Chapter NR 110

SEWERAGE SYSTEMS

History: Chapter NR 110 as it existed on November 30, 1974 was repealed and a new chapter NR 110 was created effective December 1, 1974.

NR 110.01 Applicability. This chapter is applicable to all new or modified sewerage systems, excluding only industrial waste treatment facilities. This chapter also applies to sewerage systems employing land disposal of sewage effluent, except those systems defined as plumbing within the purview of s. 145.01 (1) (b), Stats.

Note: The authority to enact these rules is contained in ch. 144, Stats. Pursuant to s. 144.99 Stats., any person who violates this chapter shall forfeit not less than $10 nor more than $5,000 for each violation. Each day of continued violation is a separate offense.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74.

NR 110.03 Definitions. For purposes of this chapter:

(1) "Approved areawide waste treatment management plan" means a plan or element thereof developed pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 as amended by the Clean Water Act Amendments of 1977 (33 USC 1251 et seq.) and approved by the state of Wisconsin.

(2) "Approval" means the written approval of the department for any project requiring approval pursuant to s. 144.04, Stats., and s. NR 108.03.

(3) "ASCE" means the American society of civil engineers. Copies of ASCE publications referenced in this chapter are available for inspection at the offices of the department of natural resources, the secretary of state's office and the office of the revisor of statutes. ASCE publications may be obtained from the American Society of Civil Engineers, 345 East 47th Street, New York, N.Y. 10017.

(4) "ASTM" means the American Society for Testing and Materials. Copies of ASTM standards referenced in this chapter are available for inspection at the offices of the department of natural resources, the secretary of state's office and the office of the revisor of statutes. ASTM standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penn. 19103.

(5) "Average design flow" means the anticipated average daily wastewater discharge to a sewage treatment facility.

(6) "AWWA" means the American Water Works Association. Copies of AWWA standards referenced in this chapter are available for inspection at the offices of the department of natural resources, the secretary of state's office and the office of the revisor of statutes. AWWA standards may be obtained from the American Water Works Association, 6666 West Quincy Avenue, Denver, Colo. 80235.

(6m) "Bedrock" means the rocks that underlie soil material or where weathered in-place consolidated material larger than 2 millimeters in size is greater than 50% by volume.

(7) "Bypass or overflow" means the discharge of wastewater directly or indirectly to the waters of the state during dry or wet weather flow conditions caused by intentional or inadvertent diversion of all or a portion of the wastewater flow from a sewerage system.

(8) "Bypass or overflow structure" means the physical structures, hydraulic control mechanisms, and piping which allow a bypass or overflow to occur.

(9) "Controlled diversion" means the discharge of untreated or partially treated wastewater around the entire sewage treatment facility, or treatment processes therein, which is recombined with the treated effluent prior to the effluent sampling location.

(10) "Controlled diversion structure" means the physical structures, hydraulic control mechanisms, and piping which allow a controlled diversion to occur.

(11) "Cost-effective analysis" means a systematic comparison of alternative means of meeting state water quality standards, effluent limitations or other treatment standards in order to identify the alternative which will minimize the total resources costs over the planning period. These resources costs include monetary costs and environmental as well as other non-monetary costs.

(12) "Department" means the department of natural resources.

(12m) "Design management zone" or "DMZ" means a 3-dimentional area, bounded by a set horizontal distance from the application or containment area, as specfied in Table 4, ch. NR 140, and by variable vertical distance which extends from the land surface downward through all saturated formations.

Note: The size of the DMZ may be altered by the department based on the criteria in s. 140.22 (5).

(13) "Dry land access" means a sewage treatment facility service road which has a minimum elevation of at least one foot above the regional flood elevation.

(13e) "High groundwater level" means the higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

(13t) "Highest anticipated groundwater elevation" means the sum of the calculated mounding effects of the disposal discharge and the seasonal high groundwater level.

(14) "Excessive infiltration/inflow" means the quantities of infiltration/inflow which can be economically eliminated from a sewerage system by rehabilitation, as determined in a cost-effectiveness analysis that compares the cost of correcting the infiltration/inflow conditions to the total costs for transportation and treatment of the infiltration/inflow.

(14e) "Hydraulic application rate" means the average daily volume of effluent discharged to a designed acreage of the land application system during a calendar month or other period of time specified in a WPDES permit. The rate is calculated by dividing the total discharge volume for the month or period of time by the acreage of land and by the number of days in the month or period of time, usually expressed in units of gallons per acre per day. For overland flow systems, the hydraulic application rate is expressed as a flow rate per unit width of slope per day.

(14t) "Hydrogeologist" means a person who is a graduate of an accredited institution of higher education and who has sucessfully completed 30 semester hours or 45 quarter hours of course work in geology. At least 6 semester hours or 9 quarter hours of the geology course work must be in hydrogeology, geohydrology or groundwater geology. This person shall also have acquired through education and actual field experience the ability to direct the drilling of borings, and the installation and development of wells; describe and classify geology samples and evaluate and interpret geologic and hydrogeologic data in accordance with the requirements of chs. NR 110 and 206.

(15) "Industrial user" means:

(a) Any nongovernmental, nonresidential user of a municipally owned sewerage system which discharges more than the equivalent of 25,000 gallons per day (gpd) of sanitary wastes and which is identified in the Standard Industrial Classification Manual, 1972, United States Office Management and Budget, as amended and supplemented as of October 1, 1978 under one of the following divisions:

Division A. Agriculture, Forestry, and Fishing

Division B. Mining

Division D. Manufacturing

Division E. Transportation, Communications, Electric, Gas, and Sanitary Services

Division I. Services.

1. In determining the amount of a user's discharge, domestic wastes or discharges from sanitary conveniences may be excluded.

2. After applying the sanitary waste exclusion in subd. 1 above, discharges in the above divisions that have a volume exceeding 25,000 gpd or the weight of biochemical oxygen demand (BOD) or suspended solids (SS) equivalent to that weight found in 25,000 gpd of sanitary waste are considered industrial users. Sanitary wastes, for purposes of this calculation of equivalency, are the wastes discharged from residential users. The municipality shall, with the department's approval, define the strength of the residential waste discharges in terms of parameters including biochemical oxygen demand (BOD) and suspended solids (SS) per volume of flow as a minimum. Dischargers with a volume exceeding 25,000 gpd or the weight of BOD or SS equivalent to that weight found in 25,000 gpd of sanitary waste are considered as industrial users.

(b) Any nongovermental user of a municipally owned sewerage system which discharges wastewater to the sewerage system which contains toxic pollutants or poisonous solids, liquids, or gases in sufficient quantity either singly or by interaction with other wastes, to contaminate the sludge of any municipal system, or injure or interfere with any sewage treatment process, constitutes a hazard to humans or animals, creates a public nuisance, or creates any hazard in or has an adverse effect on the waters receiving any discharge from the treatment works;

(c) All commercial users of an individual system constructed with grant assistance under s. NR 128.07.

(16) "Infiltration" means water other than wastewater that enters a sewerage system (including sewer service connections) from the ground through such sources as defective pipes, pipe joints, connections, or manholes. Infiltration does not include, and is distinguished from, inflow.

(17) "Inflow" means water other than wastewater that enters a sewerage system (including sewer service connections) from sources such as roof leaders, cellar drains, yard drains, area drains, foundation drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters, or drainage. Inflow does not include, and is distinguished from, infiltration.

(18) "Interceptor sewer" means a sewer whose primary purpose is to transport wastewaters from collector sewers to a treatment facility.

(18m) "Intermediate sludge storage" means the storage of sludge for a period of more than 24 hours and no more than 3 months.

(19) "Lagoon" means those sewage treatment facilities where the wastewater or sludge containment structure is constructed primarily of earthern materials.

(19m) "Long-term sludge storage" means the storage of sludge for a period exceeding 3 months.

(20) "Maximum design flow" means the largest anticipated recurrent wastewater discharge to a sewage treatment facility.

(21) "Municipality" means any city, town, village, county, utility district, town sanitary district, public inland lake protection and rehabilitation district or metropolitan sewage district.

(22) "NEC" means the 1981 National Electrical Code. Copies of the National Electrical Code are available for inspection at the offices of the

department of natural resources, the secretary of state's office, and the office of the revisor of statutes. Copies may be obtained for personal use from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

(23) "Owner" means the state, county, town, town sanitary district, city, village, firm, company, institution, association, utility district, school district, metropolitan sewerage district, or individual owning or operating a sewerage system.

(24) "Peak design flow" means the largest anticipated infrequent wastewater discharge to a sewage treatment facility.

(25) "Planning area" means that area under study as part of a facilities plan.

(26) "Planning period" means the period over which sewerage system alternatives are evaluated for cost-effectiveness. The planning period begins with the initiation of the operation of the proposed facilities.

(27) "Reviewable project" means any construction or installation project for which department approval is required, pursuant to s. 144.04, Stats., including any new sewerage system; and, any improvements, extensions, or alterations of existing sewerage systems which may effect the quality or quantity of effluent or the location of any outfall.

(28) "Sewage collection system" means the common sanitary sewers within a sewerage system which are primarily installed to receive wastewaters directly from facilities which convey wastewater from individual structures or from private property, and which include service connection "Y" fittings designed for connection with those facilities. The facilities which convey wastewater from individual structures, from private property to the public sanitary sewer, or its equivalent, are specifically excluded from the definition of "sewerage collection system"; except that pumping units and pressurized lines for individual structures or groups of structures may be included as part of a "sewage collection system" when such units are cost effective and are owned and maintained by the sewerage system owner.

(29) "Sewage treatment facilities" means sewerage systems defined in sub. (30) exclusive of interceptor sewers and sewage collection systems.

(30) "Sewerage system" means all structures, conduits and pipes, by which sewage is collected, treated, and disposed of, except plumbing inside and in connection with buildings served, and service pipes, from building to street main.

(31) "Sewer service area" means that area served or anticipated to be served by a sewage collection system.

(31e) "Sludge storage" means the retention of sludge at a treatment plant or at an approved off-site facility.

(31t) "Short-term sludge storage" means the storage of sludge for a period of no more than 24 hours.

(32) "Staging period" means the period of time during which reserve capacity will be provided in the sewerage system for future domestic, commercial, and industrial flows.

(32m) "Water table observation well" means any groundwater monitoring well whose screen intersects the water, which is installed for the specific purpose of determining either the elevation of the water table or the physical, chemical, biological or radiological properties of groundwater at the water table, or both.

(33) "WPCF" means the Water Pollution Control Federation. Copies of WPCF publications referenced in this chapter are available for inspection at the offices of the department of natural resources, the secretary of state's office and the office of the revisor of statutes. WPCF publications may be obtained from the Water Pollution Control Federation, 2626 Pennsylvania Avenue, N.W., Washington, D.C. 20037.

(34) "WPDES permit" means the Wisconsin pollutant discharge elimination system permit issued by the department under ch. 147, Stats., for the discharge of pollutants.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. Register, December, 1978, No. 276, eff. 1-1-79; cr. (20), Register, August, 1981, No. 308, eff. 9-1-81; renum. (3) to (20) to be (11), (12), (14) to (18), (21), (23), (25) to (32) and (34) and am. (29) and (34), cr. (4) to (10), (13), (19), (20), (22), (24) and (33), Register, February, 1983, No. 326, eff. 3-1-83; cr. (6m), (12m), (13e), (13t), (14e), (14t), (18m), (19m), (31e), (31t) and (32m), am. (19), Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.04 Alternative requirements. (1) If the owner of a proposed reviewable project feels that compliance with the design requirements of this chapter is impracticable, the reasons therefor shall be fully communicated in writing to the department prior to the submission of final plans. This communication must set forth alternative requirements for which department approval is sought and all pertinent facts, data, reports and studies supporting the imposition of such alternative requirements.

(2) If the department determines that compliance with the design requirements of this chapter would be impracticable in specific cases, it may approve alternative requirements which, in its opinion, are in substantial compliance with the requirements of this chapter.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74.

NR 110.05 Sewer extensions. (1) PURPOSE. The purpose of this section is to insure that department approval of applications for sanitary sewer extensions are consistent with and enhance the policy of the state to restore and maintain the chemical, physical and biological integrity of its waters to protect public health, safeguard fish and aquatic life and scenic and ecological values and enhance the domestic, municipal, recreational, industrial, agricultural and other uses of water.

(2) DEFINITIONS. As used in this section:

(a) "Bypasses and overflows" means discharges of wastewater directly or indirectly to waters of the state during dry or wet weather flow conditions caused by the intentional or inadvertent diversion of all or a portion of the wastewater flow from a sewerage system.

(b) "Category 1 bypasses and overflows" means those bypasses and overflows that occur more frequently or under less severe circumstances than category 2 bypasses and overflows within the meaning of par. (c) of this subsection.

(c) "Category 2 bypasses and overflows" means those bypasses and overflows occurring under abnormal circumstances. They may include an inadvertent bypass or overflow resulting from equipment damage or temporary power interruption; a bypass or overflow necessary to prevent loss of life or severe property damage; or a bypass or overflow of excessive storm drainage or runoff resulting from a precipitation event having a probable frequency of once in 5 years or less. For the purposes of determining sewer extension eligibility in the case of combined sewer systems, the bypass or overflow frequency necessary to achieve compliance with the applicable requirements derived from an applicable state court-approved stipulation, order or judgment shall be used in lieu of the 5-year storm frequency when that frequency is less stringent than the 5-year storm frequency; and in all other cases the 5-year storm frequency is used. If there is no state court-approved stipulation, order or judgment applicable to a combined sewer system, then the bypass or overflow frequency necessary to achieve compliance with all applicable requirements of ch. 147, Stats., shall be used in lieu of the 5-year storm frequency when that frequency is less stringent than the 5-year storm frequency; and in all other cases, the 5-year storm frequency is used. When using the 5-year storm to define category 2 bypasses and overflows, other factors besides storm frequency shall be taken into account including local storm patterns, snow melt and snow cover, soil types and soil conditions, and frost depth.

(d) "Dry weather flow" means the total flow in the sewerage system, plus the total volume of all bypasses and overflows, which occurs in the absence of wet weather flow conditions, and includes infiltration resulting from seasonal high groundwater.

(e) "Sewer extension" means installation of a sewer or interceptor sewer or extension thereof to provide additional capacity for new development within the existing or proposed tributary area of the extension. Alterations or modifications of previously existing sewerage systems designed to replace inadequate existing structures, or installed because of inadequate hydraulic sewer capacity, which do not extend sanitary sewer service to previously unserved areas are not sewer extensions within the meaning of this paragraph.

(f) "Wet weather flow" means the total flow in the sewerage system, plus the total volume of all bypasses and overflows, which occurs during periods of precipitation or snowmelt, including but not limited to rain, sleet, snow, hail, melting snow, or stream flooding.

(g) "WPDES permits" means Wisconsin pollutant discharge elimination system permits issued by the department under ch. 147, Stats., for the discharge of pollutants.

(3) PERMISSIVE APPROVALS OF SEWER EXTENSION APPLICATIONS. (a) Unless an approval would be contrary to the purpose of this section, applications for sanitary sewer extensions shall be approved if the sewer will be tributary to:

1. A sewerage system which experiences no category 1 bypasses and overflows and

2. A sewage treatment plant which discharges an effluent in compliance with the monthly average effluent limitations for biochemical oxygen demand (BOD) and total suspended solids contained in ch. NR 210

or 214, or with any more stringent water quality related effluent limitations required to achieve applicable water quality standards derived

(b) *Interim treatment facilities.* An interim treatment facility is one which would serve areas which are within the future sewer service area of another existing facility as delineated in an approved areawide water quality management plan as provided for in ch. NR 121. Proposals for new interim treatment facilities may not be approved unless:

1. They are necessary to solve a documented and severe existing water quality (groundwater or surface water) or public health problem related to inadequate existing residential sewage disposal; or, are needed to replace an existing treatment facility which is not in compliance with its WPDES permit;

2. They are the cost-effective alternative solution in accordance with s. NR 110.09 (1) (a);

3. They are municipally owned, operated and maintained;

4. The sewage collection system is designed so that it can be easily connected to the regional system in the future;

5. The sewer service area of the proposed system lies entirely within the planned service area of the regional system as delineated in an approved areawide water quality management plan; and

6. An agreement is signed by all involved municipalities which provides for a specified date of abandonment and connection. This intermunicipal agreement may be reviewed and approved by the department prior to facilities plan approval. The WPDES permits may contain schedules for facilities abandonment and connection.

(c) *Treatment facilities serving isolated nonresidential development.* Nonresidential development includes things such as parks and recreational facilities, airports, highway oriented commercial facilities and institutions such as hospitals, nursing homes, prisons and schools. Proposals for new treatment facilities to serve nonresidential development may not be approved unless:

1. Joint treatment with other wastewater treatment systems is not feasible;

2. The proposed facilities are designed to treat only wastes generated by the proposed nonresidential development; and

3. The WPDES permit limits service to the proposed nonresidential development.

(d) *Treatment facilities to serve new residential development.* 1. Proposals for new treatment facilities intended to serve new residential development such as facilities for residential subdivisions, mobile home parks and condominium developments may be denied.

2. Variances to this general prohibition may be granted:

a. Only after the department has considered:

1) The general public interest;

2) Environmental impacts;

3) Socioeconomic impacts; and

4) The impact on orderly development and provision of general governmental services within the service area; and

b. Only after a finding that all of the following criteria are met:

1) The proposal is consistent with the department's responsibility to protect, maintain and improve the quality and management of the waters of the state;

2) The proposed facilities will be municipally owned, operated and maintained;

3) The proposed facilities will be more cost-effective in accordance with s. NR 110.09(1)(a) than other treatment and discharge alternatives; and

4) All other federal, state and local approvals and permits have been obtained.

(dm) *Treatment facilities to serve existing moblie home parks and condominium developments.* Proposals for new treatment facilities to serve existing residental developments at mobile home parks and condominium developments may not be approved unless:

1. The conditions of par. (a) are met; or

2. The conditions of par. (a) 1. and 2. are met and the owner submits the following:

a. Adequate proof that sufficient funds to operate, maintain and abandon the facility, if necessary, will be available for the life of the facility;

b. Documentation showing that the new treatment facilities are being proposed as a replacement of a failing septic tank/soil absorption system which has been in use for at least 10 years; and

c. Proof of the inability to form a town sanitary district or other appropriate municipal entity to oversee the facility.

(e) *Conformance with areawide water quality management plans.* In addition to the requirements of pars. (a) through (d), the new sewage treatment facilities shall also be in conformance with any approved areawide water quality management plan. These plans may be consistent with the criteria in pars. (a) through (d). These plans as approved by the department may also contain additional criteria necessary to address regional or local considerations.

(6) COST EFFECTIVENESS. A cost-effectiveness analysis shall be performed as part of the evaluation of alternatives in each facilities plan. The cost-effectiveness analysis shall be prepared in accordance with s. NR 110.09 (2). Except as provided for in s. NR 110.09 (2) (j) 4. c., the most cost-effective alternative shall be selected for implementation.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. Register, December, 1978, No. 276, eff. 1-1-79; cr. (5), Register, August, 1981, No. 308, eff. 9-1-81; am. (1) and (2), cr. (6), Register, February, 1983, No. 326. eff. 3-1-83; cr. (5) (dm), Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.09 Sewage treatment facilities projects. (1) FACILITIES PLANS FOR SEWAGE TREATMENT FACILITIES PROJECTS. (a) Facilities plans consist of those necessary plans and studies which directly relate to the construction of the proposed facilities. Facilities planning shall demonstrate

the need for the proposed facilities. Through a systematic evaluation of feasible alternatives facilities planning shall also demonstrate that the selected alternative is the most cost-effective means of meeting established effluent limitations and water quality standards. The most cost-effective alternative is that which will result in the minimum total resources costs over the planning period. The planning period of the facilities plan shall be 20 years. The total resources costs include monetary costs, environmental and social considerations, and other nonmonetary factors. The interest (discount) rate to be used in calculating present worth shall be obtained from the department when beginning facilities planning.

(b) Facilities planning shall include the following information in such detail as the department deems appropriate for the specific project:

1. A description of the sewerage system for which construction drawings and specifications are to be prepared. This description shall include preliminary engineering data, cost estimates for design and construction of the sewerage system, and a schedule for completion of design and construction. The preliminary engineering data shall include, to the extent appropriate, information such as a schematic flow diagram, unit processes, design data regarding detention times, flow rates, sizing of units, and so forth. This is commonly referred to as the Unit Equipment and Design Report.

2. A description of the selected complete sewerage system of which the proposed facilities will be a part using maps, diagrams and plans as appropriate. This description shall include:

a. The delineation of a sewer service area for the complete sewerage system based on a 20-year population projection and density assumptions;

b. A description of the collection system including existing and proposed trunk sewers and interceptors;

c. A description of the existing and proposed sewerage treatment system including ultimate disposal of wastewater and sludge;

d. A planning area map showing individual systems, if individual systems are to be a part of the cost-effective solution proposed for state or EPA funding.

3. Infiltration/inflow documentation in accordance with subs. (5) and (6).

4. A cost-effectiveness analysis of alternatives for the sewerage system prepared in accordance with sub. (2). The most cost-effective alternatives shall be selected for implementation in accordance with s. NR 110.08 (6).

5. For facilities plans for state funded projects, parallel cost estimates shall be provided for the facilities necessary to transport and/or treat the fundable capacity, as well as a cost estimate for the total proposed sewerage system.

Note: See NR 128.05 and 128.06 for requirements regarding fundable capacity for state funded projects.

6. An identification of effluent discharge limitations including water quality related effluent limitations, and where a Wisconsin Pollution Discharge Elimination System (WPDES) permit has been issued, a copy of the permit for the proposed sewerage system.

7. Required comments or approvals of relevent state, interstate, regional, and local agencies.

8. An estimate of the anticipated cost to the average user of the system. This cost shall be presented at the public hearing required under sub. (4).

9. A brief summary of the public hearing required under sub. (4) or any other public meeting or hearing held during the planning process including a summary of the views expressed.

10. A brief statement demonstrating that the authorities who will be implementing the plan have the necessary legal, financial, institutional, and managerial resources available to insure the construction, operation, and maintenance of the proposed treatment works.

11. A description of potential opportunities for recreation, open space, and access to bodies of water analyzed in planning the proposed sewerage system and the recommended actions. The facility plan shall also describe measures taken to coordinate with federal, state and local recreational programs and with recreational elements of applicable approved areawide waste treatment management plans.

(2) CONTENT OF THE COST-EFFECTIVENESS ANALYSIS. The cost-effectiveness analysis shall include:

(a) The relationship of the size and capacity of alternative systems to the needs to be served, including reserve capacity;

(b) An evaluation of alternative flow and waste reduction measures, including non-structural methods;

(c) An evaluation of improved effluent quality attainable by upgrading the operation and maintenance and efficiency of existing facilities as an alternative or supplement to construction of new facilities;

(d) An evaluation of the capability of each alternative to meet secondary treatment standards or applicable water quality related effluent limitations. The sewerage system design must be based upon achievement of not less than secondary treatment standards as defined by ch. NR 210;

(e) An identification of and provision for applying technologies included under each of the following waste treatment management techniques:

1. Biological or physical-chemical treatment and discharge to receiving waters;

2. Systems employing the reuse of wastewater and recycling of pollutants;

3. Land application techniques;

4. Systems including revenue generating applications; and

5. On-site and non-conventional systems.

(f) All construction of publicly-owned sewerage systems and privately owned domestic sewerage systems discharging to surface waters shall be based upon application of secondary treatment as a minimum. Where application of secondary treatment would not provide for attainment of water quality standards,the facilities plan shall provide for attaining the applicable standards by designing to meet appropriate water quality related effluent limitations. Sewerage systems discharging to the ground water shall comply with the applicable discharge requirements of ch. NR 214. The alternative of treating combined sewer overflows shall also be considered.

(g) An evaluation to determine the cost-effective means of disposing of treated effluent.

(h) An evaluation of the most cost-effective means of treating, handling, and disposing of sludge. This evaluation shall include at a minimum the following items:

1. A description of the current sludge treatment, handling and disposal operations including a discussion of current quantities being produced, a description of current sludge quality including a sludge analysis, a description of any problems associated with the existing operations, and a description of industrial contributions that may affect the quantity and quality of sludge;

2. An analysis of the anticipated quantity and quality of the sludge from the proposed facility;

3. A brief description of alternative technologies applicable to the proposed facility improvements, such as, thickening, stabilization, dewatering, storage, transportation, and ultimate disposal;

4. A cost-effectiveness analysis of the feasible alternatives including an assessment of the environmental impacts as specified in sub. (3);

5. An evaluation of the storage requirements either at the sewage treatment facility or at an offsite location. The evaluation shall include an estimate of the maximum period of time necessary to store sludge, and a description of the location, accessibility, soils, necessary local permits, depth to groundwater, distance to residential homes, type of facility, topography and any other appropriate information. The storage recommendations shall comply with s. NR 110.26 (10).

6. An estimate of the amount of land required for each alternative shall be made. Land requirements for landfilling of sludge shall be based upon accepted landfill design practices. Department approval in accordance with chs. NR 500 to 520, is required for construction of sludge landfills and prior to disposal of sludge at an existing licensed landfill.

7. A discussion of the procedures and timing for abandonment of the existing sludge facilities, if appropriate. This shall include, but not be limited to, the types of sludge wastes to be disposed of during abandonment, ultimate disposal location, possible construction scheduling, quantity of wastes, quality of wastes and any special problems associated with the disposal of these wastes; and

8. A summary describing the selected plan and its anticipated environmental impacts. Those actions necessary for implementing and operating the sludge management plan shall be presented. This shall include,

but not be limited to, the estimated sludge treatment and disposal costs, operator time, discussion of applicable federal and state laws, necessary local permits, public participation programs, training of operators and any other actions necessary to provide for an environmentally sound sludge management program.

(i) An adequate assessment of the expected environmental impacts of the alternatives (including sites) in accordance with sub. (3). This assessment shall be an integral part of the analysis of alternatives for cost-effectiveness. The assessment shall be revised as necessary to include information developed during subsequent project steps.

(j) An analysis of the most cost-effective design staging and sizing. The staging and sizing of treatment works shall be based upon the following:

1. Population projections. Population projections for facilities planning shall be in conformance with those contained in applicable approved areawide waste treatment management plans and rules adopted pursuant to ss. 16.96, 144.24(4)(b), Stats. If such projections are not available, the engineer shall project future population growth based on trends in the recent past.

2. Wastewater flow estimates. a. In determining total average daily flow for the design of sewerage systems, the flows to be considered include the average daily base flows (ADBF) expected from residential sources, commercial sources, institutional sources, and industries the system will serve plus allowances for future industries and nonexcessive infiltration/inflow.

b. The estimation of existing and future ADBF from combined residential, commercial, and institutional sources, shall be based upon one of the following methods:

i. Preferred method. Existing ADBF shall be estimated based upon a fully documented analysis of water use records adjusted for consumption and losses or on records of wastewater flows for extended dry periods less estimated dry weather infiltration. Future flows for the sewerage system design shall be estimated by determining the existing per capita flows, subtracting any projected per capita water conservation flow reduction and multiplying this figure by the future projected population to be served. Seasonal population can be converted to equivalent full-time residents using the following multipliers:

Day-use visitor (0.1-0.2).

Seasonal visitor (0.5-0.8).

The preferrred method shall be used wherever water supply records or wastewater flow data exist. Allowances for future increases of per capita flow over time will not be approved.

ii. Optional method. Where water supply and wastewater flow data are lacking, existing and future ADBF shall be estimated by multiplying a gallon per capita per day (gpcd) allowance not exceeding those in the following table by the estimated total of the existing and future resident populations to be served. The tabulated ADBF allowances include estimates for commercial and institutional sources as well as residential sources. The department may approve exceptions to the tabulated al-

lowances where large commercial and institutional flows (more than 25 percent of total estimated ADBF) are documented.

Description	Gallons per capita per day (gpcd)
Non-SMSA cities and towns with projected total 10-yr population of 5,000 or less ...	60-70
Other cities and towns	65-80

3. Industrial flows. a. The sewerage system total design flow capacity may include allowances for industrial flows. The allowances may include capacity needed for industrial flows which the existing sewerage system presently serves. However, these flows shall be carefully reviewed and means of reducing them shall be considered. Capacity needs for existing flows from industrial users and for future flows from all industries intending to increase their flows or relocate in the area must be documented.

b. While many uncertainties accompany forecasting future industrial flows, there is still a need to allow for some unforeseeable future industrial growth. Thus, design capacity of the treatment works may include (in addition to the existing industrial flows and future documented industrial flows) a nominal flow allowance for future nonidentifiable industries or for unplanned industrial expansions, provided that areawide waste treatment management plans, land-use plans and zoning provide for such industrial growth. This additional allowance for future unplanned industrial flow shall not normally exceed 5% (or 10% for towns with less than 10,000 population) of the total design flow of the treatment works exclusive of the allowance or 25% of the total industrial flow (existing plus documented future), whichever is greater.

4. Staging of sewage treatment facilities. For municipally owned projects the design capacity of new, upgraded or expanded sewage treatment facilities shall not exceed that necessary for wastewater flows projected during the initial staging period. Privately owned domestic waste treatment facilities shall provide design capacity for estimated flows 20 years from the estimated time of start-up of the facilities unless the cost-effectiveness staging analysis in par. (i)4. is done to justify a lesser design staging period. The staging period for municipally owned waste treatment facilities shall be determined by either of the following methods:

a. First method. The owner shall analyze at least three alternative staging periods (10 years, 15 years and 20 years) and the least costly (i.e., total present worth or average annual cost) staging period shall be selected.

b. Second method. The staging period shall not exceed the period which is appropriate according to the following table.

Staging Periods for Treatment Facilities

Flow Growth Factors (20 yrs)	Maximum Initial Staging Period
1. Design flow less than 1.3 times initial flow	20 years
2. Design flow 1.3 to 1.8 times initial flow	15 years
3. Design flow greater than 1.8 times initial flow.	10 years

c. A municipality may stage the construction of a treatment plant for a shorter period than the maximum allowed under this subdivision. A shorter staging period might be based upon environmental factors (secondary impacts, compliance with other environmental laws, energy conservation, water supply), an objective concerning planned modular construction, the utilization of temporary treatment plants, or attainment of consistency with locally adopted plans including comprehensive and capital improvement plans. However, the staging period may in no case be less than 10 years, because of associated cost penalties and the time necessary to plan and construct later stages.

(k) An evaluation of the costs, cost-savings, and effects of flow reduction measures unless the existing average daily base flow from the area is less than 70 gpcd, or the current population of the municipality is under 5,000, or the area is exempted by the department for having an effective existing flow reduction program. A flow reduction program shall be adopted by municipalities which shall include those measures determined to be cost effective.

(l) An analysis of innovative and alternative treatment processes and techniques that reclaim and reuse water, productively recycle wastewater constituents, eliminate the discharge of pollutants or recover energy. Where certain categories of alternative technologies may not be generally applicable because of prevailing climatic or geological conditions, a detailed analysis of these categories of alternative technologies is not required. However, the reason for such a rejection must be fully substantiated in the facilities plan.

(m) An analysis of the primary energy requirements (operational energy inputs) for each system considered. The alternative selected shall propose adoption of measures to reduce energy consumption or to increase recovery as long as such measures are cost effective.

(n) A flood analysis for the selected treatment facility site if the site is in, or suspected to be in, a floodplain. The analysis shall meet the requirements of s. NR 116.07. The analysis shall determine the limits of the floodplain and the floodway, the regional flood elevation, and the effects on floodstage of constructing the sewage treatment facility, including dry land access and flood protection. The flood velocities at the sewage treatment facility site, and the duration of the regional flood shall also be determined. If a dry land access waiver is requested in accordance with s. NR 110.15 (3) (c), the flood analysis shall also include the information necessary to support the request.

(o) An assessment of the location of the sewage treatment facilities relative to commercial establishments and to buildings which are occupied or intended for residential use, and from land which is being actively developed for commercial or residential use. The location of sewage treatment facilities shall comply with the provisions of s. NR 110.15 (3) (d).

(p) An assessment of the location of land disposal systems relative to public water supply wells. The location and horizontal separation from the proposed land disposal site and any public water supply well shall be shown. The assessment shall discuss the hydrogeologic conditions of the area, the direction of groundwater movement, the depth of the public well casing, and any other appropriate information. The department will determine whether the separation distance between the land disposal system and the public well is sufficient to protect the public health and quality of the public water supply.

(q) Soil boring logs if the selected treatment alternative includes lagoons or land disposal of effluent. The borings shall supply accurate information about the soil conditions, and groundwater and bedrock elevations at the proposed treatment facility site.

(r) Any facility plan which recommends the abandonment of a wastewater treatment, sludge or septage storage lagoon, or land disposal system shall include an abandonment plan. A plan outlining the proposed method of abandonment of the facility shall be submitted to the department for approval. This plan shall provide for the removal and proper disposal of any accumulated solid matter or liquid wastes and any relandscaping necessary to prevent accumulation of standing water or runoff within 2 years of the date from which wastewater, sludge or septage was last disposed. The department shall require groundwater monitoring for a minimum of one year at a quarterly frequency after the abandonment of facilities which have an existing groundwater monitoring system. Groundwater monitoring may be required on a case-by-case basis for facilities which do not have existing groundwater monitoring systems. The monitoring data shall be reviewed after 1 year and the department shall determine whether groundwater monitoring should be continued or not. Any groundwater monitoring wells which are no longer necessary shall be abandoned in accordance with ch. NR 141 and documentation of well abandonment shall be provided to the department.

(3) CONTENT OF AN ENVIRONMENTAL ASSESSMENT. An adequate environmental assessment must be an integral, though indentifiable, part of any facilities plan submitted to the department under sub. (1). The information submitted in the environmental assessment will be used by the department for determining whether or not an environmental impact statement is necessary. The analyses that constitute an adequate environmental assessment shall include:

(a) *Description of the existing environment without the project.* This shall include for the delineated planning area a description of the present environmental conditions relevant to the analysis of alternatives or determinations of the environmental impacts of the proposed action. This description shall include, but not be limited to, discussions of the following topics where applicable to a particular study: surface and ground water quality; water supply and use; general hydrology; air quality; noise levels; energy production and consumption; land use trends; population projections, wetlands, floodplains, coastal zones and other environmen-

tally sensitive areas; historic and archaeological sites; other related federal or state projects in the area; and plant and animal communities which may be affected, especially those containing threatened or endangered species.

(b) *Description of the future environment without the project.* The future environmental conditions with the no project alternative shall be forecast, covering the same areas listed in par. (a).

(c) *Evaluation of alternatives.* This discussion shall include a comparative analysis of feasible options and a systematic development of wastewater treatment alternatives. The alternatives shall be screened with respect to capital and operating costs; significant primary and secondary environmental effects; physical, legal or institutional constraints; and whether or not they meet regulatory requirements. Special attention should be given to long term impacts, irreversible impacts and induced impacts such a development. The reasons for rejecting any alternatives shall be presented in addition to any significant environmental benefits precluded by rejection of an alternative. The analysis should consider, when relevant to the project:

1. Flow and waste reduction measures, including infiltration/inflow reduction;

2. Alternative locations, capacities, and construction phasing of facilities;

3. Alternative waste management techniques, including treatment and discharge, wastewater reuse and land application;

4. Alternative methods for disposal of sludge and other residual waste, including process options and final disposal options;

5. Improving effluent quality through more efficient operation and maintenance;

(d) *Environmental impacts of the proposed action.* Primary and secondary impacts of the proposed action shall be described, giving special attention to unavoidable impacts, steps to mitigate adverse impacts, any irreversible or irretrievable commitments of resources to the project and the relationship between local short term uses of the environment and the maintenance and enhancement of long term productivity. The significance of land use impacts shall be evaluated, based on current population of the planning area; design year population for the service area; percentage of the service area currently vacant; and plans for staging facilities. Special attention should be given to induced changes in population patterns and growth, particularly if a project involves some degree of regionalization.

(e) *Steps to minimize adverse effects.* This section shall describe structural and nonstructural measures, if any, in the facilities plan to mitigate or eliminate significant adverse effects on the human and natural environments. Structural provisions include but are not limited to changes in facility design, size, and location; nonstructural provisions include but are not limited to staging facilities as well as developing and enforcing land use regulations and environmentally protective regulations.

(f) *Documentation.* Sources of information used to describe the existing environment and to assess future environmental impacts should be docu-

mented. In addition to the department, these sources should include regional, state and federal agencies with responsibility or interest in the types of impacts listed in par. (a). In particular, the following agencies should be consulted:

1. Local, and regional land use planning agencies and areawide waste treatment management planning agencies for assessments of land use trends and population projections, especially those affecting size, timing, and location of facilities;

2. The HUD Regional Office if a project involves a flood risk area identified under the Flood Disaster Protection Act of 1973 (Pub. L. 93-234);

3. The state coastal zone management agency, if a coastal zone is affected;

4. The secretary of the interior or secretary of agriculture, if a wild and scenic river is affected;

5. The secretary of the interior or secretary of commerce, if a threatened or endangered species is affected;

6. The fish and wildlife service (department of the interior), the department of commerce, and the U.S. army corps of engineers, if a wetland is affected.

(4) PUBLIC HEARING. Municipalities shall hold at least one public hearing before a facilities plan is adopted. A copy of the facilities plan should be available for public review before the hearing and at the hearing, since these hearings provide an opportunity for public comment on the issues associated with the facilities plan.

(5) CONTENT OF AN INFILTRATION/INFLOW ANALYSIS. (a) The infiltration/inflow analysis shall demonstrate whether or not excess infiltration/inflow exists in the sewer system. The analysis shall indentify the presence, flow rate, and type of infiltration/inflow conditions, which exists in the sewer systems.

(b) For determination of the possible existence of excessive infiltration/inflow, the analysis shall include an estimate of the cost of eliminating the infiltration/inflow conditions. These costs shall be compared with estimated total costs for transportation and treatment of the infiltration/inflow. This determination shall be made at several levels of infiltration/inflow removal.

(c) If the infiltration/inflow anaylsis demonstrates the existence or possible existence of excessive infiltration/inflow and the specific sources of excessive infiltration/inflow have not been adequately identified, a sewer system evaluation survey shall be conducted in accordance with sub. (6). A detailed plan for the sewer system evaluation survey shall be included in the infiltration/inflow analysis. The plan shall outline the tasks to be performed in the survey and their estimated costs.

(d) The department may waive the requirements of pars. (a) through (c) if the owner can demonstrate to the department's sastisfaction the obvious existence or nonexistence of excessive infiltration or inflow, or both. The information necessary for this demonstration may include infiltration and inflow estimates, per capita design flows, ratio of total flow to dry weather flow, cubic meters of infiltration per centimeter diameter per kilometer of pipe per day (gallons of infiltration per inch diameter per

mile per day), bypassing, and other hydrological and geological factors. The department may require the information be expanded to meet the requirements of pars. (a) through (c) if this demonstration is inconclusive.

(6) CONTENT OF A SEWER SYSTEM EVALUATION SURVEY. (a) The sewer system evaluation survey shall determine the location, estimated flow rate, method of rehabilitation and cost of rehabilitation versus cost of transportation and treatment for each defined source of infiltration/inflow.

(b) The report shall summarize the results of the sewer system evaluation survey. In addition, the report shall include:

1. A justification for each sewer section cleaned and internally inspected; and

2. A proposed rehabilitation program for the sewer system to eliminate all defined excessive infiltration/inflow.

(7) CONSTRUCTION PLANS AND SPECIFICATIONS FOR SEWAGE TREATMENT PLANT PROJECTS. In addition to the requirements of ch. NR 108 and ss. NR 110.06 and 110.07 above, the following requirements shall be adhered to for submission of plans for sewage treatment plants.

(a) *Overall plan.* A plan shall be submitted which shows the sewage treatment plant in relation to the remainder of the system. Sufficient topographic features shall be included to indicate its location with respect to streams and the point of discharge of treated effluent.

(b) *Layout.* A general layout plan shall be submitted which includes:

1. A contour map of the site;

2. The size and location of plant structures;

3. A schematic flow diagram indicating the various plant units;

4. Piping details including piping arrangements for bypassing individual units;

5. The materials handled and the direction of flow through each pipe;

6. The hydraulic profiles for sewage and sludge flows;

7. Soil conditions at the site.

(c) *Detailed plans.* Detailed construction plans shall be submitted which include:

1. The location, dimensions, elevations and details of all existing and proposed plant units;

2. The elevation of high and low water level in the receiving stream;

3. An adequate description of all features not covered in the specifications.

(8) ADDITIONAL FACILITY PLANNING REQUIREMENTS FOR LAND DISPOSAL SYSTEM ALTERNATIVES. (a) *General requirements.* In addition to the requirements of sub. (1), a report including a soil investigation and a hydrogeologic evaluation shall be submitted as part of the facilities plan

for a land disposal discharge alternative. The report shall detail the soil types, characteristics, variability and permeability, topography, groundwater conditions and quality, and other characteristics of the disposal site. Soil boring and test pit logs and soil analyses shall be provided. Wastewater characteristics which may influence the design of the disposal system shall also be discussed. Water supply quality, local groundwater use, and potential impacts of the facility on groundwater quality shall be included.

(b) *Hydrogeological investigation.* 1. A hydrogeological investigation shall be included as part of the facilities plan. The analysis of the hydrogeological information shall be done by a hydrogeologist, or other qualified person. The investigation shall include both regional and site-specific hydrogeological information.

Note: The skills and knowledge required of a hydrogeologist making submittals under this chapter include: the ability to apply hydrogeologic principles and practices to the siting, design and operation of land disposal systems; knowledge of contaminants associated with land disposal of wastewater, their transport mechanisms and fate in the environment; familiarity standards; and proficiency in the design of groundwater monitoring systems for defining the physical and chemical characteristics of groundwater flow. A soil scientist or other environmental scientist who can demonstrate the above skills and knowledge, as reflected in submittals made under this chapter, shall be deemed a "qualified person".

2. The following site-specific groundwater information shall be required as part of the facilities plan for land disposal facilities:

a. Depth to highest anticipated groundwater elevation.

b. Groundwater flow directions and rates of flow.

c. Vertical and horizontal gradients.

d. Groundwater quality.

e. Presence of groundwater divides and barriers.

f. Presence and extent of perched groundwater.

g. Mounding calculations.

(c) *Soil investigation.* The soil evaluation may be performed in conjunction with the hydrogeological evaluation; however, each evaluation shall be performed by a person who is qualified to perform the evaluation. The following site-specific soil information shall be submitted as a part of the facilities plan for land disposal systems;

1. Soil borings and sampling performed in accordance with ss. NR 110.24 (3) (d) and 110.24 (4) (d), and test pit analyses performed in accordance with s. NR 113.09 (8). The one boring per acre minimum of s. NR 110.24 (3) (d) 4. does not apply to spray irrigation, ridge and furrow, or overland flow systems. A soil analysis may be required on a case-by-case basis for land disposal systems. The USDA soil classification system shall be used for spray irrigation systems, ridge and furrow, and overland flow systems.

2. Soil descriptions, including soil profile, stratification, slope, soil moisture content, continuity, structure, texture, relative density and depth to groundwater and bedrock.

3. Soil analyses shall be performed on the zone of soil which will provide treatment of the wastewater. The department may require that the

analyses include any or all of the following: grain size analyses, hydrometer analyses, field and laboratory horizontal and vertical permeabilities, Atterberg limits, soil pH, cation exchange capacity, bulk density and relative density, porosity, soil nutrient content, and organic matter content.

Note: The following methods are recommended for the analyses required in s. NR 110.09 (8) (c) 1.:

1. Grain size analyses (sieve and hydrometer) - ASTM D422 (1972).

2. Field and laboratory vertical permeabilities (constant and vertical head) - ASTM D2434 (1974).

3. Atterberg limits (liquid and plastic limits) - ASTM D4318 (1984).

4. Soil pH, nutrient and organic matter content - "Wisconsin Procedures for Soil Testing, Plant Analysis and Feed and Forage Analysis", soil fertility series No. 6 (1987), Department of Soil Sciences, University of Wisconsin - extension (Madison) or ASA-SSSA, "Methods of Soil Analysis; part 2, Chemical and Microbiological Properties" - agronomy monograph No. 9 - 2nd edition (1982).

5. Cation exchange capacity - ASA-SSSA, "Methods of Soil Analysis; part 2, "Chemical and Microbiological Properties" - agronomy monograph no. 9 - 22nd edition (1982).

6. Bulk density - ASA-SSSA, "Methods of Soil Analysis; part 2, Physical and Mineralogical Methods" - agronomy monograph no. 9 - 2nd edition (1982).

7. Porosity - volume calculation.

4. In-field infiltration rates (measured at the proposed elevation of application).

5. A description of the soil testing methods used.

6. Depth to bedrock.

7. Type and nature of bedrock.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. Register December, 1978, No. 276, eff. 1-1-79; am. (1) (b) 4. and (2) (h), cr. (2) (n) to (q) and (5) (d), Register, February, 1983, No. 326, eff. 3-1-83, am. (2) (h) 5. and 6., cr. (2) (r) and (8), Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.10 Sewage collection system projects. (1) FACILITIES PLANS FOR SEWER PROJECTS. For sewer projects the facilities plan shall include the following information:

(a) *Description.* A brief description of the project; including its geographic location and any necessary reference maps or exhibits;

(b) *Topography.* A brief description of the topography of the general area with specific reference to the area serviced by the proposed sewer;

(c) *Soil investigations.* A description of the extent of soil investigations, including information on rock likely to be encountered. In addition, that portion of the proposed sewer which is below high ground water level shall be indicated;

(d) *Flooding.* A designation of any portion of the proposed sewer which is located within the floodway or floodplain as defined in ch. NR 116. All projects shall conform to the requirements of ch. NR 116;

(e) *Wetlands.* A statement indicating whether the proposed sewer will pass through a wetlands area, and the approximate acreage of the wetland;

(f) *Population.* Population growth rate (annual) based on the most recent data for the municipality;

(g) *Sewer service area.* If the sewer project is tributary to a treatment plant for which a service area that has been delineated as a part of an approved areawide waste treatment management plan, indicate the location of the sewer on a map of the service area;

(h) *Downstream overflows.* A statement indicating the number and location of overflows and bypasses in the sewer system;

(i) *Description of treatment facilities.* A brief description of the type of treatment facility indicating the ability of the facility to handle the sewage of the proposed project during both wet and dry weather conditions;

(j) *Costs.* A discussion of the estimated capital costs and where an entire sewerage system is being installed, the estimated annual cost to the user of the system;

(k) *Basis of design.* The following data shall be provided for the proposed project:

1. Design period;

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facility unless the cost-effective staging analysis in s. NR 110.09 (2) (j)4. justifies a lesser design staging period.

(b) *Organic loading.* 1. The domestic design biochemical oxygen demand and suspended solids loading for upgrading or expanding existing sewage treatment facilities, or for the construction of new sewage treatment facilities to replace an existing facility shall be based on actual sewage and operating records from the existing facilities. The design shall include an appropriate growth increment.

2. When actual operating data is not available, the design loading shall be based on a contribution of 0.08 kilograms (0.17 pounds) of biochemical oxygen demand per capita per day and 0.09 kilograms (0.20 pounds) of suspended solids per capita per day. When garbage grinders are used in areas tributary to a sewage treatment facility, the design basis shall be increased to 0.10 kilograms (0.22 pounds) of biochemical oxygen demand per capita per day, and 0.22 kilograms (0.25 pounds) of suspended solids per capita per day.

3. Sewage treatment facilities which will receive industrial or commercial wastewater shall be designed to include these waste flows.

(c) *Hydraulic loading.* The design wastewater flow rate shall be estimated in accordance with s. NR 110.09 (2) (j). When flow or water use records do not exist, the maximum design flow rate shall be estimated by multiplying the average design flow rate by the appropriate peaking factor shown in Table 2.

Table 2

COMMUNITY SIZE (population)	PEAKING FACTOR
Under 1,000	4 - 5
1,000 - 10,000	3.0 - 3.5
10,000 - 100,000	2.0 - 2.5
Over 100,000	1.5 - 2.0

(d) *Sludge storage.* Adequate sludge storage shall be provided as indicated in ss. NR 110.09 (2) (h) 5 and 110.26 (10).

(5) DESIGN FEATURES. (a) *Design of conduits.* All piping and channels shall be designed to carry the peak design flow rate. The incoming sewer should be designed for unrestricted flow. Bottom corners of the channels must be filleted. Conduits shall be designed to avoid creation of pockets and corners where solids can accumulate. Suitable gates shall be placed in channels to seal off unused sections in which solids might accumulate. The use of shear gates or stop planks may be used in place of gate valves or sluice gates.

(b) *Arrangement of units.* Component parts of the facility shall be arranged for greatest operating and maintenance convenience, flexibility, economy, continuity of effluent quality, and ease of installation of future units.

(c) *Flow measurement.* Equipment for flow measurement and recording shall be provided for the total waste flow. Equipment for measuring flow streams within the treatment facility should be provided to aid facility operation.

(d) *Emergency operation.* One of the following provisions shall be made to insure continued operation of the sewage treatment facility in accordance with sub. (2) (d).

1. An emergency power generator may be provided. The generator shall have sufficient generating capacity to meet the treatment facility power demands needed to comply with sub. (2) (d); or

2. The sewage treatment facility electrical system may be connected to 2 independent electrical transmission routes which receive power from the same electrical grid network which supplies power to the treatment facility service area; or

3. The sewage treatment facility may be equipped with holding facilities which have a capacity to detain the maximum daily design flow for a minimum period of 24 hours.

(e) *New processes, methods and equipment.* The department encourages the development of new process, methods, or equipment for the treatment of sewage. However, where new processes, methods, or equipment are proposed and where limited data is available which demonstrates the performance of the equipment, the department may require written certification that the use or design of the equipment is in accordance with the manufacturer's guidelines. Furthermore, the department may require the posting of a performance bond by the manufacturer.

(f) *Disinfection.* Disinfection shall be provided in accordance with WPDES permit requirements.

(g) *Unit bypasses.* Unit bypasses shall be located and arranged to allow for proper maintenance of the treatment facility while complying with the provisions of sub. (2) (c). In all cases, it must be possible for each treatment unit to be independently removed from service.

(h) *Total treatment facility bypasses.* Total treatment facility bypasses may be permitted in accordance with sub. (2) (e). Design of treatment facility bypass structures shall meet the following requirements:

1. Design of a treatment facility bypass structure shall require the deliberate and conscious effort of the treatment facility operator to place the bypass into operation. Automatic bypasses are prohibited.

2. Bypass structures shall be used to conduct only those wastewater flows above the peak flow rate which the treatment plant can safely handle without threatening loss of life, severe property damage, or the washout of treatment media.

3. The means for measuring and sampling bypassed sewage shall be provided at all bypass structures.

(i) *Painting.* 1. The use of paints containing lead is prohibited. In order to facilitate the identification of piping, pipes shall be painted as follows:

a. Sludge line—brown;

b. Gas line—orange;

c. Potable water line—blue;

d. Chlorine line—yellow;

e. Sewage line—gray;

f. Compressed air line—green;

g. Nonpotable water line—blue with 15 centimeter (6 inch) red bands spaced 76 centimeters (30 inches) apart.

2. In addition to the color code, each pipe shall be adequately labeled with a minimum of 2 labels in each room, crawl space or compartment.

3. Existing treatment facilities which do not comply with the provisions of this subsection shall bring the facility into compliance at the time of any major upgrading or expansion of the facility.

(j) *Valve identification.* All valves shall be identified in the plans and specifications and labeled during construction.

(k) *Operational considerations.* All necessary tools and accessories for the facility operator's use shall be provided. Storage space and a work area shall also be provided. All equipment shall be located as to provide sufficient clearance for proper and convenient maintenance. All tanks, wet wells, channels and pipe systems shall be equipped with drains, valves, or sumps to facilitate draining for maintenance and repair.

(l) *Laboratory space and equipment.* A treatment facility owner shall either include a laboratory for making the necessary analytical determinations and operating control tests, or contract with a neighboring facility or independent laboratory to have the analytical and operating control tests done.

(m) *Floor slope.* Floor surfaces shall be sloped adequately to a point of drainage.

(n) *Erosion control during construction.* Effective site erosion control shall be provided during construction. Project specifications shall detail erosion control methods. Manner of spoil material disposal shall also be detailed.

(o) *Construction materials.* Materials shall be selected that are compatible with the wastewater characteristics. Dissimilar metals should be avoided to minimize galvanic action.

(p) *Sanitary facilities.* Toilet, shower, lavatory, and locker facilities should be provided in sufficient numbers and convenient locations to serve the expected facility personnel. Toilet, shower, and lavatory facilities shall be provided in the following instances:

1. Any sewage treatment facility equipped with laboratory facilities;

2. Any sewage treatment facility equipped with a potable water supply; or

3. Any sewage treatment facility which has one or more full time operating personnel.

(q) *Safety.* 1. Sewage treatment facilities shall be enclosed with a fence to discourage entry of animals or unauthorized persons.

2. Hand rails shall be installed around all treatment tanks and in other areas of the facility where the potential of falling exists.

3. The department recommends the following safety measure be considered in the design of wastewater treatment facilities:

a. Provision of first aid equipment;

b. Posting of "No Smoking" signs in hazardous areas;

c. Provision of protective clothing and equipment such as gas masks, goggles, gloves, hard hats, and safety harness;

d. Portable blower and hose;

e. Portable lighting equipment; and

f. Nonpotable water supply bibs which are labeled.

4. The safety and health rules set forth in ch. Ind. 1000, and appropriate federal and local safety codes shall be adhered to in the operation of wastewater treatment plants.

5. Specific safety requirements for hazardous chemical handling are found in s. NR 110.22 (4).

6. Specific safety requirements for chlorination facilities are found in s. NR 110.23 (2) (g).

(6) WATER SUPPLY. (a) *Potable supply.* Any sewage treatment facility which has a laboratory shall be provided with a potable water supply.

(b) *Plumbing.* Sewage treatment facility plumbing systems shall be designed in accordance with ch. ILHR 82.

(c) *Connection to public water systems.* Connection of a sewage treatment facility plumbing system to a public water system shall comply with the requirements of s. NR 111.25 and ch. ILHR 82.

(d) *On-site wells.* Construction of wells for supplying water to a sewage treatment facility shall comply with the requirements of the approval obtained under s. NR 112.26 (3).

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. (1) (c), Register, March, 1978, No. 267, eff. 4-1-78; r. and recr. Register, February, 1983, No. 326, eff. 3-1-83; cr. (4) (d), Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.16 Screening devices. (1) GENERAL DESIGN CONSIDERATIONS. (a) *Applicability.* All wastewater treatment plants shall be provided with protection for pumps and other equipment by installing coarse screens, bar racks, mechanically cleaned bar racks or comminutors.

(b) *Location.* 1. Screening devices installed in a building where other equipment or offices are located shall be separated from the rest of the building and provided with separate outside entrances.

2. Screening devices shall be provided with convenient access.

3. Screening devices may not be located such that changes in backwater elevations will interfere with the accuracy of upstream flow measuring equipment.

(c) *Ventilation.* Screening areas shall be ventilated.

(d) *Channels.* 1. The channel preceding and following the screen shall be shaped to minimize settling of solids. Fillets shall be installed as necessary.

2. The screen channel invert must be at least 8 centimeters (3 inches) below the invert of the incoming sewer.

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capacity, and be compatible with the units used by the fire department having jurisdiction over the plant.

2. A plastic bottle of ammonium hydroxide shall be provided for the detection of chlorine leaks.

3. Leak repair kits shall be provided when one ton chlorine cylinders are used.

(3) ULTRAVIOLET DISINFECTION. Provisions shall be made to clean ultraviolet units without loss of disinfection. This shall be accomplished by installing multiple ultraviolet units, by providing ultrasonic cleaners, or by providing an effluent holding tank with a capacity of one hour detention at average design flow.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. Register, March, 1978, No. 267, eff. 4-1-78; r. and recr. Register, February, 1983, No. 326, eff. 3-1-83.

NR 110.24 Lagoons. (1) DESIGN REPORT. A design report shall be submitted in accordance with s. NR 110.15 (1).

(2) BASIS OF DESIGN. (a) *Number of cells.* A minimum of 2 treatment cells shall be provided for aerated lagoons and stablilization ponds. Where a controlled discharge is required, additional effluent storage cells shall be provided.

1. For aerated lagoons designed to treat domestic wastewater only, the hydraulic detention time of each cell shall be based on the following formula:

$$T = \frac{E}{K\,(100\text{-}E)}$$

Where:

T = detention time, days

E = BOD removal efficiency, percent

K = Reaction coefficient (log base e), $days^{-1}$

a. For domestic wastewater K = 0.5 at 20°C.

b. The reaction coefficient (K) must be adjusted for temperature according to the formula:

$$K_T = K_{20}\theta^{T-20}$$

Where:

K_T = Corrected reaction coefficient

K_{20} = 0.5

θ = 1.07

T = Low design temperature, °C

2. The appropriate summertime and wintertime reaction coefficients for aerated lagoons designed to treat combined domestic and industrial wastewater shall be determined from laboratory or pilot studies, or from operating data of existing full scale aerated lagoons which are treating

similar wastewater. The reaction coefficients developed shall be used to calculate the required detention time.

3. In addition to the treatment volume calculated in subd. 1. or 2., quiescent settling zone or cell shall be provided for aerated lagoon systems. Minimum settling time shall be 6 days for surface water discharge, and 3 days for land disposal discharge.

4. Aerated lagoons designed to treat combined domestic and industrial wastewater shall be provided with the means to recirculate final lagoon effluent to the first treatment cell.

(b) *Stabilization ponds.* 1. Stabilization ponds may be used to treat domestic wastewater. Combined domestic and industrial wastewater may be treated in stabilization ponds only if the treatability of the industrial wastewater is demonstrated through pilot testing.

2. Pond design for BOD_5 loading may not exceed 23 kilograms per hectare (20 pounds per acre) per day.

3. A minimum hydraulic detention time of 150 days shall be provided.

(3) DESIGN REQUIREMENTS. (a) *Location.* Lagoon systems shall be located in compliance with s. NR 110.15 (3) (b) and (c).

(b) *Separation from groundwater.* 1. For all lagoons not sealed with a synthetic liner, a minimum separation distance of 1.25 meters (4 feet) shall be maintained between the bottom of lagoons and the highest recorded or indicated seasonal groundwater table elevation.

2. For all lagoons sealed with a synthetic liner, a minimum separation distance of 60 centimeters (2 feet) shall be maintained between the bottom of the lagoon and the highest recorded or indicated seasonal groundwater table elevation.

(c) *Separation from bedrock.* A minimum separation of 3 meters (10 feet) shall be maintained between the bottom of lagoons and bedrock. The department may waive this requirement on a case-by-case basis if it can be demonstrated that a lesser separation distance will not cause groundwater quality problems. Criteria which will be evaluated to waive this requirement include the depth to bedrock, the type of bedrock, the fracture condition of the bedrock, the direction of groundwater movement, the existing groundwater quality, and the downgradient uses of the groundwater.

(d) *Test pits and soil borings.* 1. Backhoe test pits and soil borings shall be conducted at each proposed lagoon site. Logs of the test pits and soil borings shall be submitted with the facilities plan as required in s. NR 110.09 (8) (a). Soil boring and test pit analyses shall be conducted by an independent soil testing laboratory, a qualified engineering firm or an individual or firm which has demonstrated the capability to perform and evaluate such tests.

2. Soil borings and test pits shall be used to determine subsurface soil characteristics and variability, seasonal high groundwater level and elevations, and type, nature and depth to bedrock. Soils shall be classified according to the unified soil classification system. Cross-sections using the soil boring and test pit logs shall be prepared and submitted with the facilities plan.

3. Soil sampling shall be performed in accordance with ASTM D1586 (1974) or ASTM D1587 (1974).

4. Soil profile descriptions shall be written for all soil test pits. The thickness in inches and the difference between each soil horizon shall be indicated for each test pit. Horizons shall be differentiated on the basis of color, texture, soil mottles or bedrock. Depth shall be measured from the ground surface and the slope at the test pit shall be indicated.

5. A minimum of one soil boring per acre shall be conducted at each lagoon site. The number of test pits and borings shall be sufficient to adequately characterize the soil type and variability and delineate unsuitable soil areas in the field. The department may require additional soil borings and test pits to properly describe the site soils, bedrock or groundwater conditions.

6. Each boring shall have a minimum depth of 7.6 meters (25 feet) or to bedrock.

7. All soil borings in which wells are not installed shall be properly abandoned according to s. NR 141.25.

8. All test pits shall be refilled with the excavated materials.

(e) *Lagoon shape.* The shape of lagoons shall be such that there are no narrow or elongated portions. Islands, peninsulas or coves will not be approved. Dikes shall be rounded at corners to minimize accumulations of floating materials. Commonwall dike construction is encouraged. Round, square or rectangular lagoons with a length not exceeding 3 times the width are recommended.

(f) *Dikes.* 1. The minimum top width of dikes shall be 3.6 meters (12 feet).

2. Maximum dike slopes shall be 3:1 (horizontal to vertical).

3. The minimum allowable interior slope shall be 4:1.

4. A minimum one meter (3 feet) freeboard from operating water surface to the top of dikes shall be provided.

(g) *Operating water depth.* 1. A minimum liquid depth of 0.6 meters (2 feet) for stabilization ponds and 1.8 meters (6 feet) for aerated lagoons shall be provided.

2. Maximum water depth may not exceed 1.8 meters (6 feet) for stabilization ponds and 4.3 meters (15 feet) for aerated lagoons.

(4) SEALING REQUIREMENTS. (a) *General.* All lagoons shall be sealed to prevent excessive exfiltration.

(b) *Exfiltration rate.* 1. Loss of water from wastewater treatment or storage lagoons may not exceed 10 cubic meters per water surface hectare (1,000 gallons per acre) per day and loss of water from sludge storage or treatment lagoons or other sludge handling facilities may not exceed 5 cubic meters per sludge surface hectare (500 gallons per acre) per day.

2. In circumstances where soil or groundwater characteristics, groundwater quality, or waste characteristics warrant, the department may require exfiltration rates less than 10 cubic meters per water surface hec-

tare (1,000 gallons per acre) per day for wastewater treatment or storage lagoons.

(c) *Materials.* 1. Soil materials or synthetic liners approved by the department may be used to seal lagoons.

2. Soil materials or synthetic liners used to seal lagoons shall be compatible with the wastewater characteristics.

(d) *Sampling and testing standards.* 1. Core samples taken to determine soil texture, grain size distribution or permeability shall be taken in accordance with ASTM D1586 (1974), ASTM D1587 (1974), or ASTM D 3550 (1977).

2. Permeability shall be determined using a falling head permeability test. The test shall be performed at the same approximate density as the in-place field condition. Tests on remolded or undisturbed samples are acceptable.

3. Sieve analyses performed to determine grain size distribution shall be performed in accordance with ASTM D422 (1972).

4. Plasticity index shall be determined in accordance with ASTM D424 (1971).

5. Standard proctor densities shall be determined in accordance with ASTM D698 (1978).

(e) *Uniform construction.* All lagoon seals shall be uniformly constructed across the lagoon bottom and interior dike walls. Seals shall extend up the dike wall to the berm.

(f) *Synthetic liners.* 1. Synthetic liners shall have a minimum thickness of 0.8 millimeters (30 mils).

2. All synthetic liners shall be installed under the supervision of a qualified manufacturer's representative.

3. Synthetic liners shall be protected by an inorganic soil layer. The soil layer shall have a minimum thickness of 30 centimeters (one foot). The soil shall be uniformly graded and free from large rocks, angular stones, soil clumps, sticks or other material which may puncture the liner. When a granular, noncohesive soil is used for the cover, a soil fabric shall be placed between the liner and the soil cover. The soil fabric shall be anchored at the dike berm.

4. Synthetic liners shall be securely anchored to the dike berm.

5. Synthetic liners shall be vented.

6. Riprap or other means of erosion control shall be provided to prevent exposure of the synthetic liner due to erosion of the protective soil layer.

7. Prior to constructing the synthetic liner, the underlying soils shall be treated with a herbicide in accordance with manufacturers recommendations.

(g) *Soil or soil-bentonite liners.* 1. The permeability of soil or bentonite liners may not be greater than 1×10^{-7} cm/sec. (2.83×10^{-4} ft/day).

2. The liner thickness shall be determined according to Darcy's equation, and shall include an appropriate safety factor for construction variability. In no case shall the liner thickness be less than the minimum values shown in Table 7.

3. When the soil or soil-bentonite liner is to be constructed over the existing soil at the lagoon site, 15% of the soil particles of the existing soil must pass a no. 200 sieve If this requirement cannot be met, a soil filter fabric material shall be placed between the liner and the existing soil.

4. Liners shall be compacted at or above optimum moisture content.

5. A means shall be provided to prevent the liner from desiccating after the completion of construction and prior to placing the system in operation.

6. Liners shall be protected by an inorganic soil layer. The soil layer shall have a minimum thickness of 10 centimeters (4 inches). The cover shall be uniformly graded and free from large rocks, soil clumps, and sticks.

Table 7

MINIMUM LINER THICKNESS

Coefficient of Permeability cm/sec (ft/day)	Centimeters (Inches)		Water Depth Meters (feet)	
	1.8 (6)	3 (10)	3.8 (12)	4.6 (15)
1×10^{-7} (2.83×10^{-4})	22 cm (9 in)	33 cm (13 in)	40 cm (16 in)	48 cm (19 in)
5×10^{-8} (1.42×10^{-4})	14 (6)	19 (8)	23 (8)	27 (11)
1×10^{-8} (2.83×10^{-5})	10 (4)	10 (4)	10 (4)	10 (4)
5×10^{-9} (1.42×10^{-5})	10 (4)	10 (4)	10 (4)	10 (4)
1×10^{-9} (2.83×10^{-6})	10 (4)	10 (4)	10 (4)	10 (4)

(h) *Soil liner material specifications.* 1. Soil liners shall consist of soils of which more than 50% of the soil particles pass a no. 200 sieve. The soil liner shall have a plasticity index of at least 15.

2. Soil liners shall be compacted to at least 95% of the maximum standard proctor density.

3. Soil liners shall be constructed and compacted in lifts. Each lift may not exceed a compacted thickness of 15 centimeters (6 inches).

4. Frost susceptible soils may not be used to construct the liner. Any soil which is primarily silt, silty sand, or lean clay which has a plasticity index less than 12 shall be considered as frost susceptible.

5. Soil liners constructed of natural in-place soils shall be scarified prior to compaction.

(i) *Bentonite liner material specifications.* 1. Bentonite shall be mixed with a soil in which at least 30% of the soil particles pass a no. 200 sieve. The soil shall have a plasticity index of at least 15.

2. Bentonite shall be applied at a rate recommended by the manufacturer or independent soil expert. The constructed liner shall have a minimum bentonite content of 5% by dry weight.

3. Ninety percent of the bentonite by weight shall pass a no. 80 sieve.

4. Bentonite shall be thoroughly mixed with the soil material.

5. The bentonite liner shall be compacted to at least 85% of the maximum standard proctor density.

(j) *Construction quality testing.* 1. All liners shall be tested before placing the lagoons into operation to insure compliance with par. (b). Test results shall be submitted to the department.

2. The method of testing shall be presented to the department with the project plans and specifications.

3. Testing shall be performed in accordance with one of the testing methods of par. (k).

4. All tests shall be performed under the supervision of the design engineer.

(k) *Testing methods.* 1. All liners may be tested using an in-field full lagoon water balance. The test shall occur over a minimum 14-day period. The manner of determining precipitation and evaporation rates shall be shown in the project plans and specifications.

2. The integrity of the field constructed seams for synthetic liners shall be tested with compressed air prior to placing the protective soil cover. All faulty seams shall be repaired and retested.

3. Core samples of soil or soil-bentonite liners may be taken and the liner thickness and permeability measured in a laboratory. Core samples shall be taken in accordance with ASTM D1587 (1974). A minimum of 12 samples per wetted hectare (5 samples per wetted acre) must be analyzed. The samples shall be proportionately taken from the lagoon bottoms and dikes. The lagoon liner shall be considered to meet the performance standard of par. (b) if:

a. The average seal thickness of the samples are equal or to greater than the specified design thickness. No sample shall have a thickness more than 1-inch less than the design thickness; and

b. The coefficient of permeability of 90% of the samples must be equal to or less than the design coefficient of permeability.

(5) CONSTRUCTION DETAILS. (a) *Material.* 1. Embankments and dikes shall be constructed of relatively impervious materials and compacted at near optimum moisture content to 95% of the standard proctor density.

2. Vegetation and other unsuitable materials shall be removed from the area where the embankment is to be placed.

(b) *Erosion control.* 1. Riprap or other means of preventing erosion shall be used at locations on lagoon bottoms and interior dike walls where erosion or activity of burrowing animals is likely to occur.

2. Riprap or other erosion control methods shall be used on the exterior dike walls for lagoons which are constructed in a flood fringe.

3. Exterior dike walls, berms and interior dike walls above the normal operating water depth, shall be riprapped or seeded with perennial, low growing, spreading grasses.

(c) *Fencing.* Lagoons shall be enclosed within a fence. A vehicle access gate shall be provided.

(d) *Warning signs.* Appropriate signs shall be provided along the fence surrounding lagoons to designate the nature of the facility and prohibit trespassing.

(6) AERATION EQUIPMENT. (a) *Air requirements.* Air shall be provided to the aerated lagoons at a rate of not less than 1.5 kilograms oxygen per kilogram (1.5 pounds of oxygen per pound) of BOD removed.

(b) *Surface aeration equipment.* 1. The department may approve the use of surface aeration equipment only in those cases in which the equipment can be properly maintained and operated during the winter.

2. Surface aeration equipment shall be so designed and placed to provide optimum mixing of pond lagoon contents and dispersion of oxygen to the waste. Unless sufficient justification is presented to the contrary, surface aerators shall be designed using an oxygen transfer rate of 1.2 kilograms of oxygen per kilowatt-hour (2.0 pounds of oxygen per horsepower-hour).

(c) *Subsurface aeration equipment.* 1. Flexible tubing containing air release slits shall be provided across the lagoon bottom in accordance with the manufacturer's recommendations. Air tubing shall be securely anchored to prevent floating. To prevent clogging of the air lines, provision shall be made to accommodate cleaning.

2. Air tubing and anchors shall be constructed of materials which resist corrosion.

3. Air shall be supplied to the lagoon system at a rate sufficient to meet the oxygen requirements of par. (a) assuming an oxygen transfer efficiency of 7%.

4. Tubular aeration units shall be provided in sufficient number to supply adequate air to the pond system based on a maximum transfer rate of 0.6 kilograms (1.25 pounds) of oxygen per unit per hour.

5. Where data is presented to the department to justify oxygen transfer rates varying from the requirements of this paragraph the department may approve such design transfer rates.

(d) *Aeration systems.* 1. Multiple blowers shall be provided. Capacity of the blowers shall be sufficient to meet total air demands with one blower out of service.

2. Diffusers and air piping shall be capable of supplying 200% of the average daily air demand.

(7) HYDRAULIC STRUCTURES. (a) *Materials.* Influent lines, interconnecting piping, and overflow structures shall be constructed of materials suitable for underground gravity sewer construction.

(b) *Capacity.* 1. Influent lines to all lagoon systems shall be sized in accordance with s. NR 110.13 (4).

2. Overflow structures and interconnecting piping for continuous flow lagoon systems shall be sized in accordance with s. NR 110.13 (4).

3. Overflow structures and interconnecting piping for controlled discharge lagoon systems shall be sized to handle the anticipated interlagoon flow rates during periods of discharge.

(c) *Influent piping.* 1. A manhole shall be installed at the end of the influent line or force main and shall be located as close to the dike as topography permits. Its invert shall be at least 15 centimeters (6 inches) above the maximum operating water level of the lagoon to provide sufficient hydraulic head without surcharging the manhole.

2. Influent lines shall be located such that the top of the pipe is at least 15 centimeters (6 inches) below the lower surface of the soil, bentonite, or synthetic liner.

3. For circular lagoons, the inlet shall terminate at the center of the lagoon. Influent lines to rectangular or square lagoons shall terminate in the first one third of the lagoon length. Influent and effluent piping shall be located to minimize short-circuiting within the lagoon.

4. The inlet line shall discharge either horizontally onto a concrete pad or by means of an upturned elbow terminating at least 30 centimeters (one foot) above the pond bottom.

(d) *Overflow structures.* An overflow structure shall be provided and shall consist of either a manhole or box equipped with multiple-valved pond drawoff lines or an adjustable overflow device. The overflow structure shall allow the liquid level of the lagoon to be adjusted to permit operation at depths ranging from 60 centimeters (2 feet) to the maximum design operating depth in stabilization ponds and from 1.2 meters (6 feet) to the maximum design operating depth in aerated lagoons. The department recommends that stop planks not be used in overflow structures to control operating depth.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. Register, February, 1983, No. 326, eff. 3-1-83, am. (3) (c) and (4) (b), r. and rec. (3) (d), Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.25 General conditions required for all land disposal systems. The provisions of this section apply to all municipal and privately owned domestic sewage treatment works.

(1) APPLICABILITY. Land disposal systems shall be reviewed and approved on a case-by-case basis.

(2) DESIGN REPORT. A design report shall be submitted in accordance with s. NR 110.15 (1).

(3) TREATMENT PRIOR TO DISPOSAL. All discharges to land disposal systems shall receive biological, chemical, physical or a combination of treatments necessary to meet effluent standards in ch. NR 206 and groundwater quality standards in ch. NR 140 as approved by the depart-

ment. Industrial waste discharges tributary to the municipal system shall be in compliance with applicable pretreatment standards under s. NR 211.30.

(3m) MANAGEMENT PLAN. (a) A management plan shall be submitted with plans and specifications for all land disposal facilities.

(b) The management plan shall contain specific information on pretreatment processes, scheduled maintenance, vegetative cover control and removal, load and rest schedules, application rates, operational strategies for periods of adverse weather, monitoring procedures and other pertinent information.

(4) DESIGN REQUIREMENTS. (a) *Application rates.* 1. The application rate of wastewater may not exceed the long term infiltrative capacity of the soil.

2. The application rate of wastewater containing heavy metals may not exceed the soil capacity for preventing the movement of the heavy metals through the soil.

3. Multiple wastewater application areas shall be provided to allow load and rest cycles. The discharge shall be alternately distributed to individual cells of the disposal system in a manner to allow sufficient resting periods to maintain the absorptive capacity of the soil, and to allow soil conditions to become unsaturated and aerobic between loadings.

(c) *Separation from water supplies.* 1. Land disposal systems shall be separated from private water supply wells by a minimum horizontal distance of 76 meters (250 feet).

2. The minimum horizontal separation distance between a land disposal system and public water supply wells shall be determined during facilities planning in accordance with s. NR 110.09 (2) (p). In all cases the department recommends a minimum horizontal separation of 305 meters (1,000 feet) be maintained.

(e) *Storage lagoons.* Storage lagoons shall be provided for all land disposal systems which are adversely affected by winter conditions or wet weather. Storage lagoons shall be constructed in accordance with s. NR 110.24 (3) and (4).

(f) *Load and rest cycles.* Load and rest cycles for each system shall be determined based on hydrogeologic and other relevant site conditions such as soil permeability, texture, cation-exchange capacity, topography, depth to groundwater and bedrock and the wastewater characteristics.

(g) *Construction precautions.* 1. All precautions shall be taken during construction of a land disposal system to minimize compaction of absorption areas and to prevent reduction in soil infiltration rate. Project specifications shall detail the specific precautions to take, which may include no heavy equipment use and erosion control on berms.

2. Erosion control measures shall be practiced during the construction of the land disposal system to avoid erosion of soil into a surface water and into or from the land disposal system.

(5) GROUNDWATER MONITORING. (a) *Applicability.* Groundwater monitoring systems shall be installed in accordance with approved plans and

specifications as required in ch. NR 108, for the purpose of determining groundwater conditions for the engineering report in s. NR 110.09 (1) (b) and for WPDES permit requirements. Plans and specifications shall be prepared by a hydrogeologist or other qualified person.

Note: The skills and knowledge required of a hydrogeologist making submittals under this chapter include: the ability to apply hydrogeologic principles and practices to the siting, design and operation of land disposal systems; knowledge of contaminants associated with land disposal of wastewater, their transport mechanisms and fate in the environment; familiarity with environmental monitoring practices, sampling techniques and groundwater standards; and proficiency in the design of groundwater monitoring systems for defining the physical and chemical characteristics of groundwater flow. A soil scientist or other environmental scientist who can demonstrate the above skills and knowledge, as reflected in submittals made under this chapter, shall be deemed a "qualified person".

(b) *Well locations.* 1. A minimum of 3 monitoring wells per land disposal system shall be installed to monitor groundwater quality in accordance with s. NR 206.10 (2), to determine flow direction(s) and for a flow rate determination. At a minimum, one well will be upgradient and 2 wells downgradient of the land disposal system.

2. One or more upgradient monitoring wells shall be installed at locations and depths sufficient to yield groundwater samples that are representative of background water quality near the facility. Selection of well locations should take into account past and present land uses which might affect groundwater quality. The upgradient well should be located so it will not be affected by the land disposal system. Any upgradient wells should be located at the most distant point of upgradient of the application area, and not closer that 75 feet from the application area. If the well is located beyond the property boundry, an easement for access shall be obtained prior to installation of the well.

3. Two or more downgradient wells shall be located so as to intercept any groundwater impacted by the land disposal system, considering the vertical and horizontal gradients of flow. The wells shall be no closer than 30 feet for rapid infiltration systems, and at a minimum, one well shall be located between the application area and the design management zone (DMZ) or property boundary. It is recommended that one well be located at or beyond the DMZ or property boundary. If the well is located beyond the property boundary, an easement for access shall be obtained prior to installation of a well.

(c) *Monitoring well construction.* All groundwater monitoring wells shall be constructed in accordance with ch. NR 141 and this section.

1. a. For piezometers, inlet screens shall have a length of at least 2.5 feet but not more than 5 feet unless otherwise approved by the department.

b. For water table observation wells, inlet screens shall not exceed 10 feet in length.

c. For a multilevel groundwater system, the deeper the well shall be screened at a depth to be determined from the site investigation.

2. All groundwater monitoring wells shall be developed in accordance with s. NR 141.21.

3. All groundwater monitoring systems shall be sampled in accordance with procedures contained in the "groundwater sampling guidelines," WDNR, Feb. 1987, or in s. NR 140.16.

4. All unsuccessful wells, boreholes or other vertical holes and wells whose use is no longer required must be properly abandoned in accordance with s. NR 141.25.

5. Documentation of well construction, well development and abandonment shall be submitted to the department in accordance with ss. NR 141.21 and 141.25. A location map shall also be provided in accordance with s. NR 141.065.

(d) *Alternative methods and materials.* The department may approve alternative construction methods or materials for installation of groundwater monitoring wells on a case-by-case basis.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. Register, February, 1983, No. 326, eff. 3-1-83; cr. (intro.), (3m), (4) (a) 3. and (4) (g), am. (2), r. and recr. (3), (4) (f) and (5), Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.255 Conditions required for specific types of land disposal systems. (1) ABSORPTION POND SYSTEMS. (a) *Design and construction criteria for absorption pond systems.* 1. New absorption pond systems shall consist of a minimum of 3 individual absorption ponds of approximately equal size. Absorption pond systems consisting of 1 or 2 individual ponds may be approved by the department on a case-by-case basis if it is demonstrated that the system has effluent storage capabilities or other provisions to ensure the operation of the system in accordance with the load and rest cycles determined under s. NR 110.25 (4) (f).

2. The design hydraulic application rate for an absorption pond system shall be based on field and laboratory test results for infiltration and hydraulic conductivity. The design hydraulic application rate shall be conservatively established to allow for pond resting cycles and for a long term reduction in infiltration rate due to wastewater solids clogging the soil.

3. Multiple pond systems shall be designed and constructed to allow individual ponds to be taken out of service for resting without interrupting the discharge to the remaining ponds.

4. Wastewater effluent shall be discharged to absorption ponds such that it is evenly distributed over the entire absorption pond bottom. Effluent storage may be required to provide effluent dosing control by fill and draw operation.

5. The absorption pond bottom shall be as level as possible at all locations.

6. The shape of each absorption pond and the placement of ponds at the site must take into account the information in the hydrogeologic study required by s. NR 110.09 (8) such as the groundwater flow direction, the presence of discharge or recharge zones and the variability of soils. Infiltration areas should be oriented in relation to the direction of groundwater flow in such a manner as to minimize groundwater impacts. When possible, absorption ponds shall be constructed in areas which are not groundwater recharge areas.

7. The minimum top width of an embankment or dike shall be 12 feet if the dike is intended to provide access for maintenance vehicles on a routine basis. The minimum top width shall be 8 feet if the embankment or dike is not designed for vehicle access. Outside embankment and dike slopes may not be steeper than 3 horizontal to one vertical and shall be

properly seeded with a mixture of grasses to prevent erosion. Inside embankments and dikes may not be steeper than 2 horizontal to one vertical and shall be properly graveled or riprapped to prevent erosion. Interior ramps for maintenance vehicle access are acceptable.

8. Absorption ponds may not be constructed on backfilled material. Earthwork activities within 1 foot of the final pond surface shall be limited to times when soil conditions are dry.

9. The bottom of the absorption pond may not be closer that 5 feet to the highest anticipated groundwater elevation.

10. An absorption pond system shall be constructed on soils which meet with the following minimum requirements:

a. Soil texture may not be coarser than loamy sand (USDA soils classification) or have less than 5% passing a number 200 sieve.

b. Soil texture may not be finer than clay loam (USDA soil classification) or have liquid limits greater that 50% (unified soil classification).

c. Soil pH may not be less that 6.5.

11. A minimum separation distance of 10 feet shall be maintained between the bottom of the absorption pond and bedrock.

(b) *Discharge limitations for absorption pond systems.* Effluent limitations are as specified in s. NR 206.08 (1) (b).

(2) SPRAY IRRIGATION SYSTEMS. (a) *Design and construction criteria for spray irrigation systems.* 1. All spray irrigation systems shall be designed with a wastewater distribution system capable of loading and resting various portions of the site to optimize wastewater treatment within the soil and crop growth.

2. Spray irrigation onto frozen ground is prohibited. The department may restrict loadings during times of the year when the cover crop is not actively growing.

3. Application of wastewater to the spray irrigation system shall incorporate a rest/load cycle and application intensity such that the soil moisture holding capacity in the top foot of the soil column is not exceeded and ponding or runoff do not occur. Following wastewater application to a portion of the field, that portion shall be rested. Table 8 provides values for the maximum volume of wastewater that may be applied per load cycle and the maximum intensity of wastewater application for specific soil textures. The values in Table 8 are the maximum amount approvable unless greater values can be justified through soil testing and are approved by the department. The volume applied and the intensity sprayed may be restricted by the department to values less than those listed in Table 8 if site conditions warrant.

Table 8

Soil Texture (USDA - SCS)	Maximum Volume Applied Per Load Cycle	Maximum Intensity of Application
Sands	0.65 inches	1.00 in/hr
Sandy Loams	0.90 inches	0.90 in/hr

Loams	1.30 inches	0.45 in/hr
Silt Loams	1.40 inches	0.45 in/hr
Clay Loams	1.10 inches	0.40 in/hr
Clays	0.70 inches	0.40 in/hr

4. The spray nozzle openings shall be sized to prevent plugging and shall be located as near to the ground surface as practical to minimize wind drift of the wastewater.

5. The spray nozzles shall be arranged so that the wastewater will be evenly distributed over the entire area under irrigation.

6. The spray irrigation system shall be arranged so that individual sections within the system can be taken out of service for resting without interrupting discharge to the remaining sections.

7. The spray irrigation system shall be seeded with perennial grasses such as reed canary grass, tall fescue and orchard grass. The cover crop shall be a crop which is not used for direct human consumption. New seedings shall also contain a nurse crop. The cover crop shall be maintained by cutting and removing the grass a minimum of twice per growing season. The department may approve the use of other types of cover crops such as corn but will restrict the use of such sites to times when the cover crop is actively growing. The department may also require reduced hydraulic application rates, grass buffer strips or both around the perimeter of the site to prevent wastewater runoff during rainfall events.

8. The ground surface of the spray irrigation system shall have a minimum separation distance to bedrock of at least 5 feet.

9. A minimum separation distance of 5 feet shall be maintained between the land surface elevation of the spray irrigation field and the highest anticipated groundwater elevation. The department may on a case-by-case basis allow this distance to be reduced if the permittee can show, based on hydrogeologic and other relevant site factors, that the groundwater will be adequately protected.

10. The department may require disinfection of effluent to spray irrigation systems if there is a potential risk to public health.

(b) *Discharge limitations for spray irrigation systems.* Effluent limitations are as specified in s. NR 206.08 (2) (b).

(3) RIDGE AND FURROW SYSTEMS. (a) *Design and construction criteria for ridge and furrow systems.* 1. The shape of each cell within the ridge and furrow system shall be such that a minimum of soil disturbance is necessary to form the system.

2. A ridge and furrow system may not be constructed on a site at which less that 50% of the soil particles pass a No. 200 sieve. Coarser textured soils may be approved on a case-by-case basis depending on system design and wastewater strength. Suitable soils shall extend at least 3 feet below the base grade of the furrow bottoms.

3. The furrows of the ridge and furrow system shall be one foot deep and one foot wide at the furrow bottom.

4. Furrow side slopes may not be steeper than one horizontal to 2 vertical.

5. The system shall be sized and constructed in order to allow sufficient resting to allow soil conditions to become unsaturated and aerobic prior to any wastewater being reapplied.

6. The system shall be constructed in a manner which provides equal liquid distribution during loading of each cell. The header ditch shall be sealed in order to allow complete drainage and to prevent wastewater seepage. The drainage of the header ditch and the grading of the furrows for equal liquid distribution shall be tested with water before seeding the ridges with grasses.

7. The system shall consist of at least 2 cells which can be alternately loaded and rested.

8. The wastewater distribution system shall be arranged so that individual cells within the ridge and furrow system can be taken out of service for resting without interrupting discharge to the remaining cells.

9. The bottom of the ridge and furrow system may not be closer than 5 feet to the highest anticipated groundwater elevation. The department may allow this distance to be reduced on a case-by-case basis if the permittee can show, based on hydrogeologic and other relevant site factors, that the groundwater will be adequately protected.

10. The bottom of the system shall be at least 5 feet from bedrock.

11. Outside embankments and dikes may not be steeper than 3 horizontal to one vertical. Inside embankments and dikes may not be steeper than 2 horizontal to one vertical. All embankments and dikes shall be properly seeded with perennial grasses to prevent erosion. A nurse crop of annual grasses shall be used to establish a ground cover.

12. All ridge tops shall be a minimum of 6 feet wide to allow mechanical removal of grasses. The grasses shall be cut, and if possible removed, at least once during the growing season and shall be burned or cut and removed each spring.

13. All areas within a ridge and furrow system shall be accessible for maintenance equipment.

14. The system shall be constructed to prevent surface runoff from entering the system.

15. The ridges shall be seeded with perennial grasses which are suited to wet soil conditions. A nurse crop shall be used to seed new or modified systems. In addition, the grass cover shall be established to at least a 2-inch length before the system is used for wastewater treatment.

16. Discharge to ridge and furrow systems which have frozen soils is prohibited.

(b) *Discharge limitations for ridge and furrow systems.* Effluent limitations are as specified in s. NR 206.08 (3) (b).

(4) OVERLAND FLOW SYSTEMS. (a) *Design and construction criteria for overland flow systems.* 1. Overland flow systems shall be underlain by at least one foot of heavy textured soils such as clays or clay loams to retard leakage through the base.

2. The downslope flow distance shall be 100 feet or greater.

3. The downslope gradient for the overland flow fields shall be between 2% and 8%.

4. The system shall consist of at least 2 cells of approximately equal area which can be alternately loaded and rested. Where self-propelled equipment which operates on a continuous basis is installed and division into identifiable cells is impossible, its movement shall be regulated to provide alternate loading and resting of the soil.

Note: It is recommended that an overland flow cell be rested for at least one third of the total time in the rest/load cycle.

5. The system shall be arranged so that individual cells within the system can be taken out of service for resting without interrupting discharge to the remaining cells.

6. The distribution equipment shall be arranged so that the wastewater will be evenly distributed over the entire area of an overland flow cell and the wastewater travels down the slope in a non-channelized flow.

7. The wastewater distribution equipment shall be located at or near the ground level.

Note: A pressurized distribution system is recommended for ease of operation.

8. The wastewater distribution system shall be designed to allow for cleaning of the distribution orifices. Flexibility to adjust the flow from individual orifices shall be provided to allow the system to be hydraulically balanced to minimize flow channeling.

9. An impermeable channel shall be provided for collecting runoff from the overland flow fields. The collection system shall be capable of removing the effluent and the rain from a 10-year frequency, 24-hour duration rainfall event with only temporary backing up of water onto the fields.

10. The overland flow fields shall be vegetated with a water tolerant mixed perennial grass cover crop such as reed canary grass, tall fescue and orchard grass. A nurse crop shall be used to establish the perennial grass cover. The grass cover shall be maintained by frequent resting. The crop shall be cut and the cuttings removed at least twice per year to stimulate grass growth and enhance nutrient removal from the system.

11. Winter operation may be allowed as long as the soil surface remains unfrozen. The department may require storage or additional treatment of the runoff during cold weather.

12. An overland flow field may be used when the land surface elevation is at least 5 feet above bedrock.

13. The land surface elevation of an overland flow field shall be no closer than 5 feet to the seasonally high groundwater level. The department may on a case-by-case basis allow this distance to be reduced if the permittee can show, based on hydrogeologic and other relevant site factors, that the groundwater will be adequately protected. If such a variance is approved or if the risk of groundwater contamination is otherwise high, the department may require additional pretreatment of the wastewaters.

14. The hydraulic application rate, expressed as a flow rate per unit width of slope, shall be between .16 gpm/ft and .60 gpm/ft.

(b) *Discharge limitations for overland flow systems.* Effluent limitations are as specified in s. NR 206.08 (4) (b) and applicable surface water limitations.

History: Cr. Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.26 Sludge handling, storage and disposal. (1) DESIGN REPORT. A design report shall be submitted in accordance with s. NR 110.15 (1). The report shall show calculations used to design the sludge facilities. Design of sludge handling facilities shall consider such factors as the volume of sludge generated, its percent solids and character, the degree of volatile solids reduction, sludge temperature, the degree or extent of mixing to be obtained, the sludge percent solids and characteristics after processing and the size of the installation with appropriate allowances for sludge and supernatant storage and energy requirements whenever such factors are appropriate for the design of the sludge processing facilities.

(2) GENERAL DESIGN CONSIDERATIONS. (a) *Grit removal.* When grit removal facilities are not provided, the volume of thickeners, digesters and storage facilities shall be increased to accommodate the additional solids loading.

(b) *Sludge thickening.* 1. Whenever practical, sludge thickening shall be provided.

2. Thickened sludge should have a minimum solids concentration of 5% prior to transmission to the digesters.

(c) *Multiple units.* Multiple units shall be provided. A single unit may be allowed, provided an alternate method of sludge processing, emergency storage or ultimate disposal operation exists to insure continuity of service.

(d) *Maintenance.* 1. Provisions shall be made for draining, cleaning, inspection, and maintenance of all units.

2. Tank bottoms shall be sloped to drain to a sump pump or withdrawal pipe.

3. Access manholes shall be provided. Covered tanks shall have one side wall entrance large enough to permit the use of mechanical equipment to remove grit and sand.

(e) *Storage facilities.* 1. The construction of sludge storage facilities may be required to improve sludge handling capabilities, provide flexibility in operations, and to avoid environmental or public health hazards due to improper disposal techniques.

2. Construction of these facilities will depend upon treatment plant capabilities, land availability, surface and groundwater protection, health factors, municipal sludge management capabilities and other environmental factors.

(3) GENERAL DESIGN REQUIREMENTS. (a) *Flow measurement.* Devices for measuring flow to and from sludge digestion facilities shall be provided.

(b) *Ventilation.* All enclosures which are connected with sludge digestors, or which contain sludge or gas piping or equipment shall be pro-

vided with forced ventilation in accordance with s. NR 110.14 (3) (b). The piping gallery for digesters may not be connected to other passages unless a tightly fitting self-closing door is provided at connecting passageways.

(c) *Safety.* Nonsparking tools, rubber soled shoes, safety harness, gas detectors for inflammable and toxic gases and at least 2 self-contained respiratory units should be provided for emergency use whenever inflammable and toxic gases may be present.

(d) *Supernatant withdrawal.* Sludge thickeners and aerobic digestors shall be designed for effective separation and withdrawal of supernatant and for effective collection and removal of scum and grease.

(e) *Sampling.* 1. Provisions shall be made for sampling at each supernatant draw-off level and for collecting sludge samples for analysis. Sampling pipes shall be at least 4 centimeters (1½inches) in diameter and shall terminate in a suitably-sized sink or basin.

2. Unless sampling facilities are otherwise provided, quick-closing sampling valves shall be installed at the sludge pumps. The size of valve and piping shall be at least 4 centimeters (1½inches).

(f) *Chemical handling.* Chemical handling facilities shall meet the provisions of s. NR 110.22.

(4) SLUDGE PUMPS AND PIPING. (a) *Sludge pumps.* 1. Sludge pumping systems shall be designed to handle the expected range of sludge flows.

2. Multiple pumps shall be provided.

3. Pumps with demonstrated solids handling capability shall be provided for handling raw and processed sludge.

4. A minimum positive head of 60 centimeters (2 feet) shall be provided at the suction side of centrifugal-type pumps and is desirable for all types of sludge pumps. Maximum suction lifts may not exceed 3.0 meters (10 feet) for plunger pumps.

(b) *Sludge piping.* 1. Sludge withdrawal piping shall have a minimum diameter of 20 centimeters (8 inches) for gravity withdrawal and 15 centimeters (6 inches) for pump suction and discharge lines. The department may approve the use of glass lined pipe which is at least 10 centimeters (4 inches) in diameter. Where withdrawal is by gravity, the available head on the discharge pipe shall be sufficient to maintain a minimum velocity of 90 centimeters (3 feet) per second.

2. Gravity piping shall be laid on uniform grade and alignment. The slope on gravity discharge piping may not be less than 3%.

3. Provisions shall be made for draining, flushing and cleaning sludge piping.

4. Air relief valves shall be provided at high points in pressure sludge lines.

5. Special consideration shall be given to the corrosion resistance and continuing stability of pipes and supports located inside the digestion tank.

(5) ANAEROBIC DIGESTION. (a) *General.* 1. Anaerobic digesters which will also serve as supernatant separation tanks shall have a minimum side water depth of 6 meters (20 feet).

2. Multiple sludge inlets and draw-offs shall be provided. Multiple recirculation suction and discharge points to facilitate flexible operations and effective mixing of the digester contents shall be provided unless adequate mixing facilities are provided within the digester. One sludge inlet shall discharge above the liquid level and be located at approximately the center of the tank to assist in scum breakup. Raw sludge inlet discharge points shall be so located as to minimize short circuiting to the supernatant draw-off. Sludge withdrawal for disposal shall be from the bottom of the tank. The pipe shall be interconnected with the recirculation piping to increase flexibility in mixing tank contents.

(b) *Tank capacity.* 1. The total digestion tank capacity shall be calculated based upon the factors indicated in sub. (1). If such calculations are not done, the following minimum requirements shall be met:

a. A minimum detention time of 15 days at design flows shall be provided;

b. Completely mixed digestion systems shall provide for intimate and effective mixing to prevent stratification and to assure homogeneity of digester content. The maximum system loading shall be 1.28 kilograms per cubic meter per day (80 pounds of volatile solids per 1,000 cubic feet of volume per day) in the digester;

c. The maximum system loading for moderately mixed digestion systems in which mixing is accomplished only by circulating sludge through an external heat exchanger shall be 0.64 kilograms per cubic meter per day (40 pounds of volatile solids per 1,000 cubic feet of volume per day) in the digester; and

d. The loading rates indicated in subds. 2., 3., and 4. assume that the raw sludge is derived from ordinary domestic wastewater. The loading may be modified upward or downward depending upon the degree of mixing provided. Where mixing is accomplished by other methods, loading rates may be approved on the basis of information submitted justifying the design.

(c) *Temperature.* Heating equipment shall have the ability to maintain digestion temperature in the range of 33° to 38°C (90° to 100°F).

(d) *Gas collection, piping and appurtenances.* 1. All portions of the gas system, including the space above the tank liquor, storage facilities and piping shall be so designed that under normal operating conditions, including sludge withdrawal, the gas will be maintained under positive pressure. All enclosed areas where any gas leakage might occur shall be ventilated.

2. Safety facilities shall be included where gas is produced. Pressure and vacuum relief valves and flame traps, together with automatic safety shut off valves, shall be provided. Waterseal equipment may not be installed. Gas compressors with gas safety equipment should be housed in a separate room with an exterior entrance.

3. The diameter of gas piping shall be based on the volume of gas which will be generated. Gas piping shall slope to condensate traps. The use of float-controlled condensate traps is prohibited.

4. Gas burning boilers, engines and other units using gas as a fuel shall be located in ventilated rooms, preferably at ground level and shall be isolated in accordance with the provisions of s. ILHR 54.14. Gas lines to these units shall be provided with suitable flame traps.

5. Electrical fixtures and controls in enclosed places where gas may accumulate shall comply with the national electrical code requirements for class 1, group D, division 2 locations.

6. Waste gas burners shall be readily accessible and shall be located at least 7.6 meters (25 feet) away from any plant structure if placed at ground level. Waste gas burners may be located on the roof of the control building if sufficiently removed from the tank. All waste gas burners shall be equipped with automatic ignition, such as a pilot light or a device using a photoelectric cell sensor. Consideration should be given to the use of natural or propane gas to insure reliability of the pilot light. If the waste gas burner is in a remote location, the department may approve the discharge of gas to the atmosphere through a return-bend screened vent terminating at least 3 meters (10 feet) above the walking surface, provided the assembly incorporates a flame trap.

7. A gas meter with by-pass shall be provided to meter total gas production. Additional gas meters may be required to measure gas usage.

(e) *Digestion tank heating.* 1. Whenever possible, digestion tanks shall be constructed above groundwater level. Digestion tanks shall be insulated to minimize heat loss.

2. Piping shall be designed to provide for the heating of feed sludge before introduction to the digesters. Heat exchanger sludge piping shall be sized for heat transfer requirements.

3. Sufficient heating capacity shall be provided to consistently maintain the design sludge temperature. Where digestion tank gas is used for other purposes, an auxiliary fuel supply shall be provided.

4. Consideration should be given to equipping hot water internal heating controls with an automatic mixing valve to temper the boiler water with return water so that the inlet water to the heat jacket can be maintained between 49° to 55°C (120° to 130°F) to prevent excessive caking or encrustation of sludge on the heat jacket. Manual controls shall also be provided.

5. The boiler shall be provided with automatic controls to maintain the boiler temperature at approximately 82°C (180°F). Automatic controls shall also be provided to shut off the main gas supply in the event of pilot burner or electrical failure, low boiler water level or excessive temperature.

6. Thermometers shall be provided to show temperatures of the sludge, hot water feed, hot water return and boiler water.

(f) *Supernatant withdrawal.* 1. Supernatant piping shall be 15 centimeters (6 inches) in diameter, or larger.

2. Piping shall be arranged so that withdrawal can be made from 3 or more levels in the tank. A positive unvalved vented overflow shall be provided.

3. If a supernatant selector is provided, provisions shall be made for at least one other draw-off level located in the supernatant zone of the tank in addition to a positive unvalved vented overflow pipe. High pressure backwash facilities shall be provided.

(6) AEROBIC SLUDGE DIGESTION. (a) *General.* 1. Aerobic digesters shall be designed to provide effective air mixing, reduction of organic matter, supernatant separation and sludge concentration.

2. The digester detention time may be calculated based upon the factors indicated in subd. 1. If such calculations are not done, the following minimum requirements shall be met:

a. A minimum of 15 days detention time shall be provided for waste activated sludge and 20 days for primary sludge or a combination of primary and waste activated sludge. Where sludge temperature is lower than 10°C (50°F), additional time shall be provided; and

b. The volatile suspended solids loading may not exceed 1.60 kilograms per cubic meter per day (100 pounds per 1,000 cubic feet per day) in the digestion unit. Lower loading rates may be necessary depending on temperature, type of sludge and other factors.

3. The aeration system for aerobic digesters shall be capable of meeting the oxygen requirements of par. (b), or the mixing requirements of par. (c), whichever is greater.

(b) *Oxygen demand.* 1. Aeration systems shall be capable of maintaining a minimum digester dissolved oxygen concentration of one milligram per liter.

2. In the absence of experimentally determined values, the design oxygen requirements for aerobic digesters shall be 2.0 kilograms oxygen per kilogram (2.0 pounds oxygen per pound) anticipated volatile suspended solids reduction. An additional 1.8 kilograms oxygen per kilogram (1.8 pounds oxygen per pound) of BOD_5 applied to the digester by primary sludge shall be supplied.

3. The design of the aeration system to meet the digester oxygen requirements shall comply with the provisions of s. NR 110.21 (5) (c).

(c) *Mixing requirements.* 1. Digestion tanks shall be designed for effective mixing.

2. Diffused aeration systems shall be capable of delivering a minimum air flow rate of 30 cubic meters per minute per 1,000 cubic meters (30 cubic feet per minute per 1,000 cubic feet) of digester volume.

3. Mechanical aerators shall deliver 26.3 kilowatts per 1000 cubic meters (1.0 horsepower per 1,000 cubic feet) of digester volume.

(d) *Aeration equipment.* Aeration equipment needed to meet the requirements of pars. (b) and (c) shall comply with the provisions of s. NR 110.21 (6).

(e) *Supernatant withdrawal.* Aerobic digesters shall be equipped for supernatant draw-off. It is recommended that multi-level draw-off be provided.

(7) OTHER SLUDGE STABILIZATION PROCESSES. (a) *Lime stabilization.* Sufficient lime shall be added to produce a pH of 12 after 2 hours of contact.

(b) *Composting.* Static aerated pile, within vessel, or windrow composting methods shall be maintained at a minimum operating temperature of 40°C (104°F) for at least 5 days. For 4 hours during this period the temperature must exceed 70°C (158°F). Composting design, siting and operation shall be done in accordance with ch. NR 180.

(c) *Other methods.* Other methods or operating conditions may be acceptable for sludge stabilization if pathogens and volatile solids are reduced to an extent equivalent to anaerobic digestion.

(8) SLUDGE DEWATERING. (a) *Sludge drying beds.* 1. The drying bed area shall be calculated based upon such factors as climatic conditions, character and volume of sludge to be dewatered, the method and character of sludge removal and other methods of sludge disposal. At least 0.19 square meters (2 square feet) of drying bed area per capita population equivalent shall be provided when the drying bed is the primary method of dewatering, and 0.09 square meters (1 square foot) per capita population equivalent if it is to be used as a back-up dewatering unit. The bed area shall be increased by 25% if the beds are paved.

2. At least 2 drying beds shall be provided.

3. Percolation type drying beds shall meet the following conditions:

a. The lower course of gravel around the underdrains shall be properly graded and shall be at least 30 centimeters (one foot) in depth, extending at least 15 centimeters (6 inches) above the top of the underdrains. It is desirable to place this in 2 or more layers. At least 8 centimeters (3 inches) of the top layer shall consist of gravel 3 to 6 millimeters (⅛ to ¼ inches) in size.

b. The top course shall consist of at least 15 to 23 centimeters (6 to 9 inches) of clean, medium to coarse, sand with a grain size of 1 to 3 millimeters in diameter. The finished sand surface shall be level.

c. Underdrains shall be clay pipe or concrete drain tile at least 10 centimeters (4 inches) in diameter laid with open joints. Underdrains shall be spaced not more than 6 meters (20 feet) apart.

d. An impervious layer shall be provided immediately beneath the lower course to prevent the downward movement of filtrate into the groundwater.

4. Paved surface drying beds may be used if adequate center or side drains are provided. If partially paved drying beds are used, they shall be designed with consideration for space requirement to operate mechanical equipment for removing the dried sludge.

5. Sludge influent piping to the beds shall terminate at least 30 centimeters (one foot) above the surface and be so arranged that the beds will drain. Concrete splash plates for percolation type beds shall be provided at sludge discharge points.

6. Walls shall be watertight and extend 38 to 46 centimeters (15 to 18 inches) above and at least 15 centimeters (6 inches) below the surface of the beds. Outer walls shall be curbed to prevent soil from washing onto the beds.

7. Drying beds shall be arranged to facilitate sludge removal. Concrete truck tracks shall be provided for all sludge beds. Pairs of tracks shall be on 6 meter (20-foot) centers.

(b) *Sludge drying lagoons.* The bottom of the lagoons must be at least 1.25 meters (4 feet) above the maximum seasonal high groundwater level and at least 3 meters (10 feet) above bedrock. The bottom of the lagoons shall be constructed in accordance with s. NR 110.28.

2. Lagoons may not be more than one meter (39 inches) in depth.

3. The area required will depend on design conditions. At least 2 lagoons shall be provided.

4. Lagoons shall be adequately isolated to avoid creating nuisances.

(c) *Mechanical dewatering facilities.* 1. General. Provision shall be made to maintain sufficient continuity of service so that sludge may be dewatered without accumulation beyond storage capacity. Design calculations or pilot plant data shall be submitted to justify the basis of design and equipment.

2. The capacity of vacuum filters, centrifuges, filter presses, belt filters or other mechanical dewatering facilities shall be sufficient to dewater the sludge produced with the largest unit out of service.

3. There shall be provided at least one back-up vacuum pump and one back-up filtrate pump for each vacuum filter installation. The vacuum filter shall be designed to allow for the easy removal and replacement of the vacuum pump and filtrate pump.

4. The dewatering area shall be ventilated.

(d) *Drainage and filtrate disposal.* The drainage from drying beds or shallow lagoons and the filtrate from dewatering units shall be returned to the sewage treatment process at approriate points.

(e) *Other dewatering facilities.* If other methods of reducing the quantity of sludge are proposed, a detailed description of the process and design data shall accompany the plans.

(9) SLUDGE REDUCTION. (a) *Incineration.* Adequate provisions for residue disposal and air pollution control shall be provided. The appropriate requirements of chs. NR 415 and 500 to 520 shall be met.

(b) *Other reduction facilities.* If other methods of reducing the quantity of sludge are proposed, a detailed description of the process and design data shall accompany the plans.

(10) SLUDGE STORAGE FACILITIES. (a) *General.* A detailed description of the wastewater treatment process and design data shall accompany plans for the proposed storage facility. Sludge storage facilities shall be designed and operated to maintain compliance with the groundwater quality standards in ch. NR 140.

(b) *Separation distances.* 1. Sludge storage facilities may not be located within the following distances of a water supply well.

a. 1000 feet from a community public water supply well;

b. 250 feet from a private water supply well;

2. Separation distances from residential and commercial buildings shall be maintained as required in s. NR 110.15 (3) (d).

3. A minimum separation distance of 1.25 meters (4 feet) shall be maintained between the bottom of storage lagoons and the highest recorded or indicated seasonal groundwater table elevation.

4. A minimum separation distance of 3 meters (10 feet) shall be maintained between the bottom of storage lagoons and bedrock.

(c) *Liquid sludge storage facilities.* 1. Liquid sludge storage facilities shall be designed to facilitate easy addition and removal of sludge without causing damage to the facility.

2. Liquid sludge storage lagoons and pits shall be designed and constructed in accordance with s. NR 110.24.

3. The maximum lagoon depth shall be 6 meters (20 feet). The depth may be increased by the department on a case-by-case basis.

4. Storage tanks shall be designed, installed and maintained to prevent leaks due to corrosion or structural failure.

5. In the event a sludge storage facility is temporary, it shall be abandoned in such a manner so as to prevent safety, environmental and aesthetic problems from occurring. The department shall be notified in writing if the storage facility is to be abandoned and how abandonment will be accomplished.

(d) *Cake storage facilities.* 1. Permanent and temporary cake storage facilities shall be designed to minimize odors and to protect surface waters, groundwaters and soil.

2. Surface runoff shall be diverted away from the storage location.

3. Cake storage facilities designed as pits shall provide a method of draining-off and collecting precipitation.

4. All sludge stored at an intermediate term cake storage facility shall be covered with a temporary cover. At a minimum, the cover shall be a 4 mil polyethylene cover or equivalent. The cover shall be anchored or otherwise secured.

5. All sludge stored at a long term cake storage facility shall be covered with a permanent cover.

6. Abandonment shall be accomplished in accordance with s. NR 110.26 (10) (g).

(e) *Monitoring wells.* Monitoring wells may be required on a case-by-case basis. Construction of monitoring wells shall comply with the requirements of s. NR 110.25 (5) and ch. NR 141.

(f) *Amount of storage.* Appropriate sludge storage and length of storage shall be evaluated according to the following priority:

1. POTW's that produce sludge and are in the process of upgrading their wastewater treatment facilities and are proposing to or are currently landspreading sludge will be required to provide adequate storage capacity for the 20 year design life as required under facilities planning. Long term sludge storage facilities for liquid or cake sludge shall be designed to provide capacity for 180 days of storage. Lesser storage capacity, but in no case less that 150 days, may be approved upon evaluation of the local soil and climatic conditions, the availability of suitable winter sludge disposal sites or other pertinent considerations. This storage capacity may not include storage in clarifiers, oxidation ditches or aeration basins. However, extra digester capacity that is greater than the digestive requirements can be considered as storage and can be used in calculating the 150 or 180 days of storage. The department may determine leasing to be an acceptable alternative to construction if the lease is for a minimum of 5 years with an option for another 5 years if the WPDES permit is reissued.

2. For those POTW's not upgrading their facilities, and who have 5 or more years of remaining design life of POTW but need additional sludge storage, an engineering report shall be submitted regarding the upgrading of the sludge storage capacity. POTW's that are not upgrading their facilities but are having sludge management problems due to lack of storage will be required to either: a) build 150 to 180 days of storage or b) lease for 150 to 180 days of storage covering the facilities' projected 5 to 10 year sludge production needs. The storage requirement will be based on the projected remaining design life left in the POTW and would be as follows:

Remaining Design life of POTW	DESIGN YEAR STORAGE REQUIREMENTS
0 to 5 years	Take action to address immediate needs and start facility planning
5 to 10 years	10 years
10 to 15 years	15 years
15 to 20 years	20 years

3. Facilities that are not in the process of upgrading their wastewater treatment facility and are not encountering sludge land disposal problems even though the facility has less than 150 or 180 day storage capacity are not required to expand their sludge storage capacity. If necessary, the department may require additional storage at such time as federal sludge requlations require.

(11) TRANSPORTATION OF SLUDGES. (a) *Liquid.* 1. Liquid sludge shall be transported in an enclosed watertight unit from treatment plant to disposal site.

2. The department recommends that all sludge field spreading equipment be provided with a control so that the discharge valve can be opened and closed by the driver while the vehicle is in motion.

(b) *Semi-solid cake.* Sludge cake shall be transported in a covered watertight unit to prevent leakage of sludge moisture released in transit. Provision shall be taken to prevent the spilling of sludge from the vehicle while in transit and to prevent an odor nuisance while in transit.

(12) ULTIMATE DISPOSAL. (a) *Sludge management.* 1. The owner of a municipal wastewater treatment plant shall be responsible for compliance with WPDES permit sludge management reporting requirements.

2. The owner of the municipal wastewater treatment plant shall be responsible for the implementation of the sludge management plan in accordance with WPDES permit requirements.

3. The department shall evaluate sludge management plans and reports according to the requirements of ch. NR 204 and any other pertinent information deemed appropriate to the review of sludge management plans and reports.

4. Sludge management program requirements shall include the submission of the following reports if required by the WPDES permit plus any additional information which the department may require:

a. General sludge management information;

b. Sludge characteristics;

c. Landfilling and public use;

d. Agricultural site characteristics and operations; and,

e. Sludge disposal records.

(b) *Landspreading.* Landspreading and storage of sludge from municipal wastewater treatment facilities shall be done in accordance with WPDES permit requirements and subs. (10) and (11).

(c) *Landfilling.* Landfilling of sludge from municipal wastewater treatment facilities shall comply with the requirements of chs. NR 500 to 520.

(d) *Other disposal.* All other disposal options shall be carried out in compliance with all applicable state and federal regulations.

History: Cr. Register, November, 1974, No. 227, eff. 12-1-74; r. and recr. Register, February, 1983, No. 326, eff. 3-1-83, am. (9), (12) (a) 3. and (c), r. and recr. (10) and cr. (12) (d), Register, November, 1990, No. 419, eff. 12-1-90.

NR 110.27 Requirements for certified or registered laboratory. Bacteriological analyses of groundwater samples, and all radiological analyses, shall be performed by the state laboratory of hygiene or a laboratory certified or approved by the department of health and social services. Other laboratory test results for those pollutants which are required by the WPDES permit to be monitored and which are submitted to the department in support of facility plans or plans and specifications under this chapter shall be performed by a laboratory certified or registered under ch. NR 149. The department may require, on a case-by-case basis, that certain other laboratory test results submitted to the department be performed by a certified or registered laboratory. The following tests are excluded from this requirement:

(1) Temperature,

(2) Turbidity,

(3) Bacteria tests in wastewater effluent,

(4) pH,

(5) Chlorine residual,

(6) Specific conductance,

(7) Physical properties of soils and sludges,

(8) Nutrient tests of soils and sludges,

(9) Flow measurements.

Note: The requirement in this section to submit data from a certified or registered laboratory is effective on August 28, 1986.

History: Cr. Register, April, 1986, No. 364, eff. 8-28-86.