NR 110

Filed October 14, 1974
1:05 pm GLP

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

L. P. Voigt
Secretary

BOX 450
MADISON, WISCONSIN 53701

IN REPLY REFER TO: _____

STATE OF WISCONSIN)
) ss
DEPARTMENT OF NATURAL RESOURCES)

TO ALL TO WHOM THESE PRESENTS SHALL COME, GREETINGS:

I, L. P. Voigt, Secretary of the Department of Natural Resources, and custodian of the official records of said Department, do hereby certify that the annexed copy of Natural Resources Board Order No. W-27-74 was duly approved and adopted by this Department on July 19, 1974. I further certify that said copy has been compared by me with the original on file in this Department and that the same is a true copy thereof, and of the whole of such original.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the official seal of the Department at Pyare Square Building in the City of Madison, this 9th day of October, 1974.

L. P. Voigt, Secretary

(SEAL)

STATE OF WISCONSIN NATURAL RESOURCES BOARD

IN THE MATTER OF repealing and recreating Chapter NR 110 of the Wisconsin Administrative Code pertaining to sewerage systems	W-27-74

ORDER OF THE STATE OF WISCONSIN NATURAL RESOURCES BOARD

REPEALING AND RECREATING RULES

Pursuant to the authority vested in the State of Wisconsin Natural Resources Board by sections 144.025 and 144.04 and Chapters 147 and 227, Wisconsin Statutes, the State of Wisconsin Natural Resources Board hereby repeals and recreates rules as follows:

SECTION 1. NR 110 is repealed and recreated to read:

July 22, 1974

NR 110

SEWERAGE SYSTEMS

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 Section 145.01(1)(b), Wisconsin Statutes.

Note: The authority to enact these rules is contained in Chapter 144, Wisconsin Statutes. Pursuant to Section 144.57, Wisconsin Statutes, 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.

NR 110.02 Severability.

Should any section, paragraph, phrase, sentence, clause or word of this chapter be declared invalid or unconstitutional for any reason, the remainder of this chapter shall not be affected thereby.

NR 110.03 Definitions.

The definitions in this section shall apply whenever the listed terms are used in this chapter.

(1) "Approval" means the written approval of the department for any project requiring approval pursuant to Section 144.04, Wisconsin Statutes, and NR 108.03.

(2) "Cost-effective" means the least cost waste treatment alternative which will result in the attainment of applicable water quality standards, effluent limitations, or other treatment standards.

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

(4) "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.

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

(6) "Reviewable project" shall have the same meaning as set forth in NR 108.02 (6).

(7) "Excess clear water" means that quantity of clear water that can be economically eliminated from a sewer system by rehabilitation. This quantity is determined by a cost-effectiveness analysis that compares the cost of eliminating the excess clear water with the cost of increasing the capacity of the sewerage system, including the treatment works' capacity, to provide the required level of treatment for the entire wastewater load, including the clear water.

(8) Abbreviations. The following abbreviations are used in this chapter:

(a) The abbreviation "A.S.T.M." means the American Society for Testing and Material, 1916 Race Street, Philadelphia, Pennsylvania, 19103;

(b) The abbreviation "A.W.W.A." means the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado, 80235;

(c) The abbreviation "A.A.S.H.O." means the American Association of State Highway Officials, 341 National Press Building, Washington, D.C., 20004;

(d) The abbreviation "A.S.C.E." means the American Society of Civil Engineers, 33 West 39th Street, New York, New York.

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 therefore 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.

NR 110.05 Sewer Extensions.

(1) Requests for approvals for extension of sanitary sewers to serve subdivisions, commercial establishments, institutional facilities and industrial plants shall be denied if:

(a) an organic or hydraulic overload exists at the sewage treatment plant;

(b) the sewer system to which the connection would be tributary is inadequate to carry existing dry weather flows; or

(c) the additional connections to the sewerage system created by such extension would result in overloading of the sewers or the treatment plant.

The bypassing of sewage within the sewer system or at the treatment plant or the inability of the treatment plant to produce an effluent in compliance with limitations established in the applicable Wisconsin Pollutant Discharge Elimination System (WPDES) permit issued under Chapter 147, Wisconsin Statutes, in the existing system or in the system were such extension made, shall cause such denial.

(2) Variances from the requirements under sub. (1) may be granted if it is determined that:

(a) construction of the subdivision, commercial establishment, institutional facility or industrial plant had commenced prior to the effective date of this subsection, as evidenced by the issuance of a necessary building permit, provided placement of the foundation or other like structure commences within 6 months after the effective date of this subsection;

(b) the area to be served was developed prior to the effective date of this subsection and existing inadequate private waste disposal systems pose a substantial threat to the public health or safety; or

(c) the applicant submits an acceptable schedule for increased sewerage system capacity or load reduction, which is designed to prevent such overload from occurring when such extension is made; provided that the variance shall be voided if the applicant fails to adhere to such approved schedule.

(3) Variances from the requirements under sub. (1) may be granted by the Natural Resources Board, after notice and hearing, for sewer extensions, otherwise prohibited by this section,

where there is shown to be a compelling public need or other extraordinary circumstances as determined by the board.

NR 110.06 Plans for Reviewable Projects.

(1) All plans for reviewable projects submitted to the department shall be in accordance with Chapter NR 108 and shall bear a suitable title block which includes the name of the owner, the scale and the date. The north point shall be shown on each plan. All plans shall be clear and legible. Blueprints will not be accepted. The datum used shall be indicated and shall be related to U.S.G.S. datum.

(2) Detailed construction plans shall contain appropriate plan views, elevations, necessary sections and supplemental views which together with the specifications provide all necessary information for construction of the project. Manufacturers' drawings shall not be accepted.

(3) All plans shall be in conformance with an approved engineering report as required in NR 110.08.

(Note: Applicable state and local codes, including those of the department of industry, labor and human relations, the public service commission and the department of health and social services, should be consulted for other requirements.)

NR 110.07 Specifications for Reviewable Projects.

Complete technical specifications for all reviewable projects shall accompany the plans. Where applicable, the specifications shall generally contain a plan for maintaining the same degree of treatment during construction as that which existed prior to the start of construction. The specifications accompanying the detailed construction drawings shall include, wherever applicable:

(1) All construction information not shown on the plans;

(2) The complete requirements for all mechanical and electrical equipment;

(3) The type and operating characteristics of all equipment;

(4) The laboratory fixtures and equipment;

(5) The construction materials to be used;

(6) The identification of the chemicals to be used;

(7) The instructions for testing materials and equipment to meet design standards; and

(8) The operating tests for the complete treatment plant and component units.

(Note: Specifications reproduced from manufacturers' data and bearing the manufacturers' labels will not be accepted.)

NR 110.08 Engineering Reports for Reviewable Projects.

(1) Applicability. An engineering report shall be included with each reviewable project submitted to the department for approval.

(2) Content. The engineering report shall contain, in a form for convenient and permanent reference, the controlling assumptions made and the factors used in the functional design of the sewerage system as a whole and of each of the component units. The engineering report shall make reference to applicable effluent limitations or applicable basin, metropolitan, areawide and facility water quality management plans and shall clearly indicate how the proposed project is in conformance with such requirements or plans. When applicable, the engineering report shall meet the appropriate federal requirements for facility plans. Engineering reports submitted pursuant to this section shall contain all of the following information, wherever applicable:

(a) Description. A brief description of the project;

(b) Location. A description of the geographic location of the project, including any necessary reference maps or exhibits. Specific locations of existing and proposed sewerage facilities shall also be included;

(c) Topography. A brief description of the topography of the general area with specific reference to the area involved in the project;

(d) Population. Past census data and estimated future population projected to the design year for the area involved in the project;

(e) Soil investigations. A description of the extent of soil investigations, including information on rock likely to be encountered. In addition, that portion of the project which is below high groundwater level shall be indicated. Soil boring information shall be submitted where lagoons are considered as part of the sewage treatment scheme;

(f) Flooding. A designation of any areas of the project which are located within a floodway or a floodplain as defined in Chapter NR 116. All projects shall conform to the requirements of Chapter NR 116;

(g) Implementation capability. A brief statement demonstrating that the owner who will be implementing the project will have the necessary legal, financial, institutional and managerial resources available to insure the construction, operation, and maintenance of the proposed treatment works;

(h) Flow and waste reduction. An evaluation of alternative flow reduction and waste reduction measures;

(i) Land disposal. A detailed description of the feasibility of using ultimate disposal of pollutants to land rather than to the air or the waters of the state;

(j) Cost-effectiveness. After discussion of waste treatment alternatives, the reasons for selection of the recommended alternative. For sewage treatment facilities, the report shall describe why the alternative selected is the most cost-effective alternative. If the most costeffective alternative is not selected, the reasons for selecting a less cost-effective alternative shall be stated;

(k) Costs. A discussion of estimated capital costs, estimated annual operation and maintenance costs, and estimated annual costs to the average user of the system;

(l) Schedule for completion. A basic schedule for completion of design and construction.

NR 110.09 Sewer Projects.

(1) Engineering report. For sewer projects, the engineering report shall include, in addition to the information required under NR 110.08(2), the following:

(a) Extent. A brief description of the extent of the existing and proposed sewers with reference to a general system map as well as a description of the areas of probable future expansion of the sewer system;

(b) Downstream overflows. A statement indicating the number and location of any sewage overflows or bypasses on the downstream sewer system.

(c) Location. The point of connection of the proposed sewers to the existing sewer system;

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

(e) Basis of design. The following data shall be sent forth for the proposed project:

1. Design period;

2. Population densities per acre and total population served;

3. Area served in acres;

4. Per capita sewage contribution expressed as an average and a maximum value;

5. Infiltration;

6. Industrial waste contribution;

7. Design flow rates expressed as average and a maximum values;

8. Size of pipe, grade, velocity and maximum capacity.

(2) Submission of Plans. In addition to the requirements set forth in Chapter NR 108 and in NR 110.06 above, the following requirements shall be adhered to for submission of plans and specifications for sewer projects.

(a) Comprehensive plan. A comprehensive plan shall be submitted showing the proposed sewer extensions and existing sewers in the area of the proposed extensions. The comprehensive plan shall include:

1. Existing or proposed streets and all streams or water surfaces. Contour lines at suitable intervals shall be shown;

2. The direction of flow in all streams, and high and low water elevations of all water surfaces at sewer outlets and overflows;

3. A description of the area to be served and the potential future service area.

(b) Detailed sewer plans. The detailed sewer construction plans shall include a plan and profile view of all proposed construction. The plans and profiles shall show:

1. Location. The location of streets and sewers;

2. Elevations. The line of the ground surface, the invert and surface elevation at each manhole and the grade of the sewer between each two adjacent manholes. Basement elevations shall be noted on the plans or the designing engineer shall state that all sewers are sufficiently deep to serve adjacent basements except where otherwise noted on the plans. Where gravity basement drainage to the proposed sewer will not be possible for existing buildings, the buildings' owners shall be so advised prior to construction of the sewers.

3. Pipe size and material. The pipe size, material, pipe strength and bedding class shall be shown on the plans or in the specifications.

4. Manhole spacing;

5. Special features. The locations of all special features including inverted siphons, concrete encasements, elevated sewers, and other features as appropriate;

6. Existing structures. The location of all known existing structures and utilities which might interfere with the proposed construction, particularly all water mains, gas mains, storm drains, and other pertinent structures;

7. Special drawings. Special detail drawings made to a scale to clearly show the nature of the design shall be furnished to show the following:

a. Stream crossings with elevations of the stream bed and of normal and extreme high and low water levels;

b. Details of all special sewer joints and cross-sections;

c. Details of all sewer appurtenances such as manholes, lampholes, inspection chambers, inverted siphons and elevated sewers.

NR 110.10 Sewage Lift Stations.

(1) Engineering Report. For sewage lift stations, the engineering report shall include, in addition to the information required under NR 110.08(2), the following:

(a) Contributory area. A description of the extent of the existing and proposed contributory area with reference to a general system map as well as a description of the areas of probable future expansion of the contributory area.

(b) Location. The location of the proposed life station, force main and point of discharge to the existing sewer system. In addition the report shall discuss the capacity available in the existing downstream sewer to handle the additional flow.

(c) Basis for design. The design data for the proposed project including the following:

1. Design period;

2. Population densities per acre and total population served;

3. Area served in acres;

4. Per capita sewage contribution expressed as an average and as a maximum value;

5. Infiltration;

6. Industrial waste contribution;

7. Design flow rates expressed as average and maximum values.

(d) Essential features. A description of the essential features of construction and operation of the proposed stations.

(2) Submission of Plans. In addition to the requirements set forth in Chapter NR 108 and in NR 110.06 above, the following requirements shall be adhered to for submission of plans for sewage lift stations:

(a) Location plan. A location plan shall be submitted showing the tributary area, the municipal boundaries within the tributary area and the location of the lift station and force main, and all pertinent elevations.

(b) Detailed plans. The detailed lift station plans shall show the following, where applicable:

1. The location and the topography (using a contour map) of the property to be used;

2. The station details and all appurtenant equipment including pumps, sump pumps, heaters, ventilation equipment, valving, access ladder, intermediate landings, and wet well;

3. The elevation of high water at the site, including the maximum elevation of sewage in the collection system in the event of power failure at the station;

(1) Engineering reports. For sewage treatments plants, the engineering report shall include, in addition to the information required under NR 110.08(2), the following:

(a) Contributory area. A brief description of the extent of the existing and proposed contributory areas to the proposed sewage treatment plant with reference to a general map of the area as well as a description of the areas of probable future expansion of the sewer system contributory to the sewage treatment plant.

(b) Site description. A description of the location of the sewage treatment plant and point of effluent discharge. In addition, a discussion of the various available sites and the reasons for choosing the site recommended shall be included. The site description shall also indicate the proximity of residences or developed areas and shall show access to the proposed site.

(Note: A site survey by the department is necessary prior to evaluation and acceptance of the proposed site.)

(c) Existing plant. If a plant exists, a discussion of the limitation of the plant or of individual units that require additions, modifications or expansions.

(d) Sewer system evaluation. An infiltration/inflow analysis to demonstrate the existence or nonexistence of excessive clear water infiltration or inflow into the sewer system. Where appropriate, this analysis shall be supplemented by a sewer system evaluation survey.

(e) Environmental assessment. An environmental assessment, including a record of any required public hearings, as part of the engineering report.

(f) Alternative waste treatment techniques. A discussion of alternative waste treatment techniques that have been considered and the reasons for choosing the selected alternative. The discussion should analyze the relationship of each alternative to the needs to be served, including adequate reserve capacity. The discussion shall contain an evaluation concerning the capability of each alternative for meeting applicable water quality standards in the receiving water or any applicable effluent limitations or treatment standards.

(g) Basis of design. The design data for the proposed project including:

1. The design period;

2. An analysis of the type of water supply and its effect on the character of the of the sewage;

3. The volume and strength of the sewage flow, for existing installations. (Note: Data shall be from measurements taken during periods of wet and dry weather);

4. Identified data on the flow, producing period and character of all significant industrial waste sources. Any anticipated increased industrial waste contributions and the necessity or desirability of pretreatment of industrial wastes shall also be discussed;

5. Design hydraulic loading including resident and nonresident population and industrial waste loading;

6. Strength of sewage including BOD and suspended solids for domestic sewage and industrial wastes;

7. Sewage flows including per capita and total daily flow and infiltration allowances;

8. Design flow rate including minimum, average and maximum flow rates both for the 24-hour period and for shorter significant periods;

9. A description of the major plant units including capacity, size, equipment and operation factors;

10. A description of the sludge handling process and ultimate disposal of sludge produced in the treatment process;

11. The quanity, quality and effect of recycled streams on the treatment process.

(h) Conformity to Applicable Plans. A detailed discussion demonstrating that the proposed project conforms to all applicable basin, regional, or metrolpolian plans or any applicable areawide waste treatment management plan.

(i) Sewage Treatment Plant Proliferation. In the absence of an applicable plan, the report shall include a statement from the local or regional planning agency approving the project. The report shall also contain a detailed discussion of the feasibility of treating the sewage to be treated by the proposed sewage treatment plant at a regional or municipal treatment facility. (Note: It is the express policy of the department to prevent the proliferation of sewage treatment plants where additional sewage treatment plants are not in the public interest or where alternative means of treating the sewage are feasible.)

(j) Receiving Stream. The name and a description of the nature of the watercourse into which effluent will be discharged. The report shall describe the present condition of the receiving water, its use designation and applicable water quality standards, and any available low flow data. In addition, the report shall describe how applicable water quality standards will be affected by the effluent discharge, with specific reference to the Wisconsin Pollutant Discharge Elimination System (WPDES) discharge permit for the discharge.

(k) Effluent Discharge Rights-of-Way. Where the discharge of effluent is to a ditch, drainage swale or intermittent stream, evidence that effluent discharge rights-of-way have been obtained through purchase, easement or agreement shall be submitted. Such discharge rights-of-way shall be obtained from all owners across whose lands the effluent will flow from the point of discharge to the confluence with a continuously flowing stream. In the event such rights-of-way are not obtained and no alternatives to discharge are available, notice must be given to the affected property owners that sewage effluent will flow across their lands and proof must be submitted to the department that such notice has been given.

(2) Submission of Plans. In addition to the requirements set forth in Chapter NR 108 and in NR 110.06 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. A detailed construction plan shall be submitted which includes:

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.

NR 110.12 Owner Approval Requirement.

If the engineer submitting plans to the department for approval is not an employee of or has not been retained by the owner of the sewerage system for which the plans are submitted, written acceptance of the final plans by the owner shall be required prior to submission of the plans to the department. (Note: For example, if an engineer is retained by a developer to design sewer extensions which will be connected to a municipal system and which will eventually be owned by the municipality, the plans must be accepted by the municipality before the department issues an approval.)

NR 110.13 Sewer Design Criteria.

(1) Separate Sanitary Sewers Required. New systems or extensions to existing systems shall be designed to exclude storm and other clear water sources from the sanitary sewer system. Combined sewers shall be approved as a replacement for existing structurally inadequate combined sewers only when separate sewers cannot be constructed in specific areas. Existing combined sewers shall be eliminated or the pollutional discharges from such sewers shall be controlled as soon as practical and in accordance with applicable state and federal enforcement actions.

(Note: In instances where continued use of combined sewers is proposed and a definite program for treating the combined sewage can be established and found to be cost-effective, the department may waive the requirements of this subsection and approve such plans.)

(2) Design Period. Sewer systems shall be designed for the estimated ultimate tributary population, except for those points of the system that can be readily increased in capacity.

(3) Design Factors. In determining the required capacities of sanitary sewers the following factors shall be considered:

(a) The maximum hourly quantity of sewage;

(b) The maximum waste quantity and flow rate from industrial plants;

(c) The extent of groundwater infiltration.

(4) Design Basis.

(a) New sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day. This figure is assumed to include normal infiltration. Sewers shall be designed to carry, when running full, not less than the following daily per capita contributions of sewage, exclusive of sewage or other wastes from industrial plants and other establishments having high peak flow rates:

1. Submain sewers - 400 gallons.

2. Main, trunk and outfall sewers - 250 gallons.

(b) When deviations from the foregoing per capita rates are proposed, sufficient justification and a brief description of the procedure used for sewer design shall be submitted.

(5) Construction Details.

(a) Diameter. No sewer shall be less than eight inches in diameter.

(b) Depth. Sewers shall be designed deep enough to prevent freezing and, where economically feasible, to provide gravity basement drainage for sanitary wastes.

(c) Slope. Sewers shall be laid with uniform slope between manholes. All sewers shall be designed and constructed to give average velocities when flowing full of not less than 2.0 feet per second based on Kutter's or Manning's formula using an "n" value of 0.013. The following are the minimum slopes which shall be provided:

Sewer Size	Minimum Slope (ft./100 ft.)
8"	0.40
10"	0.28
12"	0.22
15"	0.15
18"	0.12
21"	0.10
24"	0.08

(d) Alignment. Sewers shall normally be laid with straight alignment between manholes. (Note: for 36" diameter sewers or larger, the department may approve curvilinear sewers.)

(e) Increasing size. When a sewer joins a larger one, the invert of the smaller sewer shall be laid at the proper elevation to maintain the same energy gradiant.

(f) Velocity. Where velocities of greater than 15 feet per second are attained, special provision shall be made to protect against displacement or erosion.

(g) Bedding and backfill. The specifications shall provide for proper bedding and backfill for all sewer installations.

(6) Materials. Materials used in the construction of sanitary sewers shall be restricted to the following: asbestos cement, cast iron, concrete, vitrified clay, steel, ductile iron, polyvinyl chloride, Acrylonitrile-Butadiene-Styrene (A.B.S.) Composite, or other materials approved by the department for restricted or experimental use. Where a restricted or experimental use approval is issued, the department may require a construction inspection report and annual reports including television inspection of the system as a condition of its approval.

(a) Quality. All material used for sanitary sewer construction shall be free from defects that impair service.

(b) Labeling. Each length of pipe and fitting used in a sanitary sewer shall be stamped or indelibly marked with the manufacturer's name or mark.

(c) Nonpressure pipe. All nonpressure sewer pipe shall have sufficient strength to withstand the loads which will exist. The following are minimum standards for nonpressure pipe:

1. Asbestos cement pipe and fittings shall meet the requirements of A.S.T.M. C428;

2. Cast iron pipe and fittings shall be of the commercial grade known as "extra heavy" and shall meet the requirements of A.W.W.A C-100;

3. Concrete pipe shall meet the requirements of A.S.T.M. C14, C76 or C655;

4. Vitrified clay pipe shall meet the requirements of A.S.T.M. C700 or A.A.S.H.O.-M65;

5. Steel pipe shall meet the requirements of A.W.W.A. C-200;

6. Ductile iron pipe and fittings shall meet the requirements of A.W.W.A. C-100;

7. Polyvinyl chloride sewer pipe shall meet the requirements of A.S.T.M. D3033 or D3034;

8. A.B.S. Composite sewer pipe shall meet the requirements of A.S.T.M. D2680;

(Note: Other pipe material will be considered on its merits and may be approved by the department.)

9. Copies of the technical references cited above 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 and may be obtained for personal use from the American Society for Testing and Material, 1916 Race Street, Philadelphia, Penn., 19103, and from the American Waterworks Association, 6666 West Quincy Ave., Denver, Colo., 80235.

(d) Joints for nonpressure pipe. The method of making joints and the materials used shall be included in the specifications. Sewer joints shall be designed to minimize infiltration and to prevent the entrance of roots. Joint material shall be of such a composition as not to be adversely affected by the sewage.

1. Asbestos cement pipe joint shall consist of an asbestos cement sleeve and two neoprene or rubber type gaskets.

2. Cast iron pipe joints shall consist of rubber gasket joints, mechanical joints or lead joints meeting the requirements of A.W.W.A. C-100.

3. Rubber gaskets joints for concrete sewer pipe shall meet A.S.T.M. C443.

4. Resilient joints for vitrified clay sewer pipe shall meet A.S.T.M. C425.

5. Steel pipe joints shall meet the requirements of A.W.W.A. C-200.

6. Ductile iron pipe joints shall meet the requirements of A.W.W.A. C-100.

7. Polyvinyl chloride sewer pipe shall be jointed by solvent weld joints or by elastomeric joints which have been approved by the department.

8. A.B.S. Composite sewer pipe shall be jointed by solvent weld joints.

9. Copies of technical references cited above 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 and may be obtained for personal use from the American Society for Testing and Material, 1916 Race Street, Philadelphia, Penn., 19103, and from the American Water Works Association, 6666 West Quincy Ave., Denver, Colo., 80235.

(e) Infiltration limits and testing. Groundwater infiltration into the sanitary sewer system shall be minimized. Leakage tests shall be included in the specifications. Results from groundwater infiltration tests shall not exceed the following limits:

1. Water exfiltration or infiltration shall not exceed 200 gallons per inch of pipe diameter per mile per day for the total system under construction. Leakage between adjacent manholes shall not exceed 500 gallons per inch diameter per mile per day; or

2. A low pressure air test may be substituted for the water exfiltration or infiltration test. The air test, if used, shall conform to the test procedure reported on by Ramseier and Riek in the Journal of Sanitary Engineering Division of the proceedings of the American Society of Civil Engineers, April 1964. Copies of the report by Ramseier and Riek which appeared in the Journal of Sanitary Engineering Division, April 1964, are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes and may be obtained for personal use from the Journal of Sanitary Engineering Division, 345 East 47th Street, New York, New York, 10017.

(f) Pressure sewer pipe and joints. All pressure sewer pipe shall meet the following minimum requirements:

1. Asbestos cement pipe and joints shall meet the requirements of A.W.W.A. C-400.

2. Cast iron pipe and joints shall meet the requirements of A.W.W.A. C-100.

3. Ductile iron pipe and joints shall meet the requirements of A.W.W.A. C-100.

4. Steel pipe and joints shall meet the requirements of A.W.W.A. C-200.

5. Concrete pipe and joints shall meet the requirements of A.W.W.A. C-300.

(Note: Other pipe material or joints will be considered on their merit and may be approved by the department.)

6. Copies of the technical references cited above are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colo., 80235.

(7) Manholes.

(a) Location. Manholes shall be installed at the following locations: 1) at the end of each line; 2) at all changes in grade, size or alignment; 3) at all intersections; and 4) at intervals not greater than 400 feet for sewers 15 inches or less, and 500 feet for sewers 18 inches to 30 inches. Lampholes shall be used only for special conditions. (Note: For sewers greater than 30 inches, the interval between manholes shall be determined on a case by case basis.)

(b) Drop pipe. A drop pipe shall be provided for a sewer entering a manhole where the invert elevation of the entering sewer is 24 inches or more above the spring line of the outgoing sewer. (Note: For large diameter sewers, the use of drop pipes will be evaluated on a case by case basis.)

(c) Diameter. The minimum diameter of manholes shall be 42 inches. (Note: Larger diameters are preferable.)

(d) Construction. Manholes shall be constructed of precast concrete, monolithic concrete, segmented brick or block or other approved materials.

(e) Flow channel. The flow channel through manholes shall be made to conform to the shape and slope of the sewers.

(f) Water tightness. Solid manhole covers shall be used wherever the manhole tops may be flooded by street runoff or high water. Where groundwater conditions are unfavorable, manholes of brick or segmented block shall be waterproofed on the exterior with plaster coatings supplemented by a bituminous waterproof coating or other approved coatings.

(8) Inverted Siphons. Inverted siphons shall have not less than two barrels with a minimum pipe size of 6 inches and shall be provided with the necessary appurtenances for convenient flushing and maintenance. The manholes shall have adequate clearance for rodding and, in general, sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second at average flows. The inlet and outlet details shall be arranged so that the normal flow is diverted to one barrel, and so that either barrel may be removed from service for cleaning.

(9) Protection of Water Supplies.

(a) Cross-connections. There shall be no physical connection between a public or private potable water supply system and a sewer or appurtenance thereto which would permit the passage of any sewage or polluted water into the potable supply. Water main bleeders into sanitary sewer manholes are prohibited.

(b) Separation from wells. Sewers shall be laid at least 200 feet from a public water supply well and at least 50 feet from a private water supply well. All wells located within the distances referred to above shall be indicated on the plans. (Note: In the event these distances cannot be maintained, the department shall be notified and may approve alternate specifications.)

(c) Horizontal separation. Sewers shall be laid at least 8 feet horizontally from any existing or proposed water main. The distance shall be measured center to center. Should local conditions prevent a horizontal separation of 8 feet, a sewer may be laid closer to a water main provided that:

1. The bottom of the water main is at least 18 inches above the top of the sewer and the minimum horizontal separation is 3 feet measured edge to edge; and

2. A profile of the rock surface as determined from exploration shall be shown on the plan when rock excavation is the reason for the variance from the 8-foot separation. (Note: Rock which can be removed by normal excavation methods will not be grounds for a variance from this provision.)

(d) Vertical separation. Whenever sewers cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 6 inches below the bottom of the water main. Whenever sewers cross over water mains, the sewer shall be laid at such an elevation that the bottom of the sewer is at least 18 inches above the top of the water main. (Note: When the elevation of the sewer cannot be varied to meet the above requirements, the department may grant a variance from this requirement, provided that the water main is reconstructed for a minimum distance of 8 feet on each side of the sewer. The purpose of this reconstruction is to insure that one full length of water main is centered on the sewer so that both joints will be as far from the sewer as possible. Structural support of the pipes may be required at some locations.)

(e) Exception. When it is impossible to obtain the proper horizontal and vertical separation set forth in NR 110.13(9)(c) and (d) the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and pressure tested to assure watertightness. All force mains, however, shall be constructed to meet, at a minimum, the requirements set forth in NR 110.13(9)(c)(1).

NR 110.14 Sewage Lift Station Design Criteria.

(1) Location. Sewage lift stations shall be accessible at all times and shall be so located as not to be subject to flooding. (Note: The department recommends that sewage lift stations not be in the traffic lane of a street.)

(2) Design basis. The following items shall be provided where applicable:

(a) Pump chamber. The pump chamber shall be completely separate from the wet well.

(b) Pump removal. Provision shall be made to facilitate removing pumps and motors.

(c) Access. A safe means of access shall be provided to pump chambers and to wet wells containing equipment requiring inspection or maintenance. If a pump chamber is over 20 feet deep, an offset shall be made in the entrance ladder with an intermediate landing at approximately mid-depth. Where an intermediate landing is used, the diameter of the landing area shall be at least 5 feet and a suitable barrier shall be provided to prevent an individual from falling past the intermediate landing to the lower level.

(d) Duplicate units. At least two pumps or pneumatic ejectors shall be provided for each installation. Where the pumping station will serve not more than 25 homes, a single unit may be used, provided that the station is designed to permit the installation of a future duplicate pump with no structural changes. Each pumping unit shall be capable of handling the expected maximum flow. If three or more pumps are provided, they must be designed to fit expected flow conditions and must be capable of handling the maximum flow with one unit out of service.

(e) Protection against clogging. Where a potential for clogging exists, protection in the form of bar screens, mechanically cleaned bar screens, basket screens, comminutors or other suitable means shall be provided.

(f) Pump openings. Pumps must be capable of passing spheres of at least three inches in diameter. With proper protection against clogging, pumps capable of passing 2-1/2-inch spheres may be used on small installations. Pump suction and discharge openings shall be at least four inches in diameter.

(g) Priming. The pump shall be located so that under normal operating conditions it will operate under a positive suction head. Self-priming or vacuum primed pumps are excepted from this requirement.

(h) Electrical equipment. Electrical equipment in enclosed places where gas may accumulate shall comply with the hazardous application conditions of the electrical code.

(i) Intake. (Note: The department recommends that each pump have an individual intake and that intakes be designed with suction elbows with flared opening. In addition, the department recommends that the intake be placed 1/2 the diameter of the bell above the floor.)

(j) Dewatering. A sump pump shall be provided in pump chambers to remove leakage or

drainage with the discharge at an elevation as high as practical in the wet well. A siphon break shall be included at the high point in the wet well.

(k) Pumping rate. The pumping rates for stations discharging to sewage treatment plants must approximate the rate of delivery to the station.

(l) Controls. (Note: There are no requirements for alternative use of pumps in lift stations; however, the department recommends that in small lift stations, provision be made to alternate the pumps in use.)

(m) Valves. Suitable shutoff valves shall be placed on suction and discharge lines of each pump. A check valve shall be placed on each discharge line between the shutoff valve and the pump. (Note: It is recommended that the check valve preferably be on a horizontal section of pipe.)

(n) Wet well size. The effective capacity of the wet well shall provide a holding period not to exceed ten minutes for the design average flow.

(o) Wet well floor slope. The wet well floor shall have a minimum slope of 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom shall be kept to a practical minimum.

(p) Ventilation.

1. Adequate ventilation shall be provided for all pump stations. Where the pump chamber is below the ground surface, mechanical ventilation is required. Mechanical ventilation shall also be provided in all wet wells where equipment requiring inspection or maintenance is located. There shall be no interconnection between wet well and pump chamber ventilation systems. Switches for operation of ventilation equipment shall be marked and conveniently located. (Note: Consideration should be given to the use of automatic controls where intermittent ventilation is used.) Heating and/or dehumidification equipment shall be provided where needed. (Note: Ventilation is not normally required in submersible pump lift stations.)

2. Ventilation for wet wells must provide at least twelve complete air changes per hour if ventilation is continuous and at least thirty complete air changes per hour if ventilation is intermittent. Air shall be forced into the wet well rather than exhausted.

3. Ventilation for pump chambers should provide at least six complete air changes per hour if ventilation is continuous and at least thirty complete air changes per hour if ventilation is intermittent.

(q) Flow measurement. Suitable devices for measuring sewage flow shall be installed.

(r) Water supply. There shall be no connection between any potable water supply and sewage lift station which might cause contamination of the potable supply.

(3) Suction Lift Pumps.

(a) Priming. Suction lift pumps shall be of the self-priming or vacuum primed type. (Note: It is recommended that in general the total suction lift not exceed 15 feet.)

(b) Capacity. The capcity of suction lift pumps shall not exceed 500 gallons per minute. (Note: Larger units may be approved by the department if sufficient justification is presented.)

(4) Submersible Pumps.

(a) Type. Submersible pumps shall be readily removable and replaceable without dewatering the wet well and with continuity of operation of the other unit or units.

(b) Installation. The low water level in the station shall be set at a level such that the pump and motor will be continuously below the minimum sewage level in the wet well or the pump shall be rated as explosion proof by the Board of Fire Underwriters.

(5) Alarms.

(a) Alarm systems shall be provided at all stations. The alarm shall be activated in case of power failure, high water in the wet well or high water in the dry well. In the

event a telephone line to a remote location is used as the means of alarm, the alarm shall be activated in the event of a failure in the telephone line.

(b) The alarm shall be either a suitable audible or visual alarm and shall be so located as to be readily seen or heard.

(6) Emergency Operation.

(a) Provisions for emergency operation of lift stations shall be provided to prevent the discharge of raw or partially treated sewage to a surface water or to the ground surface and to prevent sewage backup into basements.

(b) Power must be available from at least two independent sources or, in the alternative, emergency power generating equipment or portable pumping equipment must be available.

(Note: It is recommended that a point of connection to the discharge force main be installed at a point where portable pumping units can be connected.)

(7) Force Mains.

(a) Velocity. A velocity in excess of two feet per second shall be maintained in force mains.

(b) Air relief valve. An air relief valve shall be placed at high points in the force main to prevent air locking.

(c) Termination. (Note: The department recommends that force mains enter gravity sewer manholes at a point not more than two feet above the spring line of the outgoing sewer.)

NR 110.15 General Requirements for Sewage Treatment Works.

(1) Quality of Effluent.

(a) For purposes of design, the minimum allowable level of treatment shall be that level

of treatment which results in the removal of 90% of the 5-day biochemical oxygen demand (BOD_5) and 90% of the suspended solids (SS). (Note: Higher levels of treatment may be required depending on the characteristic of the waste being treated, the low flow in the receiving stream or the water quality standards of the receiving stream.)

(b) Existing treatment plants capable of removing at least 85% of the BOD_5 and SS and capable of producing an effluent quality of less than 30 mg/l of BOD_5 and SS on a monthly average will be allowed to remain in service for the design life of the plant if water quality standards can be met in the receiving water.

(c) All effluents discharged to a receiving surface water, except those from stabilization ponds, shall be properly disinfected on a continuous basis. All effluents shall contain less than 200 fecal coliform bacteria per 100 ml on a monthly average.

(2) Design Period. Sewage treatment plants shall be designed to provide for the estimated population twenty years hence. (Note: The department will waive this requirement upon a demonstration to its satisfaction that a lesser design period is more cost-effective.)

(3) Plant Location.

(a) Sewage treatment processes, except for lagoon systems, shall be located on sites not less than 500 feet from the nearest inhabited dwelling. Aerated lagoon treatment system shall be located not less than 750 feet from inhabited dwellings and stabilization ponds shall be located not less than 1,500 feet from inhabited dwellings.

(b) Existing treatment facilities which when constructed met the above distance requirement but which have since been encroached upon by residential, commercial or industrial development, shall be subjected to the above requirement at the time of expansion of the facility. (Note: The department may waive this requirement on a case-by-case basis. However, it is recommended that the municipality consider either the purchase of sufficient lands surrounding the plant site or the use of zoning to prevent encroachment of residential, commercial or industrial developments.)

(c) All treatment plants and ponds shall be located such that they are not subject to flooding. No plant or pond shall be located in a floodway. If the plant or pond is

located in a floodplain, it shall conform to Chapter NR 116. The plant or pond shall be accessible at all times.

(4) New Processes, Methods and Equipment. (Note: It is the policy of the department to encourage the development of new methods or equipment for treatment of sewage wastes. 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 the posting of a performance bond by the manufacturer.)

(5) Sewage Flow. Unless satisfactory justification is given for using a different value, new sewage treatment systems shall be designed for an average daily flow of 100 gallons per capita, and for anticipated daily flows from industrial waste contributors. Modifications or expansions of existing treatment systems shall be based on gaugings of the present sewage flow, plus allowance for estimated future increase.

(6) BOD_5 and SS. Unless satisfactory justification is given for using different values, sewage treatment systems shall be designed based on a BOD_5 contribution of 0.17 pounds per capita per day and SS contribution of 0.20 pounds per capita per day and anticipated industrial waste contributions.

(7) Design Loading. The design of treatment units shall be based on an average rate of sewage flow per 24 hours except where significant deviation from normal diurnal flow pattern exists. Industrial waste design flows shall be determined from the observed rate of flow during the significant period of discharge. The following factors shall be evaluated in determining the design flow of the sewage treatment plant:

(a) Peak flow rates occurring over significant time periods;

(b) Data from similar municipalities in the case of new systems;

(c) Wet weather flows. Excessive clear water must be eliminated at its source and must not be included in the plant design.

(d) Recirculation.

(8) Design of Conduits. All piping and channels shall be designed to carry the maximum flows. The incoming sewer shall be designed to operate without surcharge. Pockets, corners and other dead areas where solids can accumulate must be eliminated.

(9) Arrangement of Units. All treatment units shall be arranged to provide operating convenience and flexibility, and to facilitate installation of future units.

(10) By-Passes. Complete plant by-passes shall not be provided. By-passing of individual units for maintenance purposes is permissible. During periods of maintenance, the minimum degree of treatment shall be solids settling and effluent disinfection.

(11) Treatment During Construction. During construction of new facilities, treatment shall be maintained at the same level as that which existed prior to the start of construction.

(12) Construction Materials. Materials shall be selected that are compatible with the characteristics of the sewage wastes. (Note: Dissimilar metals should be avoided to minimize galvanic action.)

(13) Painting.

(a) The use of paints containing lead is prohibited. In order to facilitate the identification of piping, the following color scheme shall be utilized:

1. Sludge line - brown;

2. Gas line - red;

3. Potable water line - blue;

4. Chlorine line - yellow;

5. Sewage line - gray;

6. Compressed air line - green;

7. Nonpotable water line - blue with 6-inch red bands spaced 30 inches apart.

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

(14) Operating Equipment. All necessary tools and accessories for the plant operator's use shall be provided. Storage space and a work area shall also be provided.

(15) Emergency Power. A standby power source shall be provided at each sewage treatment plant in the form of connection to two independent power sources or by providing an emergency power generator. Sufficient emergency power shall be supplied to provide a minimum treatment equivalent to solids settling and effluent disinfection at all times.

(16) Water Supply. An adequate supply of potable water shall be provided for use in the laboratory. No connections shall be made which might cause contamination of a potable water supply.

(a) Direct connections. Potable water from a public supply may be used directly at points above grade for the following hot and cold supplies: lavatory sink, water closet, laboratory sink, shower, eyewash fountain and drinking fountain. Hot water for any of the above shall not be taken directly from a boiler used for supplying hot water to a sludge heat exchanger or digester heating coils.

(b) Indirect connections. Where a potable water supply is to be used for any other purpose than those listed in par. (a), a break tank, pressure pump and pressure tank or a backflow preventer shall be provided.

1. Break tank. Potable water shall be discharged to the break tank through an air gap at least 6 inches above the maximum flood line or the spill line of the tank, whichever is higher. A sign shall be permanently posted at every hose bib, faucet or sill cock located on the water system beyond the break tank to indicate that the water is not safe for drinking.

2. Backflow preventer.

a. Backflow preventers may be used to protect the potable water supply provided that the following conditions are met:

i. Detailed plans and specifications covering the unit and its installation are approved by the Department of Health and Social Services, Plumbing Section, before installation.

ii. The installation is made above grade in a location accessible for testing, inspection and maintenance, and is protected from freezing and flooding.

iii. The unit is installed immediately downstream of the meter prior to any branches off the service line.

b. The following protective devices shall be installed where backflow preventers are used:

i. Chlorinator water supply. A vacuum breaker shall be installed downstream of the last water supply shutoff valve and at an elevation higher than the chlorinator.

ii. Hose bibs and approved yard hydrants. An approved combination backflow-siphon breaker shall be provided.

iii. Sinks or lavatories. A vacuum breaker located 6 - 7 1/2 feet above the sink or, if located at sink elevation, an anti-hose connection on the faucet shall be required.

iv. Pump bearing lubrication. A vacuum breaker shall be provided downstream of the shutoff valve and above the elevation of the pumps. Additionally, a 1/8" to 1/4" bleed line shall be installed that will allow free discharge to a storm sewer or to the ground surface.

(c) Separate potable water supply. Where it is not possible to provide potable water from a public water supply, a separate potable water supply must be provided. (Note: If a

separate well is provided, the well specifications and usage must be approved by the Private Water Supply Section of the department.)

(d) Separate nonpotable water supply. Where a separate nonpotable water supply is provided, a break tank or backflow preventer will not be necessary, but all water outlets must be posted with a permanent sign indicating the water is not safe for drinking.

(17) Sanitary Facilities. (Note: It is recommended that a toilet, shower and lavatory be provided.)

(18) Laboratory Space and Equipment. All treatment works should include a laboratory for making the necessary analytical determinations and operating control tests. Equipment necessary for making the various determinations required by the department should be provided. In lieu of laboratory testing at the plant site, a suitable contract with a neighboring plant or independent laboratory is acceptable.

(19) Flow Measurement. Equipment for flow measurement, totalizing and recording shall be provided for the total waste flow. (Note: It is recommended that measurement of other flow streams within the plant be done in aid of plant operation.)

(20) Floor Slope. Floor surfaces shall be sloped adequately to a point of drainage.

(21) Safety. (Note: Although safety regulation is beyond the scope of these rules, the department recommends that adequate provision be made to effectively protect the operator and visitors from hazards. It is further recommended that the Safety and Health Rules set forth in Chapter IND 1000, Wisconsin Administrative Code, and the appropriate federal and local safety codes be adhered to in the operation of the plant. The following are specific measures which might be taken to enhance the safe operation of the plant:

(a) Enclosure of the plant site with a fence to discourage entrance of animals or unauthorized persons.

(b) Installation of hand rails and guards where necessary.

(c) Provision of first aid equipment.

(d) Posting of "No Smoking" signs in hazardous areas.

(e) Provision of protective clothing and equipment such as gas masks, goggles, gloves.)

NR 110.16 Screening Devices.

(1) Applicability. All sewage treatment plants shall provide protection for pumps and other equipment by installing coarse bar racks or screens, comminutors or mechanically cleaned bar screens. All equipment shall be readily accessible for maintenance. A screening device shall precede grit chambers.

(2) Access. Screening devices shall be provided with convenient access, adequate lighting and ventilation, and convenient and adequate means for removing screenings when necessary.

(3) Separation From Other Equipment in Building. Screening devices installed in a building where other equipment or offices are located shall be separated from the rest of the building, provided with separate outside entrances, and provided with adequate means of ventilation.

(4) Design and Installation.

(a) Nonmechanical screens. Clear openings between bars shall not exceed two inches. Design and installation of bar screens shall be such that they can be conveniently cleaned.

(b) Mechanical screens. Clear openings for mechanically cleaned screens may be as small as adequate for conditions.

(c) Velocities. For hand raked bar screens the screen chamber should be designed to provide a velocity through the screen of approximately one foot per second at average rate of flow. For mechanically cleaned screens, maximum velocities during wet weather periods shall not exceed 2.5 feet per second.

(d) Invert. The screen channel invert must be at least three inches below the invert of the incoming sewer.

(e) Slope. Hand-cleaned screens, except those for emergency use, must be placed on a slope of 30 to 45 degrees with the horizontal.

(5) Channels. The channel preceding and following the screen shall be shaped to minimize settling of soilds. Fillets shall be installed as necessary. Channels shall be equipped with the necessary gates to divert flow from any one screening unit. Methods for dewatering each unit must be provided.

(6) Safety Devices. All mechanical units which are operated by timing devices shall be provided with auxiliary controls which will activate the cleaning mechanism at predetermined high-water marks or differentials in head.

(7) Handling Screenings. Adequate facilities must be provided for removal, handling, storage, and disposal of screenings in a sanitary manner. Hand-cleaned screening facilities must include an accessible platform from which the operator may rake screenings. Suitable drainage facilities must be provided both for the platform and for storage areas.

(8) Auxiliary Screens. Where mechanically operated screening or comminuting devices are used, auxiliary hand-cleaned screens shall be provided. Plant design must provide for the automatic diversion of the entire sewage flow through the auxiliary screens should the regular units fail.

NR 110.17 Grit Removal Facilities.

(1) Applicability. Grit removal facilities are recommended for all sewage treatment plants, and are required for plants receiving sewage from combined sewers or from sewer systems receiving substantial amounts of grit.

(2) Type and Number of Units. Grit removal facilities must have at least two hand-cleaned units, or a mechanically cleaned unit with a by-pass. Where aerated grit chambers are proposed, detailed design information and necessary supporting documents shall be provided with the plans.

(3) Design Factors.

(a) Inlet. Inlet turbulence shall be minimized.

(b) Velocity and detention. Channel-type chambers shall be designed to provide controlled velocities of one foot per second. The detention period shall be based on the size of particle to be removed.

(c) Grit washing. All facilities not provided with positive velocity control shall include means for grit washing to further separate organic and inorganic materials.

(d) Drains. Drains or other means for dewatering each unit must be provided.

NR 110.18 Settling Tanks.

(1) Inlets. Settling tank inlets shall be designed to dissipate the inlet velocity, to distribute the flow equally and to prevent short-circuiting. Channels shall be designed to maintain a velocity of at least one foot per second at one-half of design flow. Corner pockets and dead ends shall be eliminated and corner fillets or channeling used where necessary. Elimination or removal of floating materials in inlet structures having submerged ports shall be required.

(2) Length of Flow. The minimum length of flow from inlet to outlet shall not be less than 10 feet unless special provision is made to prevent short-circuiting.

(3) Scum Baffles. Scum baffles shall be provided ahead of outlet weirs on all primary and final settling tanks. Mechanical scum removal equipment shall be provided in all primary and final settling tanks. (Note: It is recommended that decanting tanks be used.)

(4) Weirs. Overflow weirs shall be adjustable. Weir loadings shall not exceed 10,000 gallons per day per linear foot for plants designed for average flows of 1.0 mgd or less. (Note: Weir loadings not in excess of 15,000 gallons per day per linear foot may be approved by the department for plants designed for flows in excess of 1.0 mgd.)

(5) Submerged Surfaces. The tops of troughs, beams, and similar construction features which are submerged shall have a minimum slope of 1.4 vertical to one horizontal. (Note: It is recommended that a slope of one to one on the underside of such features to prevent the accumulation of scum and solids be provided.)

(6) Multiple Tanks. Multiple units shall be provided at all plants with a design flow of greater than 0.5 mgd. (Note: The department may waive this requirement if it concludes that the facilities can be effectively operated for a short time with a single unit removed from service.)

(7) Servicing Facilities. All settling basins shall be provided with easy access for maintenance.

(8) Surface Settling Rates.

(a) Primary settling tanks. Surface settling rates for primary tanks shall not exceed 600 gallons per day per square foot based on the design flow for plants where excess activated sludge or recirculated flows are returned to the primary settling tanks. In other cases, the surface settling rates shall not exceed 1,000 gallons per day per square foot based on the design flow.

(b) Intermediate settling tanks. Surface settling rates for intermediate settling tanks shall not exceed 1,000 gallons per day per square foot based on their design flow.

(c) Final settling tanks. Surface settling rates for final settling tanks, based on their design flow, shall not exceed 600 gallons per day per square foot except as provided in NR 110.20(5)(b).

(3) Scum Baffles. Scum baffles shall be provided ahead of outlet weirs on all primary and final settling tanks. Mechanical scum removal equipment shall be provided in all primary and final settling tanks. (Note: It is recommended that decanting tanks be used.)

(4) Weirs. Overflow weirs shall be adjustable. Weir loadings shall not exceed 10,000 gallons per day per linear foot for plants designed for average flows of 1.0 mgd or less. (Note: Weir loadings not in excess of 15,000 gallons per day per linear foot may be approved by the department for plants designed for flows in excess of 1.0 mgd.)

(5) Submerged Surfaces. The tops of troughs, beams, and similar construction features which are submerged shall have a minimum slope of 1.4 vertical to one horizontal. (Note: It is recommended that a slope of one to one on the underside of such features to prevent the accumulation of scum and solids be provided.)

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(b) Intermediate settling tanks. Surface settling rates for intermediate settling tanks shall not exceed 1,000 gallons per day per square foot based on their design flow.

(c) Final settling tanks. Surface settling rates for final settling tanks, based on their design flow, shall not exceed 600 gallons per day per square foot except as provided in NR 110.20(5)(b).

(9) Sludge Removal. Direct pump suction to the sludge hoppers of primary settling tanks shall be provided. A sludge well shall be provided or appropriate equipment installed for viewing and sampling the sludge. Continuous sludge removal from final settling tanks shall be provided. Each sludge hopper shall have an individually valved sludge withdrawal line at least six inches in diameter. Head available for withdrawal of sludge shall be at least 30 inches for gravity withdrawal.

(10) Depth. The liquid depth of mechanically cleaned settling tanks shall be as shallow as practical but not less than seven feet. Final clarifiers for activated sludge shall not be less than ten feet in depth.

(11) Sludge Hoppers. Hoppers shall be accessible for maintenance from the operating level. The minimum slope of the side walls of sludge hoppers shall be 1.7 vertical to one horizontal. Clearance between the end of the sludge draw-off pipe and the hopper walls shall be sufficient to prevent "bridging" of solids. Hopper bottoms shall have a maximum dimension of two feet along the side.

(12) Mechanical Sludge Collection Equipment. Suitable mechanical sludge collection equipment shall be provided in all settling tanks except for installations too small to warrant the use of mechanically equipped tanks.

(13) Imhoff Tanks. Imhoff tanks are not acceptable. (Note: The department will waive this prohibition and approve Imhoff tanks only when plans are accompanied by sufficient justification and detailed design data.)

NR 110.19 Biological Treatment: Trickling Filters.

(1) Applicability. New trickling filters are not acceptable unless used in conjunction with other treatment units which will produce an overall level of treatment defined as acceptable in NR 110.15(1). Existing trickling filters may be used as a treatment unit in plant expansion if the overall requirements of NR 110.15(1) are met. Trickling filters shall be preceded by approved settling tanks equipped with scum collecting devices, or other suitable pretreatment facilities.

(2) Design Basis. Trickling filters shall be designed to accept an organic loading of less than 50 pounds of BOD_5 per 1,000 cubic feet of media. Filters using manufactured media shall be loaded at less than 75 pounds BOD5 per 1,000 cubic feet of media. (Note: The department may approve a higher loading rate depending on the use of the filter with respect to other plant units.)

(3) Dosing Equipment.

(a) Distribution. The sewage shall be distributed over the filter by rotary distributors or other suitable devices which will permit reasonably uniform distribution to the surface area.

(b) Dosing. Sewage shall be applied to the filters by siphons, pumps or by gravity discharge from preceding treatment units when suitable flow characteristics have been developed. Application of the sewage shall be continuous. A piping system which will permit recirculation shall be provided.

(c) Clearance. A minimum clearance of 6 inches between media and distributor arms shall be provided.

(4) Media.

(a) Type. The media shall be crushed rock, slag or any approved specially manufactured material.

(b) Quality. The media shall be durable, resistant to spalling or flaking, and be relatively insoluble in sewage. The top 18 inches of natural aggregate shall have a loss of not more than 10 percent as measured by the 20-cycle, sodium sulfate soundness test, with the balance passing a 10-cycle test. The test shall be done in accordance with A.S.C.E. Manual of Engineering Practice, Number 13. Copies of the A.S.C.E. Manual of Engineering Practice, Number 13, are available for inspection at the office of the department of natural resources, secretary of state's office and the office of the revisor of statutes and may be obtained for personal use from the American Society of Civil Engineers, 33 West 39th Street, New York, New York. Slag media shall be free from iron. Manufactured media shall be structurally stable and chemically and biologically inert.

(c) Depth. The filter media shall have a minimum depth of 5 feet above the underdrains and shall not exceed 7 feet in depth except where special construction is justified by studies.

(5) Size and Grading of Media.

(a) Rock, slag and similar media. Rock, slag and similar media shall not contain more than 5 percent by weight of pieces whose longest dimension is 3 times the least dimension. They shall be free from thin elongated and flat pieces, dust, clay, sand, or fine material and shall conform to the following size and grading when mechanically graded over vibrating screen with square openings:

1. Passing 4-1/2-inch screen - 100% by weight;

2. Retained on 3-inch screen - 95-100% by weight;

3. Passing 2-inch screen - 0-2% by weight;

4. Passing 1-inch screen - 0-1% by weight;

(b) Handling and placing of media. Material delivered to the filter site shall be stored on wood planked or other approved clean hard surfaced areas. All material shall be rehandled at the filter site and no material shall be dumped directly into the filter. Crushed rock, slag and similar media shall be rescreened or forked at the filter site to remove all fines. Such material shall be placed by hand to a depth of 12 inches above the tile underdrains and all material shall be carefully placed so as not to damage the underdrains. The remainder of the material shall be placed by means of belt conveyors or equally effective methods. Trucks, tractors, or other heavy equipment shall not be driven over the filter during or after construction.

(6) Underdrainage System.

(a) Arrangement. Underdrains with semi-circular inverts or equivalent should be provided and the underdrainage system shall cover the entire floor of the filter. Inlet openings into the underdrains shall have an unsubmerged gross combined area equal to at least 15 percent of the surface area of the filter.

(b) Slope. The underdrains shall have a minimum slope of 1 percent. Effluent channels shall be designed to produce a minimum velocity of 2 feet per second at average daily rate of application to the filter.

(c) Flushing. Provision shall be made for flushing the underdrains. In small filters, use of a peripheral head channel with vertical vents is acceptable for flushing purposes. Inspection facilities shall be provided.

(d) Ventilation. The underdrainage system, effluent channels, and effluent pipe shall be designed to permit free passage of air. The size of drains, channels, and pipe shall be such that not more than 50 percent of their cross-sectional area will be submerged under the design hydraulic loading. (Note: The design of the effluent channels should consider the possibility of increased hydraulic loading.)

(7) Protection From Freezing.

(a) Covers. Covers shall be provided on all filters to prevent icing and freezing during wintertime conditions and to increase the efficiency of removal through the filter during cold weather. (Note: Where it can be demonstrated that freezing is not a problem and efficiencies are maintained at a high level during all weather conditions, the department may waive this requirement. Other means to prevent freezing and improve efficiency will also be considered by the department on their individual merits.)

(b) Ventilation of covered filters. Adequate ventilation shall be provided to maintain the filter in an aerobic state at all times. (Note: Mechanical power ventilation at all installations is recommended.)

(8) Special Features.

(a) Flooding. (Note: It is recommended that filter structures be so designed so that they may be flooded.)

(b) Seals. Mercury seals shall not be used on trickling filter distributors.

(c) Maintenance. All distribution devices, underdrains, channels and pipes shall be installed so that they may be properly maintained, flushed or drained.

(d) Flow measurement. Devices shall be provided to permit measurement of flow to the filter, including the amount of recirculated flow.

NR 110.20 Biological Treatment: Activated Sludge.

(1) Applicability. (Note: The activated sludge process, and its various modifications, may be used where sewage is amenable to biological treatment.)

(2) Process Selection. All designs shall provide for flexibility in operation. (Note: Choice of the activated sludge process most applicable will be influenced by the proposed plant size, type of waste to be treated, and degree and consistency of treatment required.)

(3) Winter Protection. Measures shall be taken to insure against freezing.

(4) Pretreatment. Where primary settling tanks are not used, effective removal of grit, debris, excessive oil or grease, and comminution of solids shall be accomplished prior to the activated sludge process.

(5) Settling Tanks. The following requirements are in addition to those set forth in NR 110.18:

(a) By-pass. When a primary settling tank is used, piping shall be provided to allow raw sewage to be discharged directly to the aeration tanks following pretreatment. When a primary settling tank is not used, piping shall be provided to allow raw sewage to be discharged to the final settling tanks to permit a minimum of primary treatment and effluent disinfection.

(b) Final settling tanks.

1. Inlets, sludge collection and sludge withdrawal facilities shall be designed as to minimize density currents and assure rapid return of sludge to the aeration tanks.

2. Multiple units capable of independent operation shall be provided in all plants where design flows exceed 500,000 gallons per day, unless other provision is made to assure continuity of treatment.

3. Effective baffling and mechanical scum removal equipment shall be provided for all final settling tanks.

4. (Note: The department recommends that the following design parameters be observed in the design of final settling tanks for the following activated sludge processes, except that due consideration be given to the flow duration and the solids loading rate.

Type of Process	Average Design Flow, MGD	Average Detention Time-Hours	Surface Settling Rates (gal/day/sq.ft.)
Conventional or Step Aeration	to 0.5	3.0	600
	0.5 to 1.5	2.5	600
	1.5 up	2.0	600
Contact Stabilization	to 0.5	3.6	500
	0.5 to 1.5	3.0	600
	1.5 up	2.5	600
Extended Aeration	to 0.05	4.0	300
	0.05 to 0.15	3.6	300
	0.15 up	3.0	400
Complete mix	to 0.5	3.5	400
	0.5 to 1.5	3.0	500
	1.5 up	3.0	500)

(6) Aeration Tanks.

(a) General. The size of the aeration tank for any particular adaptation of the process shall be based on such factors as the size of the plant, degree of treatment desired, mixed liquor suspended solids concentration, BOD loading, and mixed liquor solids to BOD loading ratio. Cacluations shall be submitted to justify the basis of design of the aeration tank capacity. Pilot plant studies may be considered as a basis for justification of the design of the system. When such calculations are not submitted to justify the capacity of the aeration tank, the minimum tank capacities set forth in paragraph (b) shall be required for the various modifications of the activated sludge process.

(b) Aeration tank capacities and permissible loadings.

Type of Process	Average Design Flow, MGD	Average Aeration Retention Period-Hours	Average Aerator Loading Lb. BOD_5/1,000 cubic feet
Conventional or Step Aeration	to 1.5	7.5	30
	1.5 up	6.0	40
Contact Stabilization	to 1.5	3.0 (in contact zone)	30
	1.5 up	2.0 (in contact zone)	40
Extended Aeration	All	24	12.5
Complete mix	to 1.5	6.0	40
	1.5 up	4.5	50

(Note: Contact Zone = 30-35% of total aeration tank volumes. Balance is in the reaeration zone.)

(7) Arrangement of Aeration Tanks.

(a) General. The dimensions of each independent mixed liquor aeration tank or return sludge reaeration tank shall be such as to maintain effective mixing and utilization of air. For very small tanks or tanks with special configuration, the shape of the tank and the installation of aeration equipment shall provide for positive control of short-circuiting through the tank. (Note: The department recommends that liquid depths be not less than 10 feet nor more than 15 feet except in special design cases.)

(b) Number of units. Duplicate units shall be provided where the design flow exceeds 500,000 gallons per day.

(c) Inlets and outlets.

1. Controls. Inlets and outlets for each aeration tank unit shall be equipped with valves, gates, stop plates, weirs, or other devices to permit controlling the flow to any unit and to maintain resonably constant liquid level. The hydraulic properties of the system shall permit the maximum instantaneous hydraulic load to be carried with any single aeration tank unit out of service.

2. Conduits. Channels and pipes carrying liquids with solids in suspension shall be designed to maintain self-cleansing velocities or shall be agitated to keep such solids in suspension at all rates of flow within the design limits.

(d) Measuring devices. Devices shall be installed for measuring and displaying flow rates of raw sewage or primary effluent, return sludge, and air to each tank unit. For plants designed for sewage flows of 1.5 mgd or more, these devices must totalize and record, as well as indicate, flows. Where the design provides for all return sludge to be mixed with the raw sewage or primary effluent at one location, then the mixed liquor flow rate to each aeration unit shall be measured.

(e) Freeboard. All aeration tanks shall have a freeboard of not less than 18 inches.

(8) Aeration Equipment.

(a) General. Aeration equipment shall be capable of maintaining a minimum of 2.0 mg/l of dissolved oxygen in the mixed liquor at all times and of providing thorough mixing of the mixed liquor.

(b) Diffused air systems.

1. Diffused air systems shall provide a minimum of 1,500 cubic feet of air per pound of BOD_5 applied to the aeration tank for all processes except extended aeration. For extended aeration, a minimum of 2,000 cubic feet of air per pound of BOD_5 shall be provided. In any case, the requirements of NR 110.20(8)(a) shall be met.

2. In addition to the requirements of NR 110.20(8)(b)(1), the diffused air system shall provide such additional quantities of air as are required for channels, pumps or other air-use demands.

3. The blowers shall be provided in multiple units, adequately housed and so arranged and with such capacities as to meet the maximum air demand with the single largest unit out of service. The design shall also provide the capability of varying the volume of air delivered in proportion to the load demand of the plant.

4. The air diffusion piping and diffuser system shall be capable of delivering 200 percent of the normal air requirements. The spacing of diffusers shall be in accordance with the oxygenation requirements through the length of the channel or tank. The arrangement of diffusers shall permit their removal for inspection, maintenance and replacement without dewatering the tank and without shutting off the air supply to other diffusers in the tank. (Note: In large systems, the department may waive the requirement of removable diffusers provided the efficiency of the system can be maintained with one unit out of service.)

(c) Mechanical aeration systems.

1. A minimum of 1.0 pound of oxygen per pound of BOD_5 applied to the aeration tank shall be provided. (Note: A transfer rate of 2.0 pounds of oxygen per horsepower hour will be allowed. Higher transfer rates may be approved where adequate test data is provided.)

2. Multiple mechanical aeration units shall be designed and located so as to meet the maximum air demand with the largest unit out of service. Spare equipment shall be provided at the treatment plant so that any unit can be returned to service with a minimum amount of down time.

(d) Pure oxygen. Where pure oxygen is proposed, supporting data from pilot plant installations or similar full-scale installations shall be submitted to justify the proposed aerator loading rate and the amount and type of aeration capacity and equipment proposed.

(9) Return Sludge Equipment.

(a) Return sludge rate. The rate of sludge return expressed as a percentage of the average design flow of sewage must lie within the following limits:

	Minimum	Normal	Maximum
Conventional	15	30	75
Step aeration	20	50	75
Contact stabilization	50	100	150
Extended aeration	50	100	200
Complete mix	20	50	75

(b) Return sludge pumps.

1. If motor driven return sludge pumps are used, the maximum return sludge capacity must be met with the largest pump out of service. A positive head shall be provided on pump suctions. Pumps shall also have at least 3-inch suction and discharge openings.

2. If air lifts are used for returning sludge from each settling tank hopper, no standby unit is required provided the design of the air lifts are such as to facilitate their rapid and easy cleaning. Air lifts shall be at least 3 inches in diameter.

(c) Return sludge piping. Suction and discharge piping shall be at least 4 inches in diameter and must be designed to maintain a velocity of not less than 2 feet per second when return sludge facilities are operating at normal return sludge rates. Suitable devices for observing, sampling and controlling return activated sludge flow from each settling tank shall be provided.

(d) Waste sludge facilities. Waste sludge control facilities shall have a maximum capacity of not less than 25 percent of the average rate of sewage flow and function satisfactorily at rates of 0.5 percent of average sewage flow or a minimum of 10 gallons per minute, whichever is larger. Means for observing, measuring, sampling, and controlling waste activated sludge flow shall be provided. Waste sludge may be discharged to the primary settling tank, concentration or thickening tank, sludge digestion tank, vacuum filters, or any practical combination of these units.

NR 110.21 Biological Treatment: Fixed Film Contacters

Projects proposing to employ fixed film contacters as a means of treatment will be reviewed on their merits. The department may approve such devices if adequate substantiating design information is provided.

NR 110.22 Physical-Chemical Treatment

Projects proposing to employ physical-chemical processes as a means of treatment will be reviewed on their merits. The department may approve such devices if adequate substantiating design information is provided.

NR. 110.23 Disinfection

(1) General. Continuous year-round effluent disinfection shall be provided to reduce the risk of a public health hazard. Chlorine is the most commonly used chemical. Use of ozone and other chemcials or methods may be approved by the department in individual cases.

(2) Forms of Chlorine. Liquid chlorine or calcium or sodium hypochlorite are approved forms of chlorine. Selection of the form of chlorine must be based on waste flow rates, application and demand rates, pH of waste, cost of equipment and the chemical, availability and maintenance problems.

(3) Feed Equipment.

(a) Type. Solution-feed vacuum-type chlorinators are required for large installations. The use of positive displacement type hypochlorite feeders may be approved by the department on a case-by-case basis.

(b) Capacity. Required chlorinator capacity will vary, depending on the uses and points of application of the chlorine. For disinfection, the capacity must be adequate to produce a concentration of residual chlorine in the plant effluent of at least 0.5 mg/l as measured by the Orthotolidine-arsenite test as specified in the Standard Methods for the Examination of Water and Wastewater, 13th Edition, 1971.

NOTE: Copies of the technical reference cited above are available for inspection at the office of the department of natural resources, the secretary of state's office and the office of the revisor of statutes and may be obtained for personal use from the American Public Health Association, 1015 Eighteenth Street, N.W., Washington, D.C., 20036.

(4) Chlorine Supply.

(a) Cylinders. (Note: The department recommends use of 1-ton containers of chlorine where the average daily chlorine consumption is over 150 pounds.)

(b) Tank cars. (Note: The department recommends that large installations use tank cars, generally accompanied by gas evaporators as the source of chlorine supply.)

(c) Scales. Scales or other means of determining chlorine usage must be provided at all plants using chlorine gas for disinfection. Scales shall be of corrosion-resistant material. (Note: At large plants, scales of the indicating and recording type are recommended.)

(d) Evaporators. Where manifolding of several cylinders will be required to evaporate sufficient chlorine, gas evaporators shall be installed.

(e) Leak detection and controls. A bottle of ammonium hydroxide solution shall be available for detecting chlorine leaks. (Note: The department recommends that caustic soda solution reaction tanks be installed for absorbing the contents of leaking 1-ton cylinders where such cylinders are in use. At large installations the department recommends that automatic gas detection and related alarm equipment be installed.)

(5) Piping and Connections.

(a) Only piping systems specifically manufacured for chlorine service are approvable. Piping must be well supported and protected against temperature extremes.

(b) Due to the corrosiveness of wet chlorine, all lines designed to handle dry chlorine must be protected from the entrance of water or air containing water.

(6) Housing.

(a) Separation. If gas chlorination equipment and chlorine cylinders are to be in a building used for other purposes, a gas-tight partition shall separate this room from any other portion of the building. Doors to this room shall open only to the outside of the building, and shall be equipped with panic or emergency hardware. Such rooms shall be at least 6" above ground level, and must permit easy access to all equipment. Storage area shall be separated from the feed area.

(b) Inspection window. A clear glass, gas-tight window shall be installed in an exterior door or interior wall of the chlorinator room to permit the chlorinator to be viewed without entering the room.

(c) Temperature control. Chlorinator rooms shall be maintained at a temperature not less than 60°F and not greater than 140°F. Cylinders shall be kept at essentially room temperature.

(d) Ventilation. Forced, mechanical ventilation shall be installed which will provide one complete air change per minute. The entrance to the air exhaust duct from the room shall be near the floor and the point of discharge shall be so located as not to contaminate the air inlet to any buildings or inhabited areas. Air inlets shall be so located as to provide cross ventilation and at such a temperature that will not adversely affect the chlorination equipment. The vent hose from the chlorinator shall discharge to the outside atmosphere above grade.

(e) Electrical controls. The controls for the fans and lights shall be such that the fans and lights will automatically operate when the door is opened and can also be manually operated from the outside without opening the door.

(7) Safety Equipment. At least one gas mask in good operating condition approved by the U. S. Bureau of Mines as suitable for high concentrations of chlorine gas must be available at all installations where chlorine gas is handled and shall be stored outside of any room where chlorine is used or stored. Instructions for using, testing, and replacing mask parts, including canisters shall be posted. (Note: At large installations, the department recommends the use of self-contained, oxygen-supplying equipment.)

(8) Application of Chlorine.

(a) Contact period. After thorough mixing, a minimum contact period of 15 minutes at peak hourly flow or maximum rate of pumpage shall be provided.

(b) Contact tank. Effluent disinfection using chlorine shall be accomplished in a separate chlorine contact tank. The contact tank shall be constructed so as to minimize short-circuiting. Over-and-under- or end-around baffling or other means of achieving mixing shall be provided.

NR 110.24 Phosphorus Removal

(1) Applicability.

(a) The department may require removal of excess amounts of phosphorus from any municipal waste discharge where such discharge is causing, or may cause, over-fertilization of surface waters.

(b) Phosphorus removal shall be provided at all municipal waste discharges serving a population equivalent of greater than 2,500 in the Lake Michigan and Lake Superior drainage basins.

(2) Degree of Treatment. Phosphorus removal facilities shall be designed to achieve a monthly average phosphorus concentration in the effluent of not more than 1.0 mg/l of total phosphorus. In instances where it can be demonstrated that 1.0 mg/l phosphorus cannot be achieved on a monthly average, the system shall be operated to remove at least 85% of the influent phosphorus on an annual average.

(3) Method of Treatment. Phosphorus removal shall be achieved by use of chemical precipitation or by any other method that has been proven effective by pilot plant testing.

(a) Chemicals. The following chemicals are considered acceptable for removing phosphorus: ferrous or ferric chloride, ferrous or ferric sulfate, aluminum sulfate, sodium aluminate, or other suitable metal salts. (Note: Selection of the chemical used should be based on the waste characteristics. Pilot plant work or jar testing is recommended.)

(b) Chemical feed equipment. Feed equipment shall be selected which allows the use of various chemicals. Alternate points of chemical application within the flow scheme shall be provided for flexibility of operation and to maximize removal of phosphorus.

(c) Polymers. Polymers shall be used if necessary to meet the effluent concentration limits.

NR 110.25 Hazardous Chemical Handling

(1) Containment Materials. The materials utilized for storage, piping, valves, pumping, metering, splash guards, and any other equipment used to contain or convey hazardous or corrosive chemicals shall be selected based on the physical and chemical characteristics of each such chemical used. Chlorine shall be handled separately in accordance of the requirements of NR 110.23.

(2) Secondary Containment. Chemical storage areas shall be enclosed in dykes or curbs which will contain the stored volume until it can be either safely transferred to alternate storage areas or released to the wastewater at controlled rates which will not damage facilities, inhibit the treatment processes or contribute to stream pollution. Liquid polymer shall be similarly contained. (Note: Nonslip floor surfaces are desirable in polymer handling areas.)

(3) Eye Wash Fountains and Safety Showers.

(a) Eye wash fountains and safety showers utilizing potable water shall be provided in the laboratory and on each floor level or work location involving hazardous or corrosive chemical storage, mixing or slaking, pumping, metering, or transportation unloading. These facilities shall be as close as practical to possible chemical exposure sites and shall be fully useful during all weather conditions.

(b) The eyewash fountains shall be supplied with water of moderate temperature between 50°F and 90°F, separate from the hot water supply, suitable to provide 15 minutes to 30 minutes of continuous irrigation of the eyes.

(c) The emergency showers shall be capable of discharging 30 to 50 gpm of water at moderate temperature at pressures of 20 to 50 psi. (Note: It is recommended that the eyewash fountains and showers be no more than 25 feet from points of caustic exposure.)

(4) Splash Guards. All pumps or feeders for hazardous or corrosive chemicals shall have guards which will effectively prevent spray of chemicals into space occupied by personnel. The splash guards are in addition to guards to prevent injury from moving or rotating machinery parts.

(5) Piping, Labeling, Coupling Guards, Location. All piping containing or transporting corrosive or hazardous chemicals shall be identified with labels every ten feet and with at least two labels in each room, closet or pipe chase. Color coding may also be used but is not an adequate substitute for labeling. All connections except those adjacent to storage or feeder areas, shall have guards which will direct any leakage away from space occupied by personnel. Pipes containing hazardous or corrosive chemicals shall not be located above shoulder level except where continuous drip collection trays and coupling guards will eliminate the spraying or dripping of such chemicals onto personnel.

(6) Protective Clothing and Equipment. The following items of protective clothing or equipment shall be available for all operations or procedures where their use will minimize injury hazard to personnel and will insure the continuous operation of the facility:

(a) Respirators. (An air supply type is recommended for protection against chlorine.)

(b) Chemical workers' goggles or other suitable goggles. Safety glasses are insufficient.

(c) Face masks or shields for use over goggles.

(d) Rubber gloves.

(e) Rubber aprons with leg straps.

(f) Rubber boots. Leather and wool clothing should be avoided near caustics.

(g) Safety harness and line.

(7) Warning Systems and Signs. Facilities shall be provided for automatic shutdown of pumps and sounding of alarms when failure occurs in a pressurized chemical discharge line. (Note: The department strongly recommends that warning signs requiring use of goggles be located near chemical unloading stations, pumps and other points of frequent hazard.)

(8) Dust Collection. (Note: The department strongly recommends that dust collection equipment be provided to protect personnel from dusts injurious to the lungs or skin and to prevent polymer dust from settling on walkways.)

NR 110.26 Supplemental Treatment Facilities

(1) Applicability. Supplemental treatment facilities shall be required at all treatment plants where conventional secondary treatment facilities will not produce an effluent which will meet the water quality standards of the receiving water.

(2) Design basis. Proposals for supplemental facilities will be evaluated on an individual basis. Pilot studies to determine design criteria are recommended. The following methods of supplemental treatment may be approved by the department.

(a) Filtration. A loading rate of not more than 5.0 gallons per minute per square foot of filter surface area shall be provided at the design maximum flow. Multiple units shall be provided. Use of air scouring facilities is recommended. A backwash water holding tank shall be provided. The backwash water shall be returned to the treatment process at a rate of not more than 15% of the average design forward flow. Provision shall be made to backwash each filter unit at a rate of at least 15 gpm/ft^2 for a minimum of 10 minutes.

(b) Microstraining. A loading rate of not more than 5.0 gallons per minute per square foot of surface area shall be provided at design maximum flow. Multiple units shall be provided.

(c) Others. Other methods of supplemental treatment will be considered based on an evaluation of pilot plant studies substantiating the design.

NR 110.27 Sludge Handling and Disposal

(1) Anaerobic Sludge Digestion.

(a) General

1. Multiple units. (Note: The department recommends that multiple digestion tanks be used. Where a single digestion tank is used it is desirable to have a lagoon or storage tank for emergency use so that the tank may be taken out of service without interrupting plant operation.)

2. Sludge storage. Sludge storage and supernatant separation in an additional unit shall be required, if raw sludge concentration and disposal methods for sludge and supernatant require it.

3. Depth. The proportion of depth to diameter should be such as to allow for the formation of a reasonable depth of supernatant liquor.

4. Maintenance provisions. (Note: To facilitate emptying, cleaning, and maintenance the following features are recommended:

a. The tank bottom should slope to drain toward the withdrawal pipe.

b. At least 2 access manholes should be provided in the top of the tank in addition to the gas dome. One opening should preferably be large enough to permit the use of mechanical equipment to remove grit and sand. Consideration should be given to use of a separate side wall manhole.

c. Nonsparking tools, rubber soled shoes, safety harness, gas detectors for inflammable and toxic gases, and gas masks of the hose or oxygen helmet type should be provided.)

(b) Sludge inlets and outlets. Multiple sludge inlets and draw-offs and, where used, multiple recirculation suction and discharge points to facilitate flexible operation and effective mixing of the digester contents shall be provided unless adequate mixing facilities are provided within the digester. One 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.

(c) Tank capacity.

1. The total digestion tank capacity shall be calculated based upon such factors as volume of sludge added, its percent solids, and character, the temperature to be maintained in the digesters, the degree or extent of mixing to be obtained, the degree of volatile solids reduction required, and the size of the installation with appropriate allowances for sludge and supernatant storage. Calculations shall be submitted to justify the basis of design.

2. When such calculations are not submitted to justify the design based on the above factors, the minimum combined digestion tank capacity outlined below shall be required. Such requirements assume that the raw sludge is derived from ordinary domestic wastewater, a digestion temperature is to be maintained in the range of 85^{0} to 95^{0}F, 40 to 50 percent volatile matter in the digested sludge and that the digested sludge will be removed frequently from the process.

a. Completely mixed systems. For digestion systems providing for intimate and effective mixing of the digester contents, the maximum system loading is 80 pounds of volatile solids per 1,000 cubic feet of volume per day in the active digestion units.

b. Moderately mixed systems. For digestion systems where mixing is accomplished only by circulating sludge through an external heat exchanger, the maximum system loading is 40 pounds of volatile solids per 1,000 cubic feet of volume per day in the active digestion units. This 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.

(d) Gas collection, piping, and appurtenances.

1. General. All portions of the gas system including the space above the tank liquor storage facilities and piping shall be so designed that under all normal operating conditions, including sludge withdrawal, the gas will be maintained under pressure. All enclosed areas where any gas leakage might occur shall be adequately ventilated.

2. Safety equipment. All necessary safety facilities shall be included where gas is produced. Pressure and vacuum relief valves and flame traps together with automatic safety shut off valves, are essential. Water seal equipment shall not be installed.

3. Gas piping and condensate. Gas piping shall be of adequate diameter and shall slope to condensation traps at low points. The use of float controlled condensate traps shall not be permitted.

4. Gas utilization equipment. Gas burning boilers, engines, and other units using gas as a fuel shall be located in well ventilated rooms, preferably at ground level and shall be isolated in accordance of the provisions of IND 54.13, Wisconsin Administrative Code. Gas lines to these units shall be provided with suitable flame traps.

5. Electrical fixtures. Electrical fixtures in enclosed places where gas may accumulate shall comply with the National Fire Code specifications, Volumes 2, 3 and 5, for hazardous conditions. Copies of the National Fire Code, Volumes 2, 3 and 5, are available for inspection at the office of the department of natural resources, secretary of state's office and the office of the revisor of statutes and may be obtained for personal use from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass., 02210.

6. Waste gas. Waste gas burners shall be readily accessible and shall be located at least 25 feet away from any plant structure if placed at ground level, or may be located on the roof of the control building if sufficiently removed from the tank. In remote locations it may be permissible to discharge the gas to the atmosphere through a return-bend screened vent terminating at least 10 feet above the walking surface provided the assembly incorporates a flame trap.

7. Meter. A gas meter with by-pass shall be provided to meter total gas production.

8. Other. (Note: Other applicable state codes which should be considered are those set forth in the Wisconsin State Electrical Code, Volume 2, as set forth in the rules of the department of industry, labor and human relations.)

(e) Digestion tank heating.

1. Insulation. Wherever possible digestion tanks shall be constructed above groundwater level and shall be suitably insulated to minimize heat loss.

2. Heating facilities. Piping shall be designed to provide for the preheating of feed sludge before introduction to the digesters. Provisions shall be made in the lay-out of the piping and valving to facilitate cleaning of these lines. Heat exchanger sludge piping shall be sized for heat transfer requirements.

3. Heating capacity. 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 may be required.

(f) Supernatant withdrawal.

1. Piping size. Supernatant piping may not be less than 6 inches in diameter.

2. Withdrawal arrangements. 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. Sampling. Provision shall be made for sampling at each supernatant draw-off level. Sampling pipes shall be at least 1-1/2 inches in diameter.

(2) Aerobic Sludge Digestion.

(a) Multiple tanks are recommended. A single sludge digestion tank may be used in the case of small treatment plants. The tanks shall be designed to provide effective air mixing, reduction of organic matter, supernatant separation and sludge concentration.

(b) Mixing. Digestion tanks shall be designed for effective mixing by satisfactory aeration equipment. If diffusers are used, types shall be provided which are designed to permit removal for inspection, maintenance, and replacement without dewatering the tanks.

(c) Size and number of tanks. The size and number of aerobic sludge digestion tanks should be determined by calculations based upon such factors as volume of sludge added, its percent solids and character, the degree of reduction of volatile solids required, the size of installation with appropriate allowance for sludge and supernatant storage. Calculations shall be submitted to justify the basis of design. If such calculations are not submitted, a minimum capacity of 3 cubic feet of volume per capita shall be provided.

(d) Air supply. Air shall be supplied to aerobic digesters digesting waste activated sludge, as follows:

Population Equivalent	CFM/Cu. Ft. of Tank Volume
100-300	.030
500-700	.025
1,000-5,000	.020
7,500-10,000	.015

(Note: Additional air shall be provided if digestion of primary sludge is to take place.)

(e) Supernatant separation. Facilities shall be provided for effective separation or decantation of supernatant.

(3) Sludge Pumps and Piping.

(a) Sludge pumps.

1. Capacity. Adequate pump capacities shall be provided. (Note: Provision for varying pump capacity is desirable.)

2. Duplicate units. Duplicate units shall be provided.

3. Type. Plunger pumps, screw feed pumps or other types of pumps with demonstrated solids handling capability shall be provided for handling raw sludge.

4. Minimum head. A minimum positive head of 24 inches shall be provided at the suction side of centrifugal type pumps. Maximum suction lifts shall not exceed 10 feet for plunger pumps. (Note: The department recommends that a minimum positive head of 24 inches be provided at the suction side of all sludge pumps.)

5. Sampling facilities. Unless sludge 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 1-1/2 inches.

(b) Sludge piping.

1. Size and head. Sludge withdrawal piping shall have a minimum diameter of 8 inches for gravity withdrawal and 6 inches for pump suction and discharge lines. Where withdrawal is by gravity, the available head on the discharge pipe shall be at least 4 feet.

2. Slope. Gravity piping shall be laid on uniform grade and alignment. Slope on gravity discharge piping shall not be less than 3 percent. Provisions shall be made for draining and flushing discharge lines. (Note: the department recommends that air relief at high points in a pressure sludge line be provided.)

(4) Sludge Dewatering.

(a) Sludge drying beds.

1. Area. At least one square foot of drying bed area per capita shall be provided. If necessary, wet sludge shall be hauled.

2. Percolation type.

a. The lower course of gravel around the underdrains shall be properly graded and shall be at least 12 inches in depth, extending at least 6 inches above the top of the underdrains. (Note: It is desirable to place this in 2 or more layers.) The top layer of at least 3 inches shall consist of gravel 1/8 inch to 1/4 inch in size.

b. The top course shall consist of at least 6 to 9 inches of clean coarse sand. The finished surface shall be level.

c. Underdrains shall be at least 4 inches in diameter laid with open joints. Underdrains shall be spaced not more than 20 feet apart.

3. Impervious types. Paved surface beds may be used if adequate center or side drains are provided. Special consideration shall be given to the total bed area required.

4. Walls. Walls shall be watertight and extend 15 to 18 inches above and at least 6 inches below the surface. Outer walls shall be curbed to prevent soil from washing on to the beds.

5. Sludge removal. Not less than 2 beds shall be provided and they shall be arranged to facilitate sludge removal. Concrete truck tracks shall be provided for all percolation type sludge beds. Pairs of tracks for percolation type beds shall be on 20-foot centers.

6. Sludge influent. The sludge pipe to the beds shall terminate at least 12 inches above the surface and be so arranged that it will drain. Concrete splash plates for percolation type beds shall be provided at sludge discharge points.

(b) Sludge lagoons. The use of shallow sludge drying lagoons in lieu of drying beds is permissible subject to the following conditions:

1. Soil and groundwater conditions. The soil must be reasonably porous and the bottom of the lagoons must be at least 3 feet above the maximum groundwater table and at least 5 feet above bedrock. Surrounding areas shall be graded to prevent surface water entering the lagoon.

2. Depth. Lagoons shall not be more than 36 inches in depth.

3. Area. The area required will depend on design conditions. Not less than 2 lagoons shall be provided.

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

(c) Mechanical Dewatering facilities. Provision shall be made to maintain sufficient continuity of service so that sludge may be dewatered without accumulation beyond storage capacity. Vacuum filters, sludge presses or other appropriate mechanical dewatering facilities may be approved where sufficient pilot data is presented to justify the design.

(d) Drainage and filtrate disposal. Drainage from beds or filtrate from dewatering units shall be returned to the raw sewage inlet to the treatment plant.

(e) Other dewatering facilities. If it is proposed to dewater or dispose of sludge by other methods, a detailed description of the process and design data shall accompany the plans.

(5) Sludge Disposal.

(a) General requirements. Alternates for ultimate sludge disposal shall be investigated and a specific sludge disposal program shall be developed for each wastewater treatment plant and submitted with the final plans and specifications. The method of ultimate disposal must protect the public health, the surface and groundwaters, and the air and land resources.

(b) Site suitability. To determine suitability of a disposal site, the location, geology, hydrology, soils, areas for future expansion and adjacent land use shall be evaluated.

(c) Sanitary landfill. Burial of sewage sludge in a sanitary landfill shall meet the following requirements:

1. The sludge must be capable of being mixed well with the other refuse in the compaction process.

2. The sludge must be able to support compaction equipment.

3. The sludge must be capable of permanent confinement within the earth excavation.

(d) Surface application. If surface application of digested sludge, whether liquid, filter cake or drying bed cake is utilized, it must be spread and plowed under or otherwise worked into the soil as soon as practicable after spreading. Locations suitable for this method of ultimate disposal must be well isolated from residential areas with no means of public access. Surface application disposal of raw sludge is not permitted.

(e) Incineration. Adequate provisions for residue disposal and air pollution control shall be provided. The appropriate requirements of NR 154 shall be met.

(f) Transportation of sludges.

1. Liquid. Liquid sludge shall be transported in an enclosed watertight unit from treatment plant to disposal site.

2. 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 spillage of sludge from the vehicle while in transit and to prevent an odor nuisance while in transit.

NR 110.28 Lagoons.

(1) Basis of Design.

(a) Stabilization ponds.

1. Area and loadings. A minimum of two cells shall be provided. The primary cell shall be designed on the basis of one acre of water surface for each 100 design population or population equivalent. The secondary cell shall be 1/4 to 1/3 the size of the primary cell. Where a controlled discharge is required, the secondary cell may be larger.

2. Industrial wastes. The effects of industrial wastes on the treatment process must be reflected in the design basis of the stabilization ponds. Milk wastes are not permitted in stabilization ponds. (Note: The department may waive this prohibition if adequate supporting data is presented in the plans.)

(b) Aerated lagoons.

1. For aerated lagoons designed to treat domestic wastes only, a minimum of two cells shall be provided. The primary cell shall have a minimum retention time of 18 days and the secondary cell shall have a minimum retention time of 26 days. In the event a three-celled system is desired, the secondary cell shall have a minimum retention time of 18 days and the final cell shall have a minimum retention time of 6 days. Aeration equipment shall be provided in the first two cells of all aerated lagoons.

(Note: The above detention times were based on the following formulae and assumptions:

$T = \frac{E}{K(100-E)}$ where T = detention time, K = reaction coefficient and E = efficiency. For domestic waste K is assumed to equal 0.5 at 20°C. To correct for anticipated wintertime temperature, the formula $KT' = K_{20}\theta^{T'-20}$ was used. In this formula, T' is the anticipated low temperature and θ is a temperature coefficient. For Wisconsin, T' is assumed to be 0° C. and θ is assumed to be 1.07. Where studies indicate a variation from the above criteria will provide an adequate degree of treatment, the department will consider such data in determining whether to waive this requirement.)

2. For aerated lagoons designed to treat combined domestic and industrial wastes, laboratory or pilot studies shall be conducted to develop an appropriate reaction coefficient at both anticipated summertime and wintertime temperatures. The reaction coefficient developed shall be used to calculate the required detention time. The laboratory or pilot plant results and engineering calculations shall be submitted to justify the design. A minimum of two cells shall be provided with additional volume provided in the second cell to facilitate removal of solids. Provisions shall be made to recirculate final lagoon effluent to the inlet of the treatment system.

(2) Pond Shape. The shape of all cells shall be such that there are no narrow or elongated portions. No islands, peninsulas, or coves are permitted. Dikes shall be rounded at corners to minimize accumulations of floating materials. (Note: Round, square, or rectangular ponds with a length not exceeding 3 times the width are considered most desirable.)

(3) Location.

(a) Distance from habitation. The locational requirements of NR 110.15(3) shall be adhered to.

(b) Groundwater pollution. Lagoons shall be located to minimize the potential of groundwater pollution. (Note: The department recommends that pond bottoms be located a minimum of three feet above high groundwater and five feet above bedrock. Consideration shall be given to the nature of the subsoil and bedrock in determining the exact depth.) The primary cell of a

stabilization pond and the first two cells of an aerated lagoon shall be adequately sealed to prevent loss of liquid such that the design operating depth can be achieved and maintained.

(4) Pond Construction Details.

(a) Material. Embankments and dikes shall be constructed of relatively impervious materials and compacted to a density of 95% as measured by the Standard Proctor test.

(b) Top width. The minimum embankment top width shall be 12 feet to permit access of maintenance vehicles.

(c) Maximum slopes. Embankment slopes steeper than 3 horizontal to 1 vertical are prohibited.

(d) Minimum slopes. Embankment sloped flatter than 4 horizontal to 1 vertical for the inner slope are prohibited.

(e) Freeboard. Minimum freeboard shall be 3 feet.

(f) Minimum depth. A minimum normal liquid depth of 2 feet for stabilization ponds and six feet for aerated lagoons shall be provided.

(g) Maximum depth. A maximum normal liquid depth of 5 feet for stabilization ponds and 14 feet for aerated lagoons shall be provided.

(h) Seeding. Embankments shall be seeded from the outside toe to 1 foot above the high water line on the dikes, measured on the slope. Additional protection for embankments, such as riprap, shall be provided where the dikes are subject to erosion.

(i) Vegetation control. A method to prevent vegetation growth over the bottom of the lagoon and up to 1 foot above the water line on the dikes shall be specified in the plans.

(5) Pond Bottom.

(a) Uniformity. The pond bottom shall be as level as possible at all points.

(b) Vegetation. The bottom shall be cleared of vegetation and debris.

(6) Influent Lines.

(a) Material. Influent lines may be constructed with any generally accepted material for underground sewer construction.

(b) Manholes. A manhole shall be installed at the terminus of the outfall line or the force main and shall be located as close to the dike as topography permits. Its invert shall be at least 6 inches above the maximum operating level of the pond to provide sufficient hydraulic head without surcharging the manhole.

(c) Influent lines. Influent lines shall be located along the bottom of the pond so that the top of the pipe is just below the average elevation of the pond bottom.

(d) Point of discharge. For circular or square ponds, the inlet shall be located at the center of the pond. Influent lines to rectangular ponds shall terminate at approximately the third point farthest from the outlet structure. Influent and effluent piping shall be located to minimize short-circuiting within the pond.

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

(7) Overflow Structures and Interconnecting Piping.

(a) Material. Interconnecting piping and overflows may be constructed of any generally accepted material for underground sewer construction.

(b) Overflow structure. Overflow structures shall consist of a manhole or box equipped with multiple-valved pond drawoff lines or an adjustable overflow device so that the liquid level of the pond can be adjusted to permit operation at depths of 2 to 5 feet in stabilization ponds and 6 feet to the design depth in aerated lagoons.

(8) Miscellaneous.

(a) Fencing. The pond area shall be enclosed with a suitable fence to prevent livestock movement into and discourage trespassing on the pond area. A vehicle access gate of sufficient width to accommodate mowing equipment shall be provided. All access gates shall be provided with locks.

(b) Warning signs. Appropriate signs shall be provided along the fence around the pond to designate the nature of the facility and the advice against trespassing.

(c) Flow measurement. The capability of installing flow measurement devices on the inlet and outlet of all lagoon systems shall be provided.

(9) Aeration Equipment.

(a) Air requirements. Air shall be provided to the aerated lagoons at a rate of not less than 1.5 pounds of oxygen per pound of influent BOD_5.

(b) Surface aeration equipment. Surface aeration equipment shall be so designed and placed to provide optimum mixing of pond contents and dispersion of oxygen to the waste. The equipment shall be operated continuously throughout the year. Provisions must be made to prevent ice formation on the aerator during the winter season resulting in shutdown of aeration equipment. Unless sufficient justification is presented to the contrary, surface aerators shall be designed using an oxygen transfer rate of 1.5 pounds of oxygen per horsepower hour.

(c) Subsurface aeration equipment.

1. Flexible tubing containing air release slits shall be provided across the pond bottom in accordance with the manufacturer's recommendations. To prevent clogging of the air lines, provision must be made to accommodate cleaning at least four times per year or more often if necessary. Air shall be supplied to the pond system at a rate of at least 1,000 cubic feet of air per pound of design BOD_5 with the largest blower unit out of service.

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

3. Where data is presented to the department to justify oxygen transfer rates varying from the above, the department may approve such design transfer rates.

(10) Effluent Holding Ponds.

(a) Effluent holding ponds shall be provided following all extended aeration activated sludge sewage treatment plants. (Note: The department may require effluent holding ponds at other locations.)

(b) The detention time in the effluent pond shall be at least 30 days based on design flow. (Note: Lesser detention times may be approved by the department on a case by case basis if supported by sufficient design data.)

(11) Seepage Ponds. (Note: Seepage ponds should be considered where stream water quality must be maintained at a high level or where no stream exists for discharge of sewage effluent. Soil and groundwater conditions shall be thoroughly evaluated and conditions must be favorable to permit use of a seepage pond. The pond should be sized based on an evaluation of the soil's capability to accept liquid wastes.)

NR 110.29 Land Disposal of Effluent

(1) General. Land disposal of secondary treated effluent may be approved by the department on a case by case basis. The effect of land disposal on groundwater is of concern; therefore the quality, direction and rate of movement and local use of the groundwater must be thoroughly analyzed in any design report submitted to the department.

(2) Design Report. The design report shall be as comprehensive as possible and shall include all necessary maps, diagrams and additional information needed to conduct an evaluation of the proposed system. The following items must be thoroughly considered and discussed in the design report:

(a) location;

(b) geology;

(c) hydrology;

(d) soils;

(e) agricultural practice;

(f) adjacent land use; and

(g) direction of groundwater movement.

NR 110.30 Intermittent Sand Filters

(1) General. Intermittent sand filters may be used for treatment of relatively small waste streams. All such intallations shall be preceded by gravity settling devices such as in conventional primary clarifers or septic tanks. Waste from intermittent sand filters shall be disinfected and discharged to an effluent holding pond prior to discharge to a receiving water.

(2) Loading. The loading on the sand filter shall not exceed one gallon per square foot per day for the total bed area for installations which operate with a significant rest period. The loading shall not exceed 0.5 gallon/ft^2/day for the total bed area for installations used on a continuous year round basis.

(3) Media

(a) Gravel base. Clean graded gravel placed in three layers around the underdrains and to a depth of at least 6 inches over the top of the underdrains shall be provided. (Note: Suggested gradings for the three layers are: 1-1/2" to 3/4", 3/4" to 1/4", 1/4" to 1/8".)

(b) Sand. At least 24 inches of clean sand above the gravel base shall be provided. The effective size of the sand shall be 0.3 to 0.6 mm, and the uniformity coefficient shall not exceed 3.5.

(4) Dosing.

(a) Duplicate units. The filter bed shall be divided into at least two separate units to provide for maintenance and adequate rest periods.

(b) Volume. The dosing tank volume shall be such that the filter bed will be covered to a depth of two to four inches by each dose.

(c) Siphons or pumps. The siphons or pumps shall have a discharge capacity at minimum head of at least 100 percent in excess of the maximum rate of inflow to the dosing tank and at average head of at least 90 gpm/1,000 ft^2 of filter surface area.

(d) Discharge lines. Discharge lines shall have sufficient capacity to permit the full rated discharge of the siphons or pumps.

(5) Distribution.

(a) Arrangement. Troughs or piping used for distribution of the settled sewage over the filter surface shall be located not more than 20' center to center.

(b) Splash pads. Splash pads shall be provided at each point of discharge.

(c) Drain. A drain opening from troughs or discharge piping shall be provided.

(6) Underdrains. Open joint or perforated clay or concrete pipe underdrains may be used. They shall be sloped to the outlet and spaced not to exceed 10 feet center to center.

(7) Covering. All sand filter installations shall be covered with roofing paper or other suitable material and at least three feet of soil unless they are designed to operate only during the summer months in which case the filter may be exposed to the atmosphere.

The foregoing rules were approved by the State of Wisconsin Natural Resources Board on July 19, 1974, and will take effect upon publication.

Dated at Madison, Wisconsin October 9, 1974

STATE OF WISCONSIN DEPARTMENT OF NATURAL RESOURCES

By _____
L. P. Voigt, Secretary

(SEAL)