dark-colored silt and clay loams.

C) Light- and medium-colored silt and clay loams; dark- and medium-colored loams; dark-colored sandy loams.

D) Light-colored loams; light- and medium-colored sandy loams; sands.

E) Muck and peat.

Note: Color is related to organic matter. Light-colored soils usually have less than 2.5 percent organic matter; medium-colored soils have 2.5 to 4.5 percent organic matter; dark-colored soils have above 4.5 percent organic matter; sands are excluded.

VI. With the above assumptions and referring to Chart I the corresponding typical agricultural limestone application rate is 6 tons per acre.

Since 0.5 tons of water treatment lime sludge is approximately equivalent to 1.0 ton of typical agricultural lime (calculated in II. above) apply only 3 dry tons of water treatment plant lime sludge per acre of farm land.

Similar metal loading rates as calculated in APPENDIX D should then be performed based on the 3 dry ton loading rate.

Note that due to the fineness efficiency of 100, the water treatment plant lime sludge may only be effective in raising the soil pH for one or two years after application.

Suggested limestone rates based on soil type, pH, and cropping system.

GRAPHIC MATERIAL
See printed copy of IAC for detail
(Taken from Illinois Agronomy Handbook)
GRAPHIC MATERIAL
See printed copy of IAC for detail

Section 391.APPENDIX F General Buffer Area, Geological and Topographic Criteria for Sludge Application

SLUDGE APPLICATION METHOD	
Incorporation or Injection	20 ft. from occupied dwelling. 10 ft. from closet edge of traveled portion of public road or within fence. 200 ft. from surface water.
Ridge and Furrow	200 ft. from occupied dwelling. 200 ft. from closest edge of traveled portion of public road or within fence. 200 ft. from surface water.
Dewatered material or Splash Plate to Land Surface	200 ft. from occupied dwelling. 20 ft. from closest edge of traveled portion of primary and secondary public roads; or 10 ft. from closest edge of lesser utilized public roads; or within fence. 200 ft. from surface water.

Low Pressure Sprayers (less than 50 psi) (as measured from outer boundary of spray)	200 ft. from occupied dwelling. 200 ft. from closest edge of traveled portion of public road. 200 ft. from surface water, waterways or flood plains. Wind velocity less than 15 mph.
High Pressure Sprayers (greater than 50 psi) (as measured from outer boundary of spray)	1000 ft. from occupied dwelling. 1000 ft. from closest edge of traveled portion of public road. 1000 ft. from surface water, waterways or flood plains. Wind velocity less than 15 mph.

GEOLOGICAL CONSIDERATIONS

Minimum Depth of Earth Cover to the Mean Annual Water Table	10 ft. with rapid permeability (greater than 2.0 inches/hr) 5 ft. with moderate to slow permeability (less than 2.0 inches/hour)
Distance from Potable Water Well ----------	150 ft. in all instances, however, if a water supply is located in a consolidated bedrock (such as limestone) or sinkhole area and is within one-fourth of a mile of the sludge application site, then 50 foot depth of non-sandy, non-gravelly unconsolidated material is needed for water supply protection

TOPOGRAPHIC CONSIDERATIONS

Maximum Slope ----------	8% (incorporation)* 5% (surface application)*
Application to Waterways ----------	Not allowed
Application in a flood plain ------- having a flooding frequency often than once every ten years	Only if approved by Agency after review of project.

*May be exceeded under certain conditions. See discussion in Section

391.404.

Section 391.APPENDIX G Sludge User Information Sheet

1. Date:
2. Name of User:
3. Address of User:
4. Phone Number of User:
5. Location Where Sludge is to be Used:
6. Size of Area Where Sludge is to be Used:
7. Proximity of Site to closest: (a) Stream or other body of water

   (b) Dwelling (c) Well
   (d) Other Water Supply, (describe)
8. Amount of Sludge Obtained:
   (Specify units)
9. Describe Use(s) of Sludge (e.g., Farmland or Agricultural, Garden, Yard, Reclamation of Nutrient Deficient Land, Other):

10. Manner in Which Sludge is to be Applied (e.g., Spread by Truck or dry applicator, by Hand, Worked into the Soil by Plowing, Rototilling, Surface Application, Splash Plate, Knife injection, other):

11. Will Sludge be Stockpiled Before Application: Yes No (Circle One)
12. Estimated Length of Time Sludge is to be Stockpiled:
13. Type and expected yield of crops to be grown on sludge conditioned land:

14. I desire to have the sludge applied at a rate that will satisfy my crop's NITROGEN; PHOSPHORUS (Circle One) needs.
15. The soil pH of the land that I am applying sludge is:
16. The average depth to the groundwater table on the site where I am using the sludge is ft.
    How determined?
17. Limitations from Site Characteristics:

18. Has sludge been applied to land within last 5 years? Yes No (Circle One)
    Name of Generator
    Amount Applied
    Years Applied

SPECIFIC REQUIREMENTS FOR THE USE OF SLUDGE

The sludge that you are obtaining contains the following:

Plant Available Nitrogen (N)	% and/or	lbs. per dry ton
Phosphorus (PO)	% and/or	lbs. per dry ton
Soluble Potash (KO)	% and/or	lbs. per dry ton
Cadmium (Cd)		lbs. per dry ton
Copper (Cu)		lbs. per dry ton
Lead (Pb)		lbs. per dry ton
Manganese (Mn)		lbs. per dry ton
Nickel (NI)		lbs. per dry ton
Zinc (Zn)		lbs. per dry ton

To maximize the benefits of conditioning soils with sludge and minimizing possible adverse effects on the environment, it is required that the following provisions be adhered to:

1. Cropping and Access Restrictions:
   a. It is not recommended that leafy or root vegetables such as lettuce, Swiss chard, potatoes, horseradish, carrots, etc., be grown on sludge conditioned soil.
   b. Pasture or hay ground that has received sludge shall not be harvested or used for livestock grazing for one month or until precipitation of sufficient duration and intensity has occurred and washed all sludge from that area of the plant which can be injested by an animal, whichever is greater.
2. Climate Conditions:
   a. Sludge application shall not be permitted on land during precipitation.
   b. Sludge application shall not be permitted on land which is saturated or with ponded water.
   c. Sludge application should not be permitted upon sites when precipitation is imminent or which have received greater than 1/4 inch rainfall within the 24 hour period preceding the application time.
   d. Sludge application shall not be permitted on ice or snow covered ground. Frozen ground which is not ice or snow covered and has a slope of 5% or less may be used for winter spreading providing a 200 feet grassy area of forage crop exists between the sludge applied land and any surface water or water well.
3. Buffer Area Requirements
   a. Sludge shall not be applied on land which lies within 150 feet from wells or other water supplies and 200 feet from surface waters or within one-fourth of a mile of any potable

water supply well located in consolidated bedrock or sinkhole areas unless 50 feet of non-sandy or non-gravelly unconsolidated material exists.

b. Sludge application by incorporation or injection shall not be done closer than 20 feet from any occupied dwelling or 10 feet from the closest edge of traveled portions of a public road or outside roadway fence lines.

c. Top application of sludge with no immediate incorporation shall not be done closer than 200 feet from any occupied dwelling or 20 feet from the closest edge of traveled portions of a primary and secondary public roads or 10 feet from the closest edge of lesser utilized public roads or outside roadway fence lines.

d. Sludge application by ridge and furrow shall not be done closer than 200 feet from any occupied dwelling or the closest edge of traveled portions of a public road or outside roadway fence lines.

e. Sludge shall not be applied in waterways. Application to flood plains having a frequency of return more often than a ten-year frequency shall not be allowed.

4. Soil and Geologic Conditions:

a. Sludge applied land must have a soil pH of 6.5 or greater and cation exchange capacity of 5 or greater. Water treatment plant lime sludge may be used to raise the soil pH.

b. For sludge applied soils having the following infiltration rates/hour as determined by standard percolation tests, the listed minimum soil depth to the mean annual water table shall be adhered to:
Greater than 2 inches/hour -- 10 feet
Less than or equal to 2 inches/hour -- 5 feet

c. Sludge shall not be top applied (no incorporation) to farm land having greater than 5% slope. If the slope does exceed 5% top application can be used providing the annual soil loss, as calculated by the Universal Soil Loss Equation shall not exceed 5 tons/acre.

d. Sludge may be incorporated on lands having slopes up to eight percent, irrespective of soil loss. If the slope exceeds eight percent, incorporation methods may be used providing the annual soil loss does not exceed five tons per acre when applying the Universal Soil Loss Equation.

5. Interim Storage and Application Restrictions:

a. Off-site interim storage of liquid sludge prior to land application is not allowed.

b. Off-site interim storage of dried sludge in excess of 2 months is not allowed.

c. Annual sludge application shall not exceed the nitrogen agronomic rates for the crop grown nor exceed the rate for the most restrictive heavy metal for the site lifetime, whichever is more restrictive. Therefore, the maximum annual amount of sludge you can apply for your specific needs may not exceed dry tons/acre; gallons/acre (Circle One).

I hereby agree to adhere to the above conditions.

All blanks other than the above sign-off shall be filled in by the sludge generator.

Section 391.APPENDIX H Public Distribution Information Sheet

1. Date:
2. Name of User:
3. Address of User:
4. Phone Number of User:
5. Location Where Sludge is to be Used:
6. Size of Area Where Sludge is to be Used:
7. Proximity of Site to closest: (a) Stream or other body of water

   (b) Dwelling (c) Well
8. Amount of Sludge Obtained:
   (Specify units)
9. Describe Use(s) of Sludge (e.g., Garden, Yard, Horticultural, Reclamation of Nutrient Deficient Land, Other):

10. Manner in Which Sludge is to be Applied and Incorporated (e.g., Spread by Truck or dry applicator, by Hand, Worked into the Soil by Plowing, Rototilling, other):

Specific Requirements for Public Distribution Programs

The sludge that you are obtaining contains the following:

Plant Available Nitrogen (N) % and/or lbs. per dry ton
Phosphorus (PO) % and/or lbs. per dry ton
Cadmium (Cd) lbs. per dry ton and/or mg/kg (not to exceed 25 mg/kg)
Copper (Cu) lbs. per dry ton
Lead (Pd) lbs. per dry ton
Manganese (Mn) lbs. per dry ton
Nickel (Ni) lbs. per dry ton
Zinc (Zn) lbs. per dry ton

1. Sludge shall not be applied to sites used for growing of

commercial truck gardening vegetables grown and sold for direct human consumption. It is also not recommended that sludge be applied to sites for individual use that may grow leafy (lettuce, spinach, Swiss chard. etc.) or root vegetables (potatoes, carrots, radishes, etc.) unless the following conditions are met:

a. the sludge does not contain more than 10 mg Cd/kg (dry weight basis);
b. the sludge has been aged for approximately 3 years after digestion or stabilization;
c. all vegetables are thoroughly washed or cooked prior to consumption.

2. Sludge shall be uniformly spread on the land as soon as possible after transport to the application site.
3. Sludge shall not be applied on land:
   (1) during precipitation;
   (2) which is saturated or with ponded water.
4. Sludge should not be applied on land:
   (1) when precipitation is imminent;
   (2) which has received greater than 1/4 inch rainfall within the 24 hour period preceding the intended application time.
5. Sludge shall be incorporated as soon as possible after application to prevent odor emission and runoff potential. Sludge shall be incorporated within 48 hours or prior to any rainfall after application whichever is most restictive.
6. The application rate shall not exceed 10 dry tons/acre or inches in depth.
7. Sludge shall not be applied on land which lies within 150 feet from wells or other water supplies and 200 feet from surface waters or intermittent streams.
8. Wind direction and velocity, humidity and the day of the week shall also be considered prior to sludge transport and applications with respect to neighboring activities.
9. Sludge amended land shall not lie fallow, but shall be seeded and stabilized for plant growth as soon as possible after sludge application and incorporation.

I hereby agree to adhere to the above conditions.

Section 391.APPENDIX I Water Treatment Plant Sludge User Information Sheet

1. Date:
2. Name of User:

3. Address of User:
4. Phone Number of User:
5. Location Where Sludge is to be Used:
6. Size of Area Where Sludge is to be Used:
7. Proximity of Site to closest: (a) Stream or other body of water

   (b) Dwelling (c) Well
   (d) Other Water Supply, (describe)
8. Amount of Sludge Obtained:
   (Specify Units)
9. Describe Use(s) of Sludge (e.g. Farmland or Agricultural, Garden, Yard, Reclamation of Nutrient Deficient Land, Other):

10. Manner in Which Sludge is to be Applied (e.g. Spread by Truck or dry applicator, by Hand, Worked into the Soil by Plowing, Rototilling, Surface Application, Splash Plate, Knife injection, other):

11. Will Sludge be Stockpiled Before Application Yes No (Circle One)
12. Estimated Length of Time Sludge is to be Stockpiled:
13. Type and expected yield of crops to be grown on sludge conditioned land:

14. The soil type and pH of the land that I am applying sludge is:

15. Limitations from Site Characteristics:

16. Has sludge been applied to land within last 5 years? Yes No (Circle One)
    Name of Generator
    Amount Applied
    Years Applied

SPECIFIC REQUIREMENTS FOR THE USE OF WATER TREATMENT PLANT SLUDGE

The sludge that you are obtaining contains the following:

Calcium Carbonate Equivalent %
pH
Barium (Ba) lbs. per dry ton
Cadmium (Cd) lbs. per dry ton
Copper (Cu) lbs. per dry ton

Lead (Pb) lbs. per dry ton
Nickel (Ni) lbs. per dry ton
Selenium (Se) lbs. per dry ton
Zinc (Zn) lbs. per dry ton

To maximize the benefits of conditioning soils with sludge and minimizing possible adverse effects on the environment, it is required that the following provisions be adhered to:

1. Climate Conditions:
    a. Sludge application shall not be permitted on land during precipitation.
    b. Sludge application shall not be permitted on land which is saturated or with ponded water.
    c. Sludge application should not be permitted upon sites when precipitation is imminent or which have received greater than 1/4 inch rainfall within the 24 hour period preceding the application time.
    d. Sludge application shall not be permitted on ice or snow covered ground. Frozen ground which is not ice or snow covered and has a slope of 5% or less may be used for winter spreading providing a 200 feet grassy area or forage crop exists between the sludge applied land and any surface water or water well.
2. Buffer Area Requirements
    a. Sludge application by incorporation or injection shall not be done closer than 20 feet from any occupied dwelling or 10 feet from the closest edge of traveled portions of a public road or outside roadway fence lines.
    b. Surface application of sludge with no immediate incorporation shall not be done closer than 200 feet from any occupied dwelling or 20 feet from the closest edge of traveled portions of a primary and secondary public roads or 10 feet from the closest edge of lesser utilized public roads or outside roadway fence lines.
    c. Sludge shall not be applied in waterways. Application to flood plains having a frequency of return more often than a ten-year frequency shall not be allowed.
3. Soil and Geologic Conditions:
    a. Sludge shall not be top applied (no incorporation) to farm land having greater than 5% slope. If the slope does exceed 5% top application can be used providing the annual soil loss, as calculated by the Universal Soil Loss Equation shall not exceed 5 tons/acre.
    b. Sludge may be incorporated on lands having slopes up to eight percent, irrespective of soil loss. If the slope exceeds eight percent, incorporation methods may be used providing

the annual soil loss does not exceed five tons per acre when applying the Universal Soil Loss Equation.

4. Interim Storage and Application Restrictions:
   a. Off-site interim storage of liquid sludge to land application is not allowed.
   b. Off-site interim storage of dried sludge in excess of 2 months is not allowed.

I hereby agree to adhere to the above conditions.

All blanks other than the above sign-off shall be filled in by the sludge generator.