

(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 cost-effective 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.

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

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); Wis. Adm. Code, 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 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 108⁴ and in NR 110.06⁵ 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 2 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, lamp-holes, inspection chambers, inverted siphons and elevated sewers.

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

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), Wis. Adm. Code, 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 lift 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;

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

NR 110.11 Sewage treatment plants. (1) **ENGINEERING REPORTS.** For sewage treatment plants, the engineering report shall include, in addition to the information required under NR 110.08 (2), Wis. Adm. Code, 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, in-

cluding 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 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 quantity, 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 metropolitan 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.

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

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.

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

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 8 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 gradient.

(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 (1972);

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 (November 10, 1967);

3. Concrete pipe shall meet the requirements of A.S.T.M. C14 (1971), C76 (1972) or C655 (1970);

4. Vitrified clay pipe shall meet the requirements of A.S.T.M. C700 (1971) or A.A.S.H.O.-M65 (1961);

5. Steel pipe shall meet the requirements of A.W.W.A. C-200 (January 23, 1966);

6. Ductile iron pipe and fittings shall meet the requirements of A.W.W.A. C-100 (November 10, 1967);

7. Polyvinyl chloride sewer pipe shall meet the requirements of A.S.T.M. D3033 (1972) or D3034 (1973);

8. A.B.S. Composite sewer pipe shall meet the requirements of A.S.T.M. D2680 (1972);

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 Water Works 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 (November 10, 1967).

3. Rubber gasket joints for concrete sewer pipe shall meet A.S.T.M. C443 (1972).

4. Resilient joints for vitrified clay sewer pipe shall meet A.S.T.M. C425 (1971).

5. Steel pipe joints shall meet the requirements of A.W.W.A. C-200 (January 23, 1966).

6. Ductile iron pipe joints shall meet the requirements of A.W.W.A. C-100 (November 10, 1967).

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 (January 31, 1972).

2. Cast iron pipe and joints shall meet the requirements of A.W.W.A. C-100 (November 10, 1967).

3. Ductile iron pipe and joints shall meet the requirements of A.W.W.A. C-100 (November 10, 1967).

4. Steel pipe and joints shall meet the requirements of A.W.W.A. C-200 (January 23, 1966).

5. Concrete pipe and joints shall meet the requirements of A.W.W.A. C-300 (January 27, 1964).

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. Manholes 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 2 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), Wis. Adm. Code, 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.

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

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.

Register, November, 1974, No. 227
Environmental Protection

(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 2 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 2½-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 ½ 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 alternate 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 10 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 12 complete air changes per hour if ventilation is continuous and at least 30 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 6 complete air changes per hour if ventilation is continuous and at least 30 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 capacity 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 tele-