RULEMAKING ACTION:
PERMANENT final adoption

PROPOSED RULES:
Subchapter 1. Introduction [AMENDED]
Subchapter 3. Permit Procedures [AMENDED]
Subchapter 5. Sanitary Sewer Standards [AMENDED]
Subchapter 7. Permit Procedures [AMENDED]
Subchapter 9. General Standards [AMENDED]
Subchapter 11. Lagoon Standards [AMENDED]
Subchapter 13. Primary Treatment Standards [AMENDED]
Subchapter 15. Biological Treatment Standards [REVOKEK]
Subchapter 16. Biological Treatment Standards [NEW]
Subchapter 17. Clarifier Standards [AMENDED]
Subchapter 19. Sludge Facility Standards [AMENDED]
Subchapter 21. Disinfection Standards [AMENDED]
Subchapter 23. Supplemental Treatment Standards [AMENDED]
Subchapter 25. Wastewater Land Application Systems [AMENDED]
Appendix B. Settling Tank Minimum Criteria [REVOKEK]
Appendix B. Settling Tank Minimum Design Criteria [NEW]

AUTHORITY:
Environmental Quality Board powers and duties, 27A O.S., § 2-2-101; Water Quality Management Advisory Council powers and duties, 27A O.S. § 2-2-201; and Water Quality, 27A O.S. § 2-6-101 et seq.

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None

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None

ANALYSIS:
This rulemaking is to revise and clarify the water pollution control facility construction rules. These rules amend existing procedures and requirements for the construction of wastewater treatment and collection systems. New provisions include clarification of requirements for submittal of engineering reports, plans and specifications, and construction standards for sanitary sewers, pump stations, and wastewater treatment facilities.

CONTACT PERSON:
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PURSUANT TO THE ACTIONS DESCRIBED HEREIN, THE FOLLOWING RULES ARE CONSIDERED FINALLY ADOPTED AS SET FORTH IN 75 O.S., SECTION 308.1(A), WITH AN EFFECTIVE DATE OF JUNE 15, 2005.
SUBCHAPTER 1. INTRODUCTION

252:656-1-1. Purpose
(a) This chapter sets the permit and construction standards for wastewater collection systems and treatment works. It does not apply to innovative technology (see Title 27A O.S. § 2-6-401), to small on-site public sewage systems as defined in Title 27A O.S. § 2-6-101 (also see the Individual and Small Public On-Site Sewage Disposal Regulations), nor does it apply to industrial wastewater (see the Discharge Standards and the Industrial Wastewater Regulations). There are other rules that also may govern wastewater systems, such as the Discharge Standards, the Non-Industrial Impoundment rules, the Sludge Management Rules, the Solid Waste and Sludge Management Rules, and the federal OSHA standards.
(b) This chapter applies to any person or entity that constructs or modifies a wastewater collection system or treatment works that is not a small residential or commercial system, small public sewage system as defined in Title 27A O.S. § 2-6-101, or an industrial system.

252:656-1-2. Definitions
In addition to terms defined in Title 27A of the Oklahoma Statutes, the following words or terms, when used in this Chapter, shall have the following meaning unless the context clearly indicates otherwise:

"Biosolids" means primarily organically treated wastewater materials from municipal wastewater treatment plants that are suitable for recycling as a soil amendment. This term is within the meaning of "sludge" as defined in 27A. O.S. § 2-6-101(11).
"Bypass" means the intentional or unintentional diversion of a waste stream from any portion of a wastewater system.
"Cell" means an individual basin of a lagoon system.
"Collection system" means pipelines or conduits, pumping stations, force mains and all other facilities used to collect or conduct wastewater to a treatment works.
"Deviation" means change from the adopted or current standards for equipment, material or process.
"Discharge point" means the point at which wastewater enters Waters of the State or become Waters of the State.
"Domestic wastewater" means wastewater from drinking fountains, showers, toilets, lavatories and kitchens.
"Engineer" means a person licensed to practice engineering in Oklahoma.
"Freeboard" means the vertical distance from the surface water level to the overflow elevation in a treatment unit.
"Land application" means the controlled application of treated wastewater onto the land surface for beneficial use.
"New technology" means any method, process or equipment which is used to treat or convey sewage which is not addressed in this Chapter. This does not refer to innovative technology as defined by 40 CFR Part 35.
"Person" means any individual, company, corporation, government agency, municipality, or any other entity.
"Population equivalent" and "PE" mean the calculated population which would normally contribute the same amount of biochemical oxygen demand (BOD) per day of wastewater. It is computed on the basis of 0.17 lb. of 5-day BOD per capita per day.

"Retention time" means the theoretical time required to displace the contents of a tank or treatment unit at a given rate of flow (volume divided by rate of flow).

"Sludge" means partially treated wastewater materials from municipal wastewater treatment plants as defined in 27A. O.S. § 2-6-101(11) except for Biosolids as defined in this chapter.

"Treatment works" means any plant, disposal field, lagoon, incinerator or other facility used to treat, stabilize, hold or reclaim wastewater.

"Wastewater system" means collection system and treatment works.

SUBCHAPTER 3. PERMIT PROCEDURES

252:656-3-1. Uniform permit process

This subchapter implements the Uniform Permitting Act, Title 27A O.S. § 2-14-101 and following and the rules promulgated pursuant thereto. A permit is required to construct or modification of a wastewater system. The permit application is a two-step process: first is an engineering report (logical analysis of design choices) (as described in OAC 252:656-3-4), followed by the final design report (with plans and specifications) submitted with the application form and fees. The final design report shall reflect any changes from the approved engineering report. Unless an extension is granted, a construction permit expires if construction does not begin in one year.

252:656-3-2. Applications

(a) Submit legible applications on forms provided or approved by the DEQ. Applicants shall provide a legal description of the proposed project and of the type of entity that is applying. Submit legible applications on forms provided by the DEQ and include:

(1) the type of entity that is applying
(2) the legal description,
(3) a minimum of 2 sets of plans and specifications,
(4) a final design analysis, and
(5) fees.

(b) Public entities other than municipalities shall provide certified copies of the results of the last election or appointment of the members of the governing body. Public entities must also provide a citation of their legal authority to own and operate the proposed facility.

(c) Applicants other than public entities must provide copies of documents that created them and provide a citation to their statutory authority. If their proposed facility is to be located within a political subdivision, they must notify the political subdivision.

(d) All applicants must demonstrate they have adequate financial accountability to continuously maintain the facility.

(1) If the applicant is not a city, town or other public
entity, the applicant must demonstrate to the satisfaction of the DEQ:
(A) that the facility can cover the expected costs for operation and maintenance, replacement and closure;
(B) continued existence and financial accountability of the facility; and
(C) that provisions have been made for continued existence of the operating entity for the expected life of the facility.
(2) Continued existence may be demonstrated in one of the following fashions:
(A) The applicant may be a property owners' association or a nonprofit corporation established under the laws of the State of Oklahoma. The association must have the legal authority to own and manage the wastewater system including the authority to set and collect fees from users for operation and maintenance of the system. The instrument creating the association shall be filed in the office of the county clerk where the property is located; or
(B) The applicant must provide proof of a sufficient amount on deposit to the credit of a trust, the powers of which are to operate and maintain the wastewater system for the expected life of the facility; or
(C) Other proof of financial viability, such as the issuance of a bond or insurance contract covering the operation and maintenance of the wastewater system may be submitted to DEQ for approval; and
(3) Costs for closure of the wastewater system as required by law must be included in any funding plan.
(e) Applications and unexpired permits may be transferred upon showing the transferee has legal authority and financial accountability, and that both parties agree to the transfer.
(f) Applicants must construct facilities according to the plans and specifications that are approved. Applicants must comply with the terms of the permits that are issued. Permits may contain provisions more stringent than these rules in order to meet water quality standards.

252:656-3-4. Engineering report
Submit two copies of an engineering report for proposed new construction or modifications to sewage collection systems or treatment works. Engineering reports must include:
(1) Volume and strength of sewage flow. Establish the anticipated design average and design peak flows and waste load for the existing and ultimate conditions. Include the basis for projecting initial and future flows and waste load for the existing, or initial, service area, and the anticipated future service area.
(2) Existing system. Describe the existing system and evaluate the conditions and problems needing correction.
(3) Project Description and Alternatives. Describe the project and the process to select wastewater treatment alternatives. Provide a site map and schematic diagram of the proposed treatment process. Describe the proposed project and, where two or more solutions exist providing wastewater treatment solution,
discuss the alternatives including cost analysis and discuss the reasons for selecting the one recommended. 

(4) Construction sequence. Describe the sequence of construction and steps needed to maintain compliance during construction. If the project is not to be completed in one sequence, then provide details of the phases. 

(5) Site. Describe the topography, soils, geologic conditions, depth to bedrock, groundwater level, floodway or floodplain considerations, and other pertinent site information. The project must be constructed on a site consistent with approved plans. Include 6 months of data on the groundwater level. Refer to Section 11-3(a) for soil boring requirements for lagoon projects. 

(6) Water supply. Locate nearby water supplies, including known water wells. 

(7) Receiving stream. Identify the receiving stream and its wastewater requirements according to the Water Quality sections of OAC 252:605-252:606 (Discharges). 

(8) Sludge—Sewage sludge disposal. Discuss the available alternatives for sludge disposal (OAC 252:640-252:606 and OAC 252:520-252:515). Include sludge management plans, which must be approved before construction commences. 

(9) Industrial wastes. Discuss the characteristics and volume of anticipated industrial wastes. 

(10) Collection system. Describe the area to be served by existing and proposed sewers and explain any uncovered areas. 

(11) Financing. Provide cost estimates to build, operate and maintain the proposed project. Discuss financing methods. 

252:656-3-5. Plans and specifications 

(a) General layout. Submit two copies of general plans for sewage works that: 

(1) Top–Plan view. Include a top–plan view of the plant and discharge points, using at least 10-foot contours. 

(2) Flood elevations. Show both the 25-year and 100-year flood elevations and their boundaries. 

(3) Existing and proposed treatment works. Show the physical arrangement of all treatment units on a project site plat. 

(4) Existing collection systems. Show the location, size and direction of flow of all existing sanitary sewers at the point of connection with proposed new sanitary sewers. Show the elevations of all sewer inverts close to the manholes. 

(5) Proposed collection systems. Show the location of all proposed sewers, sewer easements and direction of flow. Number all manholes on the layout and correspondingly on the profile. 

(6) Drawings. Show the name of the municipality, sewer district, or institution; scale in feet; north point; date; and name, telephone number, address, signature of engineer and/or imprint of engineer’s seal on each page of the drawings. In the case of bound documents, engineers must affix their seal, signature and date to the cover sheet or index page, which identifies all documents bound together for which the registrant has responsible charge. In the absence of a cover sheet or index page each sheet must have the seal, and dated signature of
the registrant who has responsible charge. For bound documents involving multiple registrants, either each document in the bound set must be sealed, signed and dated by the registrant in responsible charge for that portion of the work, or the cover sheet or index page must be sealed, signed and dated by each registrant with a breakdown of responsibility for each document clearly identified. Draw general plans to a scale of 100 feet per inch. Establish and reference a permanent benchmark. The minimum plan size shall be 11" x 17", one-sided and of adequate contrast sufficient for microfilming.

(b) **Detailed plans.** Draw Prepare two copies of detailed plans to a suitable scale. Plans to modify or extend existing wastewater systems shall clearly indicate the changes. The detailed plans shall:

1. **Sewer plan and profile.** Include a plan and profile of all sewers to be constructed showing all special features, such as inverted siphons, extra strength pipe, concrete encasements, outfall structures and sewer bridges. Show all stream crossings on the profile with stream bed elevations, normal flow elevation and extreme high and low water levels. Scale the profiles to not more than 100 feet per inch horizontal and 10 feet per inch vertical. Show the scale on the profiles. Show all known existing structures both above and below ground that might interfere with the proposed construction; including water mains, gas mains, storm drains, and nature of street surfacing. Show wyes on the plan view and dimensions from the nearest down-stream manhole recorded on maps.

2. **Sewer details.** Include profiles showing manhole stationing, size of sewers, top of rim and sewer invert elevations at each manhole and the grade and length of sewers between adjacent manholes. Show ground elevations at the house line or at approximately 50 to 75 feet from the centerline of the sewer in each direction except in the case of out-fall and/or relief sewers, where no wyes for house connections are needed.

3. **Sewer appurtenances.** Include the details of all ordinary sewer appurtenances such as manholes, drop manholes, inverted siphons and pumping stations. A sufficiently detailed drawing of each structure shall show dimensions, equipment, elevations, capacities, and any explanatory notes necessary to make them easily interpreted.

4. **Sewer cross sections.** Include cross sections for manholes, outfall structures, headwalls, pipe cradling and encasement, and similar structures.

5. **Sewage pumping station details.** Include complete construction details showing number and size of pumps, isolation valves, check valves, alarm system and emergency operation provisions.

6. **Treatment works hydraulic profile.** Show hydraulic profiles with sewage, supernatant liquor and sludge flow through the plant.

7. **Schematic diagrams.** Label schematic piping diagrams with all lines, appurtenances and direction of flow.

8. **Treatment units.** Provide complete construction details of
all treatment units including high and low water levels of receiving stream.

(9) **Fillets.** Eliminate dead spots in all tanks by designing fillets and otherwise rounding edges.

(c) **Specifications.** Complete detailed specifications for the proposed project shall accompany, or be included in, the plans and must include detailed summary of equipment and design data.

(d) **Construction materials.** Applicants are responsible for complying with any occupational, safety and building codes. Reference in the plans or specifications where these codes require special construction materials, such as the National Electrical Code requirement for explosion-proof wiring where gases may accumulate. The DEQ will not, however, determine whether the proposed construction will meet such codes.

(e) **Redundant equipment.** Provide a backup for all control points, treatment units and pumping mechanisms to handle minimum design flow during equipment to provide for equipment maintenance and repair.

(f) **Drains and bypasses.** Maintenance and cleaning. For maintenance and operational controls, equip all units with bypass piping and drainage shall be equipped with means for cleaning. Direct discharge of untreated sewage is prohibited.

(g) **Weather protection.** Protect the structures and all electrical and mechanical equipment and controls from elements and a 100-year flood. Protect pumps, valves and piping from freezing.

(h) **Construction sequence.** Include a program for keeping existing wastewater facilities in compliance with all applicable water quality permit conditions during construction of additional facilities (see 656-3-4(3)).

252:656-3-7. Variances from construction standards

(a) Deviations from this Chapter may be allowed if the DEQ finds the deviations will not increase the likelihood of a system failure. No deviation will be allowed unless it is noted on the construction permit. For deviations after the permit has issued, submit a Change Order and apply for an amendment to the permit.

(b) The policy of the DEQ is to encourage better wastewater treatment methods and equipment, including the use of new technology. The DEQ may approve processes or equipment not specifically covered by these rules provided the permittee requests a deviation. The consulting engineer shall justify the requested deviation by submitting data showing the proposed process or equipment will equal or exceed the performance of a process or equipment known to perform the same function according to current standards. The DEQ will require the following:

1. Monitoring observations, including test results and engineering evaluations, that demonstrate the efficiency of such processes or equipment.

2. Detailed description of the test methods.

3. Testing, including appropriately compositied samples, under various ranges of strength and flow rates (including diurnal variations) and waste temperatures over a sufficient length of time to demonstrate performance under climatic and other conditions which may be encountered in the area of the proposed
installations.

(4) The DEQ also may require that appropriate testing be conducted and evaluations be made under the supervision of a competent process engineer other than those employed by the manufacturer or developer.

(5) Suppliers of proprietary equipment or processes will be required to post a performance bond payable to the permittee for sufficient monetary value to replace said equipment or process with equipment or processes proven to produce the required results.

(6) Proposals of processes not covered by these standards will require a process performance bond from the engineer of sufficient monetary value to replace a failed process with a process proven to produce the required results.

(7) These bonds shall be effective for at least one year after the date the process or equipment is placed in operation.

252:656-3-8. Financial responsibility [REVOKED]
(a) If the applicant is not a city, town or other public entity, the applicant must demonstrate to the satisfaction of the DEQ:
   (1) expected costs for operation and maintenance, replacement and closure;
   (2) continued existence and financial accountability; and that
   (3) provisions have been made for continued existence of the operating entity for the expected life of the facility.

(b) Continued existence may be demonstrated in one of the following fashions:
   (1) The applicant may be a property owners' association or a nonprofit corporation established under the laws of the State of Oklahoma. The association must have the legal authority to own and manage the wastewater system including the authority to set and collect fees from users for operation and maintenance of the system. The instrument creating the association shall be filed in the office of the county clerk where the property is located; or
   (2) The applicant must provide proof of a sufficient amount on deposit to the credit of a trust, the powers of which are to operate and maintain the wastewater system for the expected life of the facility; or
   (3) Other proof of financial viability, such as the issuance of a bond or insurance contract covering the operation and maintenance of the wastewater system may be submitted to DEQ for approval; and

(c) Costs for closure of the wastewater system as required by law must be included in any funding plan.

252:656-3-9. Fees
(a) Permits will not be issued until all fees are paid. Municipalities may enter into unless a monthly billing agreement with the DEQ and the permittee is current.

(b) Treatment works construction permit fees are based on design flow as follows:
   (1) New facilities or major modifications:
      (A) 1.0 MGD and greater $2,000
      (B) 0.50 MGD - 0.99 MGD $1,500
(C) 0.10 MGD - 0.49 MGD $1,000
(D) 0.01 MGD - 0.09 MGD $500
(E) less than 0.01 MGD $250

(2) Minor modifications that will not alter the design capacity of the facility such as flow measurement, discharge structures and equalization basins:
(A) 1.0 MGD and greater $500
(B) 0.50 MGD - 0.99 MGD $400
(C) 0.10 MGD - 0.49 MGD $300
(D) 0.01 MGD - 0.09 MGD $200
(E) less than 0.01 MGD $100

(c) Collection system improvement fees are:
(1) Line extensions: $10 per 100 ft., rounded to the nearest 100 ft. with a $100 minimum.
(2) Lift station(s): $50 per 100 GPM, rounded to the nearest 100 GPM peak capacity with a $100 minimum.
(3) Municipal permit exemptions under OAC 252:656-3-3 pay 20% of the collection system fees quarterly.

(d) Emergency grant projects are exempt from construction permit fees (wastewater systems funded in part or in whole by grant monies made available through the Oklahoma Water Resources Board as authorized by Title 82, § 1085.39).
(e) REAP (Rural Economic Assistance Program) and CBEP (Community Based Environmental Projects) Grant Projects are exempt from permit fees.
(f) The maximum fee for any one application will not exceed $2,000.00.
(g) Any person or entity that constructs or modifies a wastewater collection system or treatment works subject to these rules, prior to the issuance of a permit, is subject to the doubling of all fees required by this chapter, as deemed necessary to offset additional administrative costs of such reviews. Further, the submission of appropriate fees and/or the issuance of a permit does not preclude any person or entity from further enforcement and/or fines as set out by State statutes and rules, for constructing or modifying a wastewater collection system or treatment works prior to the issuance of all appropriate permits as required by this chapter.

SUBCHAPTER 5. SANITARY SEWER STANDARDS

252:656-5-1. Design capacity
Design sewers for the maximum possible estimated ultimate future population that may be served.
(1) Consider the maximum hourly domestic flow, industrial flow, inflow and infiltration and the topography regarding the slope and pumping needs.
(2) Design for an average daily per capita flow of 100 gpd, which includes normal infiltration. Peak design flow must be based on an acceptable infiltration/inflow (I/I) study or, for new sewer extensions, the ratio of peak to average daily flow from a widely recognized engineering standard.
(3) Exclude storm water from roof drains, streets and other areas.

252:656-5-2. Design standards
(a) **Standard.** Design and construct sewers with hydraulic slopes sufficient for full flowing velocities of 2.0 fps (feet per second) or greater—obtaining a velocity of 2 fps (feet per second) or greater. Base the design on Manning's formula using an "n" value of 0.013. Gravity sewers shall not be smaller than 8-inch diameter, except those sewer lines meeting the requirements in Subchapter (c) below.

(b) **Slope.** The depth of flow and the slope of the conduit affects the velocity of a liquid flowing under gravity conditions. The following table gives minimum slopes for different sizes of pipe to meet the required flow velocity.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Slope (feet/100 feet)</th>
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</thead>
<tbody>
<tr>
<td>4&quot; sewers</td>
<td>1.00</td>
</tr>
<tr>
<td>6&quot; sewers</td>
<td>0.50</td>
</tr>
<tr>
<td>8&quot; sewers</td>
<td>0.40</td>
</tr>
<tr>
<td>10&quot; sewers</td>
<td>0.29</td>
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<tr>
<td>12&quot; sewers</td>
<td>0.22</td>
</tr>
<tr>
<td>14&quot; sewers</td>
<td>0.17</td>
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<tr>
<td>15&quot; sewers</td>
<td>0.15</td>
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<tr>
<td>16&quot; sewers</td>
<td>0.14</td>
</tr>
<tr>
<td>18&quot; sewers</td>
<td>0.12</td>
</tr>
<tr>
<td>21&quot; sewers</td>
<td>0.10</td>
</tr>
<tr>
<td>24&quot; sewers</td>
<td>0.08</td>
</tr>
</tbody>
</table>

(c) **Exceptions.** The following may be approved where the proper slope cannot be achieved.

1. **Lesser loading Pipe Diameter.**
   - The DEQ may approve a different pipe diameter where the pipe diameter is larger than necessary to carry the expected load, or a smaller diameter pipe (but not smaller than 8-inch) will give better hydraulic flow, and the average liquid depth will be 1/3 of the pipe diameter. The applicant must furnish computations and compare the hydraulic conditions in the pipe at average, high and low flow conditions. **Under the following conditions, DEQ may approve a smaller pipe diameter than stated in (b) above (but not less than 8 inches) if:**
     - (A) The available ground slope or an obstruction dictates a different pipe diameter to meet the slope/velocity criteria.
     - (B) A smaller diameter pipe (but not smaller than 8-inch) will provide better hydraulic flow characteristics than the larger pipe (i.e., greater depth of flow, higher velocity, etc.). The applicant must furnish computations and compare the hydraulic conditions in the pipe at average, high and low flow conditions. Computations shall show capacity in the pipe at projected peak flow conditions.

2. **No future expansion.** Up to 400 feet of 6-inch pipe may be installed at the end of a line that is isolated from future expansion.

3. **Private—Privately-owned collection lines.** Privately owned collection lines serving private parks may have 4 or 6 inch pipe where individual lots will not be sold and the system will not be dedicated to the public. For 4 inch lines, connect no more than 10 mobile homes or 160 plumbing fixtures with a slope of at least 1/8 inch per foot. For 6 inch lines, connect no more than 40 mobile homes or 700 plumbing fixtures with a slope of at least 1/16 inch per foot. **Under the following conditions four-**
and six-inch diameter lines may be installed in privately owned developments such as mobile home parks, recreational vehicle parks and similar establishments:

(A) Individual lots or units within the development are not intended for sale or transfer of ownership or where the collection system will not be dedicated to a public entity.

(B) No more than 10 mobile homes or 180 fixture units shall be connected to a four-inch line; and, no more than 40 mobile homes or 700 fixture units shall be connected to a six-inch line.

(C) The minimum slope for a four-inch line shall be 1/8 inch per foot and for a six-inch line 1/16 inch per foot.

(4) Small diameter gravity sewers. A small diameter gravity sewer system is acceptable where only settled sewage will be transported and consist of septic tanks and small diameter collection mains. They may only be considered for low density residential areas and commercial developments that have no potential for population growth, small municipalities or rural sewer districts with less than 100 connections or a population equivalent less than 250 with no or low potential for population growth. Locate septic tanks so all sewage is settled before the connection to small diameter sewers. Grinder pumps shall not be used.

(A) Hydraulic design. The design flow shall be at least 0.3 gpm per connection. The velocity in lines carrying only settled effluent may be reduced to not less than 1.0 fps based on Manning's open channel flow formula using a "n" value of not less than 0.013 and depth of flow at one half the pipe diameter.

(B) Collector mains. The horizontal alignment may bend so long as the radius of a bend does not exceed the manufacturer's recommendations. Use a positive gradient. The pipe diameter shall be at least 4 inches, and determined through hydraulic analysis. Determine burial depth by the elevation of the interceptor tank outlet invert elevation, frost depth or anticipated trench loadings.

(C) Service laterals. Lines between septic tanks and collector lines shall be 3-inch PVC or larger.

(D) Interceptor tanks. Septic tanks must meet the design requirements of OAC 252:641 with routine maintenance. Septic tanks and service lines from them must be regarded as integral components of the wastewater system and not part of the individual home plumbing.

(E) Manholes and cleanouts. Cleanouts may be used instead of manholes, except at major junctions of mains. Cleanouts are required at the upstream ends of mains, at minor main junctions, at changes in main diameter and at least every 400 feet. Cleanouts shall be flush with the ground and designed to prevent damage from vehicular traffic.

(F) Corrosion. Use corrosion resistant materials in lift stations.

(G) Vents. Vents are necessary to maintain free-flowing conditions in the main and are commonly used in combination with cleanouts.
(H) Testing. In addition to leak testing the small diameter system, conduct vacuum and/or hydrostatic tests on interceptor tanks. Typical acceptance criteria are less than 1.0 inch loss of Hg vacuum after five minutes with initial vacuum of 4.0 inches of Hg or a drop in water level of 1.0 inch after 24 hours in an overfilled tank.

(5) Pressure sewers. Pumping units, septic tanks and holding tanks shall be regarded as integral components of the wastewater system and not part of individual home plumbing. There must be at least one pump per housing unit and an audio/visual alarm for malfunctions.

(A) Sewer design. Flow velocities must be in the range of 2 to 5 feet per second for grinder pump installations. Lower velocities may be approved only for pipe/pipes carrying settled effluent from septic tanks. System Systems must have air relief valves, a means to flush all lines, cleanouts and rerouting procedure in the event of maintenance. Each line without a grinder pump must have a septic tank meeting OAC 252:641, Individual and Small Public On-Site Sewage Disposal Systems, to separate solids.

(B) Pumps. Pump size must meet the volume and head conditions. Grin der pumps shall be at least two-horsepower and have back flow prevention devices. Pumps shall be housed in a tank separate from the septic tank with at least 24 hours holding capacity unless the applicant can show that the manufacturer of the complete pump system has a minimum of 5 successful installations permitted by the DEQ serving ten (10) or more homes. Systems will be designed to provide back-flow prevention. Pumps shall be housed in a tank separate from the septic tank with at least 12 hours holding capacity to allow for power outages and equipment failures.

(C) Equipment Inventory. A minimum number of pumps shall be purchased by the system to provide back up for maintenance of the system. The system is required to provide one pump for the first 1-10 homes, one (1) additional pump for the next fifteen (15) homes and one (1) additional pump for each additional twenty-five (25) homes thereafter.

252:656-5-3. Materials

(a) ASTM. All pipe, materials and construction must meet ASTM standards. List the standard for all materials and methods in the detailed specifications.

(b) Bedding. Specify the ASTM material class of bedding, which must be matched to the proper strength pipe to support the anticipated loads.

(c) Backfill. Specify the ASTM standard for the backfill material and its placement.

(d) Manhole bases-material.

(1) Bases. Pour manhole bases with at least 3,000 psi concrete with no more than 4 inches of slump, vibrated or tamped. They must be at least 8 inches thick, with a diameter 8 inches larger than the largest outside diameter of the manhole. Construct leakproof joints.

(2) Cast-in-place manholes. Pour manholes with at least 3,000
psi concrete. ASTM material standards are ASTM C150 for Portland cement; ASTM C144 for mortar aggregate; and ASTM C33 for fine and coarse aggregate.

(3) **Fiberglass Manholes.** Specifications for glass fiber-reinforced polyester manholes shall be in accordance with ASTM D3753-99 Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells. Provide design calculations, including information on the groundwater table, to indicate prevention of flotation of the manhole.

(4) **Pre-cast Manholes.** ASTM material standards for pre-cast manholes are ASTM C-478.

(5) **Exclusions.** Bricks and/or concrete blocks will not be approved for manhole construction.

(e) **Cast-in-place manholes.** Pour manholes with at least 3,000 psi concrete. ASTM material standards are ASTM C150 for Portland cement; ASTM C144 for mortar aggregate; and ASTM C33 for fine and coarse aggregate.

(f) **Exclusions.** Brick or concrete block manholes will not be approved.

252:656-5-4. **Construction standards**

(a) **Sewer.** Lay sewers in straight alignment with uniform grade between manholes. Protect all pipe from traffic load damage.

(b) **Trench.** The width of the trench shall be ample to allow the pipe to be laid and joined properly and to allow the backfill to be placed and compacted as needed.

1. Trench sides shall be kept as nearly vertical as possible. When wider trenches are dug, appropriate bedding class and pipe strength shall be used.

2. Large stones, ledge rock and boulders shall be removed to provide a minimum clearance of 4 inches from all pipe. Provide a minimum clearance of 4 inches between all pipe and any large stones, ledge rock, or boulders.

3. Except for cast iron or ductile iron pipe, provide 30 inches of soil cover or other protection from traffic load damage to the pipe. ASTM installation standards for ductile iron pipe are A-746.

4. Do not encase PVC pipe in concrete.

(c) **Separation.** Sanitary sewers located in the street right-of-way or adjacent to potable water lines must be justified by the engineer and comply with the following separation requirements: must be located on opposite sides of the streets from potable water lines. Sewer service lines crossing water lines must comply with subsections (2) or (3).

1. **Horizontal separation.** Sanitary sewers must be at least: 50 feet from petroleum product tanks unless constructed of ductile iron pipe which shall be no closer than 10 feet (joint material shall be resistant to petroleum products); at least 300 feet from a public water supply well and 50 feet from a private water well; and at least 10 feet from any existing or proposed water main; and at least 5 feet from electrical lines and petroleum lines. Sewer lines shall not be laid in water line trenches. (see section (3) below)

2. **Vertical separation (crossings).** Sanitary sewers must
cross at least 24 inches above or below water mains, and the crossing section centered so that the joints will be as far away as possible from the water mains.

(3) **Special conditions.** Where horizontal or vertical separation from potable water lines cannot be met, construct sanitary sewers with water line pipe (PVC ASTM 2241, SDR 32.5; AWWA C900, DR18; cast iron or equal). Test these lines with the ASTM air test procedure with no detectable leakage. Sanitary sewers constructed less than 50 feet from petroleum storage tanks shall be constructed of cast or ductile iron pipe and be no closer than 10 feet. Joint material shall be resistant to petroleum products. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, design and construct the sewer line equal to water pipe, and pressure test it to assure water tightness of joints adjacent to the water line prior to backfilling. Sewer lines shall not be laid in water line trenches. See OAC 252:626-19-2(8)(C).

(d) **Aerial Stream crossings - aerial.** Support all joints in aerial crossings. Design aerial crossing supports to prevent frost heave, overturning and settlement. Use concrete encasement (except around PVC pipe) or riprap where the pipe enters stream banks. Use expansion joints between above-ground and below-ground sewers and force mains, and protect them from freezing. Protect pipes that cross streams from the impact of flood waters and debris.

(e) **Stream crossings - below-grade.** The top(s) of all sewers entering or crossing stream beds must be at least three feet below the natural bottom of the stream bed. Construct or encase the crossing with cast or ductile iron pipe and using mechanical joints. The sewers must remain watertight and free from changes in alignment or grade. Trench backfill must be stone, coarse aggregate, washed gravel or other material that will not cause siltation. Specify construction methods to minimize siltation and bank erosion.

(f) **Flood plain structures.** Protect sewer outfalls, headwalls, manholes, gate boxes and other structures located in flood plains from stream erosion. Locate structures so they do not interfere with the free discharge of flood flows.

(g) **Manholes.** Manholes should be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 400 feet apart for sewers 15 inches in diameter or less, and 500 feet for sewers 18 to 30 inches in diameter. Greater spacing may be permitted in larger lines, those carrying a settled effluent or where adequate modern cleaning equipment for such spacing is provided. Lampholes may be used only for special conditions and cleanouts shall not be substituted for manholes nor installed at the end of laterals longer than 250 feet. One such special condition is in privately owned and operated mobile home parks, recreational vehicle parks and similar installations. At these types of facilities lampholes or clean outs may be used at the ends of 4 and 6 inch lines. Manholes may be omitted in straight runs of 4 and 6-inch lines provided clean outs are located every 100 feet if one way or every 200 feet if two-way clean-outs are used. Manholes will be required for all lines transporting the sewage from the collection area to
a public sewer or to all treatment works. See OAC 252:656-5-2(c)(4) Small diameter gravity sewer for other uses of cleanouts.

(1) Drop manhole. A drop pipe is required for all sewer lines entering a manhole at an elevation of 24 inches or more above the manhole invert. Drop pipes must be constructed on the outside of the manholes. Encase the entire outside drop connection in concrete.

(2) Diameter. The minimum inside diameter of manholes shall be 48 inches with a conical section at top to receive a standard manhole ring and cover.

(3) Flow channels. The flow channels through manholes shall conform to the sewer flow in shape and slope to that of the sewer lines.

(4) Inlet and outlet pipes. Join inlet and outlet pipes to the manhole with a gasketed gasket or other flexible watertight connection or any watertight connection that allows for differential settlement of the pipe and manhole wall.

(5) Steps, rings, and lids. Use watertight covers on manholes that may become submerged. Conduct leakage tests on all new manholes.

(6) Bases. Manhole bases must be at least 8 inches thick, with a diameter 8 inches more than the largest outside diameter of the manhole. Construct with leakproof joints between the base and manhole.

(7) Leakage Testing. Specify the ASTM standard for the test to be used. ASTM testing standards are ASTM C-969 and C-1244.

(h) Inverted siphons. Inverted siphons must have at least two barrels with a pipe size at least 6-inch pipe 6 inches in diameter. Design provide necessary appurtenances for convenient flushing and maintenance. Provide adequate clearance for rodding manholes. Construct manholes with adequate clearance for rodding the pipes. Provide sufficient head and select a pipe size for a velocity of at least 3.0 fps for average flows. Arrange the inlet and outlet details so normal flow can be is diverted to one barrel when the other is being cleaned and either barrel may be taken out of service for cleaning. The vertical alignment should permit cleaning and maintenance.

252:656-5-5. Tests

(a) Deflection test. Perform deflection tests on all flexible pipe after the final backfill has been in place at least 30 days. Deflection must not exceed 5%. Tests shall be run using a rigid ball or mandrel with a diameter equal to 95% of the inside diameter of the pipe taking into account manufacturing tolerances, and Tests shall be performed without mechanical pulling devices.

(b) Leakage test. Leakage tests are required for all gravity lines. Hydrostatic tests must use a 2-foot test head and leakage inward or outward shall not exceed 10 gallons per inch of pipe diameter per mile per day. Where air tests are proposed, specify the ASTM standard for the test to be used. Uni-Bel Plastic Pipe Association procedures may be used for plastic pipe. Water tests must use a 2 foot test head, and not flow inward or outward more than 10 gallons per inch of pipe diameter per mile per day.
An air test result must assure a leakage limit equivalent to the hydrostatic test limit.

SUBCHAPTER 7. PUMP STATION STANDARDS

252:656-7-1. Pump station design
(a) Required design factors for pumping stations are:
   (1) Emergency plan. Provide an emergency plan for handling sewage should the lift station completely fail. Required emergency operations are in section 7-4.
   (2) Separate wells. Wet and dry wells shall be completely separated, each with a separate its own entrance.
   (3) Access Accessibility and Safety. Provide a suitable stairway or ladder for dry wells and for wet wells with bar screens or mechanical equipment. Provide a fence or building to prevent unauthorized access. Adequate provision shall be made to effectively protect maintenance personnel from hazards. Equipment for confined space entry in accordance with OSHA and regulatory agency requirements shall be provided for all wastewater pumping stations. The design of the system shall protect the pump station controls and appurtenances from unauthorized access and vandalism. Provide a building or other form of protection such as fencing or access hatches with locks. The design of the system shall prevent unauthorized access or vandalism to control system and equipment. This could be provided by use of appropriate measures such as fencing, locked access hatches, buildings, or other equivalent measures.
   (4) Equipment removal. Provide for removal of pumps, motors, and other mechanical and electrical equipment during all weather conditions.
   (5) Dry well dewatering. Provide a sump pump in dry wells to remove leakage or drainage. The discharge pipe shall terminate above the overflow level of the wet well and include a check valve located near the pump. Do not connect water ejectors to a potable water supply. Slope all floor and walkway surfaces to the sump. Pump seal water shall be piped to the sump.
   (6) Flood Protection. Wastewater pumping stations structures and electrical and mechanical equipment shall be protected from physical damage by the 100 year flood. Wastewater pumping stations should remain fully operational and accessible during the 25 year flood. Regulations of state, provincial and federal agencies regarding flood plain obstructions shall be followed.
   (7) Buoyancy. Where high groundwater conditions are anticipated, buoyancy of the wastewater pumping station structures shall be considered and, if necessary, adequate provisions shall be made for protection.
(b) Pump requirements are:
   (1) Multiple units. Provide at least two pumps. With any pump out of service, the remaining pump(s) must have the capacity to handle maximum sewage flows.
   (2) Protect against clogging. Pump stations with screening devices shall provide for the storage and disposal of the collected material. Provide a suitable bypass where screening
or comminutor devices are installed.

3) **Pump openings.** Pumps, other than grinder type pumps, that handle raw sewage shall be capable of passing a 3-inch sphere. Suction piping shall be at least 4 inches in diameter. Suction lines to dry wells shall include suitable shut-off valves to allow pump removal.

4) **Priming.** Locate pumps so they will operate under a positive suction head under normal conditions.

5) **Intake.** Each pump shall have an individual intake and be designed to avoid turbulence near the intakes.

6) **Dry well dewatering.** Provide a sump pump in dry wells to remove leakage or drainage. The discharge pipe shall terminate above the overflow level of the wet well and include a check valve located near the pump. Do not connect water ejectors to a potable water supply. Slope all floor and walkway surfaces to the sump. Pump seal water shall be piped to the sump.

7) **Pumping rates.** Size pumps to prevent hydraulic surges.

(c) Force main requirements are:

1) **Diameter.** Force mains shall be at least 4 inches in diameter and provide at least 2 fps velocity.

2) **Air relief valve.** Install air relief valves at high points in force mains.

3) **Termination.** Terminate force mains not more than 2 feet above the flow line of the receiving manhole, and design them to reduce splashing and erosion.

4) **Design pressure.** Design the force main and fittings, including reaction blocking, to withstand normal pressure and pressure surges (water hammer).

5) **Special construction.** Force main construction near streams or used for aerial stream crossings shall meet applicable requirements of OAC 252:656-5-4.

6) **Design friction losses.** Calculate friction losses through force mains with the Hazen and Williams formula (or equivalent), using these C values:

   - (A) Unlined iron or steel - 100
   - (B) All other lined ductile or cast iron - 120
   - (C) PVC - 140

7) **Separation from water mains.** Refer to OAC 252:656-5-4(c).

8) **Controls.** Locate the control system so it is not affected by turbulence of incoming flow or pump suction. Provide automatic alternation of constant speed pumps at each cycle automatically.

9) **Valves.** Place suitable shut-off valves on suction and discharge lines of each pump. Place a check valve or equivalent on each discharge line, between the shut-off valve and the pump. Shut-off valves are not required on the suction side of pumps that can be removed from service without discharging.

10) **Wet wells.** Wet well size and control settings shall be appropriate to meet the chosen manufacturer’s recommended cycling times and to avoid heat buildup in the pump motor due to frequent starting and not to exceed 30 minutes between pump off to pump on to avoid septic conditions due to excessive retention time. The effective volume of the wet well shall be based on design average flow and a filling time not to exceed 30 minutes.
unless the facility is designed to provide flow equalization. Slope wet well floors to the pump intake at least 1 to 1 (1:1). Covered wet wells shall have provisions for air displacement to the atmosphere.

(11) **Ventilation.** Adequate ventilation shall be provided for all pump stations. Where the pump room is located below ground surface, mechanical ventilation is required. There shall be no interconnection between wet well and dry well ventilation systems. If the wet well must be entered to service mechanical equipment, forced ventilation is required, independent of dry well ventilation. Ventilation equipment switches shall be well marked and located at the entrance to the dry well. Intermittent operation ventilation systems shall be interconnected with the lighting system. The fan wheel(s) shall be fabricated from non-sparking material.

(A) **Wet wells.** Ventilation may be either continuous or intermittent. Mechanical ventilation is required if screens or mechanical equipment requiring maintenance and/or inspection are located in a wet well. Continuous ventilation shall provide at least 12 complete air changes per hour. Intermittent ventilation shall provide at least 30 complete air changes per hour. Air shall be forced into, rather than exhausted from, the wet well. Wet wells not designed for access shall have provision for air displacement to the atmosphere. The top of the pumping station shall be located higher than the 100-year flood.

(B) **Dry wells.** Provide adequate ventilation for all dry wells. Ventilation may be either continuous or intermittent. Continuous ventilation shall provide at least six complete air changes per hour; intermittent ventilation shall provide at least 30 complete air changes per hour. Ventilation equipment switches shall be marked and located at the entrance to the dry well. All intermittently operated ventilating equipment shall be interconnected with the respective pit lighting system. The fan wheel shall be fabricated from non-sparking material.

(12) **Water supply interconnection.** There shall be no direct connection between any potable water supply and sewage pumps or piping.

(13) **Pressure testing/leakage testing.** Test the installed pipe for leakage in accordance with ASTM standard specifications. The design working pressure of the pipe must not exceed 2/3 of the rated pressure of the pipe. Specify the ASTM standard to be used.

252:656-7-3. **Submersible pump stations**

Submersible pump stations shall meet the applicable requirements under OAC 252:656-7-1 (design), except as provided in this section.

(1) **Construction.** Submersible pumps and motors must be designed specifically for raw sewage use, including totally submerged operation during a portion of each pumping cycle. Provide an effective method to detect shaft seal failure or potential seal failure. The motor shall be of squirrel-cage type design without brushes or other arc-producing mechanisms.
(2) **Pump removal.** Submersible pumps shall be readily removable and replaceable without dewatering the wet well or manually disconnecting any piping in the wet well.

(3) **Electrical.**

(A) **Power supply and control.** Electrical supply, control and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well or through use of watertight seals. If the location is not sheltered, use weatherproof equipment.

(B) **Controls.** Locate the motor center outside the wet well. Protect it by a conduit seal or other appropriate measures meeting National Electrical Code requirements to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal.

(C) **Power cord.** Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage and shall meet the requirements of the National Electrical Code standards for flexible cords in wastewater pump stations. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent the entry of moisture into the cable, provided with strain relief appurtenances and designed to facilitate field connection.

(4) **Valves.** Air relief valves Valves for force mains shall be located outside the wet well in a separate enclosure. Provide drain systems for below-ground enclosures. If the valve enclosure is drained to the wet well, include a method to prevent sewage from entering the enclosure during surcharged wet well conditions.

**252:656-7-4. Emergency operation**

(a) **Design.** Design pumping stations to prevent or minimize bypassing of raw sewage during periods of power outage or mechanical failure. The pumping station must meet one of the following design conditions:

(1) an onsite standby generator or engine-driven pump with automatic means of activation in the event of a power failure; one hour of emergency storage at design flow above the alarm level; or

(2) a portable engine-driven pump with a quick connection to the force main; four hours of emergency storage at design flow above the alarm level; and telemetry to the city office during working hours and to the home of the person(s) in responsible charge of the lift station during off-duty hours; or

(3) 24 hours of emergency storage at design flow above the alarm level with an audio/visual alarm system.

(b) **Alarm systems.** Pumping stations shall have an automatic alarm system capable of alerting responsible maintenance personnel of an equipment failure before an overflow occurs, even during a power
failure. If telemetry is not provided to an office manned 24 hours per day, then show an equivalent alerting capability. **Equipment requirements.**

(1) **General.** The following general requirements shall apply to all internal combustion engines used to drive auxiliary pumps, service pumps and electrical generating equipment:

(A) **Engine protection.** The engine must be protected from operating conditions that would result in damage to equipment. Unless continuous manual supervision is planned, protective equipment shall be capable of shutting down the engine and activating an alarm.

(B) **Size.** The engine shall have adequate rated power to start and continuously operate all connected loads. The engines shall be capable of handling the peak capacity of the station.

(C) **Routine start-up.** All emergency equipment shall be provided with instructions indicating the need for regular starting and running of such units at full loads.

(D) **Equipment protection.** Emergency equipment shall be protected from damage due to restoration of regular electrical power.

(E) **Instructions, tools and parts.** Post a complete set of operational instructions, emergency procedures and maintenance schedules at the station. Provide any special tools and spare parts.

(2) **Engine-driven pumping equipment.** Where permanently installed or portable engine-driven pumps are used, the following requirements shall also apply:

(A) **Pumping capacity.** Engine-driven pump(s) shall meet the design pumping requirements unless storage capacity is available for flows beyond pump capacity. Pumps shall be designed for anticipated operating conditions, including suction lift if applicable.

(B) **Operation.** The engine and pump shall be equipped for automatic start-up and operation, and for manual start-up.

(C) **Portable pumping equipment.** Where part or all of the engine-driven pumping equipment is portable, a riser from the force main with quick-connect coupling and appropriate valving shall be provided to hook up portable pumps.

(3) **Engine-driven generating equipment.** Where permanently-installed or portable engine-driven generating equipment is used, the following requirements shall also apply:

(A) **Generating capacity.** Generating unit size shall be adequate to provide power for pump motor starting current and for lighting, ventilation, and other auxiliary equipment necessary for safety and proper operation of the lift station. Provide sequencing controls to start pump motors unless the generating equipment has capacity to start all pumps simultaneously with auxiliary equipment operating.

(B) **Operation.** Provide for automatic and manual start-up and load transfer. Protect the generator from damaging operating conditions. The engine must start and stabilize at operation speed before assuming the load.

(C) **Portable generating equipment.** If portable generating
equipment will be used, include special electrical connections.
(c) Overflow basins. See Subchapter 11 (Lagoon Standards). General construction of overflow basins shall be in accordance with OAC 252:656-11-(3).
(d) Equipment requirements.
(1) General. A portable pump is required. Also, the following general requirements shall apply to all internal combustion engines used to drive auxiliary pumps, service pumps and electrical generating equipment:
(A) Engine protection. The engine must be protected from operating conditions that would result in damage to equipment. Unless continuous manual supervision is planned, protective equipment shall be capable of shutting down the engine and activating an alarm.
(B) Size. The engine shall have adequate rated power to start and continuously operate all connected loads. The engines shall be capable of handling the peak capacity of the station.
(C) Routine start-up. All emergency equipment shall be provided with instructions indicating the need for regular starting and running of such units at full loads.
(D) Equipment protection. Emergency equipment shall be protected from damage due to restoration of regular electrical power.
(E) Instructions, tools and parts. Post a complete set of operational instructions, emergency procedures and maintenance schedules at the station. Provide any special tools and spare parts.
(2) Engine-driven pumping equipment. Where permanently installed or portable engine-driven pumps are used, the following requirements shall also apply:
(A) Pumping capacity. Engine-driven pump(s) shall meet the design pumping requirements unless storage capacity is available for flows beyond pump capacity. Pumps shall be designed for anticipated operating conditions, including suction lift if applicable.
(B) Operation. The engine and pump shall be equipped for automatic start-up and operation, and for manual start-up.
(C) Portable pumping equipment. Where part or all of the engine-driven pumping equipment is portable, a riser from the force main with quick connect coupling and appropriate valving shall be provided to hook up portable pumps.
(3) Engine-driven generating equipment. Where permanently installed or portable engine-driven generating equipment is used, the following requirements shall also apply:
(A) Generating capacity. Generating unit size shall be adequate to provide power for pump motor starting current and for lighting, ventilation, and other auxiliary equipment necessary for safety and proper operation of the lift station. Provide sequencing controls to start pump motors unless the generating equipment has capacity to start all pumps simultaneously with auxiliary equipment operating.
(B) Operation. Provide for automatic and manual start-up and
load transfer. Protect the generator from damaging operating conditions. The engine must start and stabilize at operation speed before assuming the load.

(C) **Portable generating equipment.** If portable generating equipment will be used, include special electrical connections.

**Alarm systems.** Pumping stations shall have an automatic alarm system capable of alerting responsible maintenance personnel of an equipment failure before an overflow occurs, even during a power failure. If telemetry is not provided to an office manned 24 hours per day, then show an equivalent alerting capability.

**SUBCHAPTER 9. GENERAL STANDARDS**

252:656-9-1. **Plant location and design life**

(a) **Minimum separation distances.** Local ordinances and zoning requirements may establish separation distances greater than those required by this Chapter. Otherwise, no facility shall be constructed or extended closer than 100 feet from the property line. Measure lagoons from the center of dike. The minimum separation distance from any public water supply well is 300 feet, and from any public water supply intake structure will be determined on a case by case basis. No part of any wastewater treatment facility shall be constructed or extended within 100 feet of a plant site property line. Measurement for lagoons shall be from the centerline of the nearest dike.

(b) **Flood protection.** Protect the treatment works structures, electrical and mechanical equipment from physical damage by a 100-year flood. Treatment works must remain operational and be accessible during a 25-year flood. Flood protection applies to new construction and to existing facilities undergoing major modification.

(c) **Design life.** Design sewage treatment plants for an estimated 20-year population projection. Construction may occur in phases to reduce initial cost.

(d) **Phased.** For facilities to be built in phases, the engineer shall furnish design data for ultimate plant capacity. The data shall include size, type, loading and location of all units. Use dashed lines to show units that are to be constructed as a later phase. Furnish a hydraulic profile showing the water elevations of all units and the flood elevation of streams that can affect the plant site. Detailed design data are required for all units to be constructed as Phase I.

(e) **Access Restriction.** All facility boundaries must contain the following access restrictions: All facilities must be fenced to prevent unauthorized entry. Fencing must be posted with warning signs to indicate the nature of the facility, listing emergency contact information. Post at least one sign on each side of the site.

(1) fencing to prevent unauthorized entry; and
(2) warning signs to indicate the nature of the facility and to list emergency contact information.
252:656-9-2. Essential facilities

(a) Emergency power facilities.
   (1) General. Provide all plants with portable or in-place internal combustion engine equipment which will generate electric power to allow continuity of operation during power failures. Where only emergency pumping is necessary, a portable engine driven pump may be used.
   (2) Power for aeration. Standby generating capacity normally is not required for aeration equipment used in the activated sludge process. In cases where a history of long-term (four hours or more) power outages have occurred, auxiliary power for minimum aeration will be required. Contact the DEQ for discharge requirements to sensitive streams.
   (3) Power for disinfection. Where disinfection is required, provide standby power to operate the disinfection equipment.

(b) Water supply.
   (1) General. Provide potable water under pressure to laboratories, restrooms, offices, drinking fountains and showers. Do not cross-connect potable and non-potable water lines. Cross-connections between potable and non-potable water lines is prohibited.
   (2) Direct connections. Potable water from a municipal or separate supply may be used directly at points above grade. Hot water shall not be taken directly from a boiler used for supplying hot water to a sludge heat exchanger or digester heating unit.
   (3) Indirect connections. Where a potable water supply is to be used for any purpose in a plant other than those listed in paragraph (1), above, provide a break tank, pressure pump, and pressure tank. Discharge water to the break tank through an air gap at least six inches above the maximum flood line or the spill line of the tank, whichever is higher. Post a permanent sign at every hose bib, faucet, hydrant, or sill cock located on the water system beyond the break tank to indicate that the water is not safe for drinking. The installation of two reduced pressure backflow prevention devices in series a reduced pressure zone backflow prevention device will be considered in lieu of the break tank on a case-by-case basis. To allow maintenance on the backflow prevention device, the design shall include a bypass line with equal backflow prevention. Do not locate back-flow devices in a pit or vault where they may become submerged; they must be easily accessible for routine testing for proper operation.
   (4) Separate potable water supply. Where it is not possible to provide potable water from a public water supply, a separate well may be provided. Install the well according to the Public Water Supply Construction Standards.
   (5) Non-potable water outlets. Post a permanent sign at non-potable water outlets indicating the water is not safe for drinking. Prevent cross connections between a non-potable water system and the potable water system. Cited in 9-2 (b)(1).

(c) Laboratory equipment. All treatment works shall have access to a laboratory for making analytical determinations and operation
control tests.
(d) **Sewage flow measurement.** Provide for the measurement of incoming flow at all wastewater treatment plants. Provide indicating, totalizing, and recording devices for all mechanical discharging plants of 0.5 MGD design capacity or greater. Where all incoming flow to a lagoon system less than 0.5 MGD design capacity is through a single pump station, flow measurement may be satisfied by calibration of pumps and installation of run-time meters. Also provide for the measurement of wastewater to be discharged or land applied effluent flow in accordance with the system’s OPDES permit and OAC 252:606. Flow measurement devices shall be selected for reliability and accuracy. All flow measurement equipment must be sized to function effectively over the full range of flows expected and shall be protected against freezing. For land application systems, effluent flow measurement must be in accordance to OAC 252:621.

252:656-9-3. **Plant outfalls**
(a) **Entrance impact control.** All wastewater treatment facilities designed to discharge treated wastewater shall provide an outfall sewer pipe to a defined water course. Consider the following when designing outfall lines:
   (1) Free fall or submerged discharge;
   (2) Utilization of cascade aeration to increase dissolved oxygen;
   (3) (1) Dispersion of the effluent across the stream as needed to protect aquatic life; and
   (4) (2) Access for effluent sampling.
(b) **Protection and maintenance.** Protect the outfall sewer from the effects of floodwater, ice, or other hazards to reasonably assure its structural stability and freedom from stoppage. Provide a manhole at the shore end of all gravity sewers extending into the receiving waters. Consider hazards to navigation in the outfall design. Provide at least a 12-inch diameter pipe or appropriate screening for submerged discharges to prevent blockage by aquatic animals.
(c) **Discharge to reservoirs.** Proposed discharges within 600 feet of the maximum conservation pool elevation shall extend by the line into the reservoir. Anchor such the lines to the bottom in such a fashion as to be at least 10 feet below the surface and 100 feet from the water line at the conservation pool elevation.
(d) **Sampling provisions.** Design all outfalls for obtaining effluent samples at a point after the final treatment process and before it reaches the receiving waters.

**SUBCHAPTER 11. LAGOON STANDARDS**

252:656-11-1. **Lagoon siting**
(a) **Winds.** Locate lagoons to minimize wind obstructions.
(b) **Surface runoff.** Do not locate lagoons in floodways, and avoid flood plains. Divert storm water runoff around lagoons and protect embankments from erosion.
(c) **Hydrology.** Use sound sanitary and engineering practices to
protect ground water aquifers and public water supplies from pollution from lagoons. Maintain a 4-foot separation between the lagoon bottom and the highest known groundwater elevation.

(d) Geology. Areas which may be subjected to karstification (i.e., sink holes or underground streams generally occurring in areas underlain by limestone, gypsum or dolomite), are not suitable lagoon sites. Maintain a 4-foot separation between the lagoon bottom and any bedrock formation.

(e) Public Water Supply wells. The separation from Public Water Supply wells is specified in OAC 252:626 300 feet.

252:656-11-2. Basis of design

(a) Aerobic. Design lagoon systems for sufficient oxygen to maintain aerobic conditions in each cell using aeration devices or algal photosynthesis. Facultative Lagoons. Facultative lagoons depend on the relationship between organic loading and surface area (algal photosynthesis) or on surface area and supplemental mechanical aeration to provide an aerobic layer of water at the surface. Facultative lagoons may be either total retention or flow-through (discharge) to waters of the state.

(b) Flow-through lagoons.

(1) Organic loading. Limit the organic load to 35 pounds \( \text{BOD}_5 \) per acre (water surface area) per day for any cell depending solely on algal photosynthesis for oxygen. The total water surface area requirement based on organic loading is calculated at the average water depth. For total loading, calculate the design depth at the average operating depth. For design depth of 6 feet, the average operating depth would be 4.5 feet.

(2) Number of cells. Flow Control. Provide at least two primary cells on new systems. Design the primary cells to operate so they may be operated in either series or in parallel, with at least 60 days retention time in the primary cells. Provide at least two secondary cells operating in series with the primary cells and in series with each other. Provide a bypass line around any secondary cell in a series to the next cell. The secondary cells shall have at least 60 days detention and for a total of at least 120 days detention in the system.

(3) Depth. The maximum water depth shall not exceed 6 feet in primary cells and 10 feet in secondary cells. Provide structures to allow the primary cells to operate between three four foot depth and the maximum design depth plus three feet of freeboard. The operating depth for a flow-through lagoon shall be between 4 and 6 feet.

(c) Surface evaporation lagoons (total retention). Where more than one acre of surface area is needed, provide at least two cells. Size the primary cell(s) for the expected organic loading and additional evaporation cells designed for the hydraulic load. Base the design of all cells receiving raw water wastewater on an organic loading of 35 lbs \( \text{BOD}_5 \) per surface acres per day at the
average operating depth. Provide sufficient area to evaporate the annual inflow. Base the total flow influent flow based on the average daily design flow with allowances for infiltration and inflow to the sewage collection system. Base the evaporation rates on the annual average pan evaporation minus the 90th percentile annual precipitation for the geographical location.

(d) Aerated lagoon systems. Addition of aeration equipment to existing non-aerated lagoons may be considered for a temporary solution to intermittent overload of primary cells. Approval will be with the full understanding of the owner that additional construction may be necessary for compliance with facility permit conditions. The following apply to all new aerated lagoon systems—either complete mix or partial mix. Only partial-mix systems will be considered for systems with 30 day average concentration limits for BOD, and TSS of 30 mg/l and 90 mg/l, respectively, as their basic permit requirement.

1. Number of cells. At least two aerated cells, in series, followed by one settling lagoon with a hydraulic retention time of at least two days is recommended.

2. Depth. The design water depth shall be 10 to 15 feet.

3. Complete-mix system. Sufficient horsepower is required to keep solids in suspension in aerated cells. An additional cell or basin is required for solids separation before discharging the effluent. Two cells or basins are recommended to remove solids. Provisions for recycling from the settling basin to the aerated basins are recommended.

4. Partial-mix system. Sufficient horsepower is required to meet the applied organic load oxygen requirements. No attempt is made to keep all solids suspended in aerated lagoons. An additional cell or basin is required for solids separation before discharging the effluent.

5. Design Requirements. Submit design calculations to the DEQ for review, and justify the use of any constants not listed.

6. Aeration requirements. Oxygen requirements will depend on organic loading, required treatment, and concentration of suspended solids to be maintained in the aerated basins cells. Aeration equipment shall be capable of maintaining a minimum dissolved oxygen level of 2 mg/l in the lagoons at all times. In the absence of experimentally determined values, the design oxygen requirements shall be 1.8 lb O₂/lb BOD₅ applied at maximum loading.


6. Disinfection. Disinfection will be required for all aerated lagoon systems proposed to discharge to water bodies where water quality standards require coliform limits.
(a) **Soil borings.** Accurately represent the soil characteristics. Provide soil borings boring data conducted by an independent soil-testing laboratory. Borings shall extend at least 24 inches 5 feet below the proposed lagoon bottom and at least one boring shall be at least 25 feet deep or into bedrock. Borings shall be conducted during the time of highest groundwater level. Provide enough borings to be representative of the entire site. If bedrock is encountered, describe its general characteristics and identification, and the underlying corresponding geological formation(s). Include a log of soil types encountered at each boring, the elevation of the water table where encountered and the permeability of soil samples taken from the same elevation as the proposed lagoon bottom. Fill and seal all boring borings after testing.

(b) **Dikes.**

1. **Material.** Construct dikes of relatively impervious material and compact them to at least 90 percent Standard Proctor Density to form a stable structure. Remove vegetation and other unsuitable materials before construction.
2. **Top width.** The top of the dike must be at least eight feet wide for maintenance vehicles.
3. **Slope.** Inner and outer dike slopes shall not be steeper than 1 vertical to 3 horizontal (1:3). Steeper slopes will only be considered where surface construction is of soil cement or other material that will prohibit vegetation growth. Inner dikes should shall not be flatter than 1 vertical to 4 horizontal (1:4).
4. **Freeboard.** Design the lagoon to maintain at least 3 feet of freeboard above the design maximum water depth at all times.
5. **Lagoon shape.** Round, square or rectangular lagoons, with a length not over more than three times the width are recommended, constructed without islands, peninsulas or coves. Common wall dike construction is encouraged. Round all corners.
6. **Erosion control.** Protect inner dikes from wave action and outer dikes from runoff and floodwaters.
   - **Seeding.** Where riprap is not used, apply at least 4 inches of fertile top soil to dikes to establish an adequate vegetative cover. Before prefilling, establish vegetation on dikes from the outside toe to 2 ft above the lagoon bottom on the interior as measured on the slope. Specify perennial, low-growing grasses that spread rapidly. Alfalfa or other long-rooted grasses should not be used for seeding since the roots of this type are apt to impair the water holding efficiency of the dikes. Do not use alfalfa or other long-rooted vegetation for seeding since the roots of this type are apt to impair the water holding efficiency of the dikes.
   - **Additional protection.** Provide extra protection where inner dikes may be subjected to severe wind action, such as lagoons larger than 5 acres and where the lagoon surface will often be exposed to strong winds. Also protect areas of turbulence in aerated cells and all pipe
penetrations. Install riprap, soil cement or other recognized material. Protect the inner dikes from 1 foot vertically above the high water elevation to 2 feet vertically below the minimum operating elevation. Place riprap on a filter bed at least 6 inches thick, and use material that will stay in place and resist erosion.

(c) **Bottom Lagoon seal.** The seepage rate through the lagoon bottom and inside dike shall not exceed 500 gal/day/acre \( (5.4 \times 10^{-7} \text{ cm/s}) \) at a water depth of 6 feet for soil and bentonite seal. Synthetic seals shall have no measurable leakage. Construct a soil seal as specified below. If native soils might exceed this seepage rate, then a soil or bentonite seal or synthetic liner must be specified. Written certification to the effect that the seal was provided and applied in accordance with specifications and that the hydraulic conductivity is equal to or less than \( 5.4 \times 10^{-7} \text{ cm/s} \) shall be furnished by the project engineer. Use ASTM Method 5084. Analysis of soil must include how soil will be applied.

(1) **Soil seal.**

(A) The soil used for sealing must have a high, uniform content of fine material (clay and silt). Soil containing rock or a high gravel content is not acceptable for a soil seal or for mixing with bentonite.

(B) Soil used to construct the lagoon bottom seal and dike cores shall be relatively incompressible and compacted at a water content up to 4% above the optimum to at least 90% Standard Proctor Density.

(C) The soil used for sealing shall be at least 12 inches thick with the coefficient of permeability \( (K) \) no greater than \( 10^{-7} \text{ cm/s} \). The soil seal should be applied in lifts no greater than 6 inches.

(D) If the \( K \) value of the soil used for sealing exceeds \( 10^{-7} \text{ cm/s} \), the thickness of the seal should be adjusted according to: \[ L = 0.13 \times 10^9 \times K \]

(2) **Bentonite seal.**

(A) The application rate should be at least 125% of the minimum rate that is determined to be adequate by laboratory tests.

(B) The water content of the soil-bentonite mixture should be up to 4% above the optimum for maximum compaction. Bentonite shall be applied to soil that is free of all vegetation, trash, roots, frozen soil, snow or ice, stones over 2 inches in diameter or other objectionable material.

(C) Split the material in half and apply in two perpendicular directions. Split the material in half and apply in two perpendicular 3-inch lifts for a finished compacted blanket thickness of 6 inches.

(D) Mix the bentonite into the soil to a uniform depth of at least 3 inches. After mixing and compacting, analyze a sample of the soil/bentonite mixture for permeability. If the coefficient of permeability exceeds \( 5.4 \times 10^{-7} \text{ cm/s} \), the depth of the mixture or content of bentonite must be increased as necessary to obtain the
required seal.

(E) Compact the mixture at the proper water content to at least 90% Standard Proctor Density (specifically excluding use of a sheepsfoot roller).

(F) Cover the completed seal with at least 4 inches of soil in addition to necessary erosion control.

(G) Hydrate with fresh water and keep at or above the optimum water content until the pond is prefilled.

(H) Written certification to the effect that the seal was provided an applied in accordance with specifications and that the coefficient of permeability is equal to or less than $10^{-7}$ cm/s shall be furnished by the supplier, project engineer or independent soils laboratory.

(3) **Synthetic liner.**

(A) The liner must be at least 30 mil (0.030 inch) thick.

(B) Remove or cover sharp objects in the subsoil with a bedding of 2 to 4 inches of clean soil or sand.

(C) Use 4-inch perforated pipe to allow venting and draining of the soil to reduce gas and hydrostatic pressures and facilitate monitoring for leakage.

(D) Seal panels **shall** be laid out in a longitudinal direction with an overlap of 4 to 6 inches.

(E) The anchor trench **shall** be a 6-inch minimum depth and placed at least 9 to 12 inches beyond the slope break of the dike.

(F) Take adequate measures to protect the integrity of the liner. On dike slopes, backfill **shall** consist of at least a 3-inch layer of sand or finely textured soil and covered with at least a 3-inch layer of heavier cobble, coarse gravel or small riprap.

(4) **Uniformity.** The bottom shall be as level as possible. Finished elevations shall not deviate more than 3 inches from the average elevation.

(5) **Prefilling.** Protect the integrity of the liner by hydrating with fresh water until the lagoon is used.

(d) **Certify.** The project engineer or independent soils laboratory must certify in writing that the seal was provided and applied according to approved specifications.

(e) (d) **Influent lines.** Influent lines shall terminate in a manhole or flow distribution manhole or control structure with the invert at least 6 inches above the maximum design high water elevation of the lagoon. Design the control structure to proportionally split the flow to the primary cells.

(1) **Placement.** Influent Raw sewage distribution lines up to 12 inches in diameter may be placed on the surface of the lagoon bottom. Locate larger lines in trenches so the top of the pipe is no more than 12 inches above the lagoon bottom. Anchor plastic pipe to prevent floating or settling. Soil shall not be mounded over the distribution lines. The method of construction shall not alter the integrity of the lagoon seal.

(2) **Point of discharge.** To minimize short-circuiting in primary cells, terminate influent lines at the lesser of
either the center of the cell or a point at least 100 feet from the inside toe of any dike. Install multiple inlets when the distance from any inlet to the toe of an adjacent dike exceeds 250 feet. Terminate influent lines for aerated cells within the mixing zone of the aeration equipment. Consider multiple inlets for diffused aeration systems.

3) Discharge apron. To control erosion of the lagoon bottom, influent lines must discharge horizontally into shallow, saucer-shaped depressions and terminate on a concrete apron. The apron shall be at least 2 feet square or in diameter. Provide additional energy dissipating devices where influent will enter the lagoon at a high velocity (steep slopes, force mains, etc.).

(e) Miscellaneous construction standards. All pipes entering and exiting the seal shall be constructed with a seepage collar.

(f) Control structures and interconnecting piping.

1) Structure. Provide structures to control water depth in cells, route water through the system, and measure flow at discharging facilities. Control structures in primary cells must be capable of controlling the operating depth between a minimum of 3 feet and the maximum design operating depth. For suspended solids control, the discharge structure should allow the withdrawal point to vary below the surface to obtain the best quality effluent. Valves, slide tubes, dual slide gates or removable boards are recommended, and they shall:

(A) Be accessible for maintenance and adjustment of controls;
(B) Control water level and flow rate, and complete shutoff;
(C) Be constructed of non-corrosive materials; and
(D) Be located to minimize short-circuiting within the cell.

2) Discharge piping. Pipe meeting ASTM standards for sanitary sewers shall be adequately anchored but not interrupt the integrity of the seal.

(A) Hydraulic capacity. The hydraulic capacity for continuous discharge structures and piping shall allow for a minimum of 250 percent of the design flow of the system.

(B) Minimum pipe size. All piping within the lagoon should be at least 12 inches in diameter for facilities serving 100 P.E. or more and at least 8 inches for facilities serving less than 100 P.E. Design influent pipe for rodding. Protect all piping within the lagoon cells from the entrance of turtles.

252:656-11-4. Other lagoon construction

(a) Fence. Enclose the lagoon area within a fence to discourage livestock and trespassers. Fences must have a lockable gate and not obstruct maintenance vehicles and equipment. Lagoons located within 350 feet of existing or platted residential or recreational areas shall be enclosed with a 6-foot high woven wire fence. Decorative fences around facilities located in recreational areas
will be considered on a case-by-case basis.

(b) **Access.** Provide an all-weather access road to the lagoon site.

(c) **Warning signs.** Provide appropriate permanent signs along the fence around the lagoon site that designate the nature of the facility and advise against trespassing. Place at least one sign on each side of the site. The warning sign shall include the name of the owner and a contact number for the owner.

(d) **Flow measurement.** Flow measurement requirements are presented in 252:656-9-2(d). Provide effective weather protection for recording equipment.

**SUBCHAPTER 13. PRELIMINARY TREATMENT STANDARDS**

252:656-13-1. Screening devices

(a) **Required.** Screening devices are required at all mechanical treatment plants.

(b) **Bar screens.** Bar screens shall comply with the following:

1. **Flow measurement.** Locate screening devices so that changes in backwater elevations due to intermittent cleaning of screens will not interfere with flow measuring equipment.

2. **Size.** Clear openings between bars shall not be greater than 1 3/4 inches. Screens shall be designed to be easily raked.

3. **Slope.** Hand-cleaned screens, except those for emergency use, shall slope 30 to 45 degrees from horizontal.

4. **Channels.** Shape the channels before and after screens to prevent sedimentation of solids. The channel entrance to the screens must evenly distribute the flow to minimize turbulence.

5. **Controls.** All mechanical units operated by timing devices shall have auxiliary controls to start operation at predetermined high water elevations. Automatic controls shall have a manual override.

6. **Screenings.** Hand-cleaned screens must have suitable drainage, a platform with suitable drainage and ample facilities for removal, handling, storage and disposal of screenings.

(c) **Comminutors.** Comminutors shall be used in plants that do not have bar screens. They shall be designed as follows:

1. **Location.** Locate comminutors downstream of any grit removal equipment.

2. **Size.** Comminutor capacity must be adequate for peak flow.

3. **Protection.** Install a screened channel to automatically bypass flows above design capacity. Install a 6 inch deep gravel trap to protect each comminutor that is not preceded by grit removal equipment. Provide gates to isolate the flow from the comminuting and screening units.

252:656-13-2. Grit chambers

(a) **Where required.** Grit chambers are required at all sewage treatment plants where grit is anticipated or is known to be present and ahead of pumps and other equipment that may be damaged by grit.
(b) **Housed facilities.** Introduce fresh air continuously at a rate of 12 air changes per hour, or intermittently at a rate of 30 air changes per hour. Odor control facilities may also be warranted. Provide adequate stairway access to above or below ground installations. All electrical installation in enclosed grit removal areas where hazardous gases may accumulate shall meet the requirements of the National Electrical Code.

(c) **Outside facilities.** Protect grit removal facilities located outside from freezing.

(d) **Velocity and detention.** Velocity shall be regulated to minimize organic matter deposition. Channels shall be designed for velocities of 0.8 to 1.3 fps, with a total detention period time of 20 seconds to one minute.

(e) **Grit washing.** Provide facilities to remove grit from the chambers. Chambers without positive velocity control must have grit washing devices to further separate organic and inorganic materials in all chambers not equipped with positive velocity control. Include provisions for draining each unit.

(f) **Grit removal.** Provide facilities for hoisting grit to ground level from equipment located in deep pits, provide access by stairways, and provide adequate ventilation and lighting.

### 252:656-13-3. Diurnal Flow equalization

(a) **General.** Provide flow equalization basins to reduce dry weather and equalize variations in organic and hydraulic loadings where large organic or hydraulic diurnal variations of organic or hydraulic loading are expected, where peak to average is greater than 2:1. Wet weather (excess flow) basins are covered in the next rule (13-4).

(b) **Location.** Locate basins downstream of pretreatment facilities such as bar screens, comminutors and grit chambers.

(c) **Size.** Capacity must be sufficient to reduce expected flow and load variations to the extent economically feasible. The volume required to achieve the desired degree of equalization can be determined from a cumulative flow plot over a representative 24-hour period.

(d) **Operation.**

1. **Mixing.** Provide aeration air or mechanical equipment to maintain adequate mixing. Design corner fillets and hopper bottoms with draw-offs to alleviate the accumulation of sludge and grit.

2. **Aeration.** Aeration equipment shall be sufficient to maintain a minimum of 1.0 mg/l of dissolved oxygen in the basin at all times. Air supply rates should be at least 1.25 cfm/1,000 gallons of storage capacity. Isolate the air supply from other treatment plant aeration requirements to facilitate process aeration control.

3. **Controls.** Equip inlets and outlets for all basin compartments with flow control devices. Provide facilities to measure and indicate liquid levels and flow rates leaving the basin(s).

### 252:656-13-4. Wet weather flow equalization basins

(a) **Types of basins.** The elevation of the influent sewer line at
the wet weather flow equalization basin will dictate the hydraulic design of the basin. **Basin type.**

1. **Gravity systems.** Construction of a diversion structure with excess flow diverted to the basin is desirable. For gravity inlet systems, construction of a diversion structure with excess flow diverted to the basin is desirable. Usually it will be necessary to pump the contents of the basin back to the primary units for treatment. Design shall include a method to return contents to primary basins.

2. **Pumped systems.** Installation of control valves or dedicated pumps to handle wet weather flow is used to divert excess flow to the basin. For pumped systems, installation of control valves or dedicated pumps to handle wet weather flow is used to divert wet weather flow to the basin. Depending on the elevation of the basin, it may be possible to return the flow to the plant's primary units by gravity. If not, a pump return system will be necessary.

(b) **Design criteria.** The design of basins requires a thorough evaluation of flow patterns and volumes. Items to be considered are basin geometry, construction materials, storage capacity and operational controls.

(c) **Basin geometry layout.** The available land area will dictate the layout of the basin. A minimum of two compartments are required with all flow diverted to a lined basin where solids can settle and, when full, overflow to additional basins. Basins designed for storage for five million gallons or more require a minimum of two compartments designed to operate in series. All flow must be diverted to a lined basin where solids can settle and, at a predetermined elevation, overflow to additional basins. A single basin equipped with an impervious liner is acceptable where the required storage capacity is less than five million gallons. Provisions are required for returning the contents of the basins to the treatment plant and for removal of settled solids are required.

(d) **Construction materials. Basin construction.** New basins must meet the lagoon standards, Subchapter 11. Provided, however, the top dike may be reduced to a 6-foot width; and single cell basins or cells receiving raw wastewater must be lined with concrete, asphalt or equivalent material below the maximum water elevation line. Basin construction must be in accordance with 252:656-11-3 and 4 Lagoon standards with the following exceptions:

1. Top of dikes may be reduced to a width of 6 feet
2. Bottoms of lagoon cells shall be adequately sloped to allow drainage to waste return structure(s)
3. For basins with two compartment, the first basin must be lined below the maximum design water elevation with concrete, asphalt, or equivalent material. Single compartment basins must be lined as above.

(e) **Storage capacity.** Design minimum storage to contain the largest seven-day wet weather period in 10 years, with the capability to be timely emptied in a timely manner. Actual flow data shall be used to develop flow balance or mass diagrams for determining basin capacity. Base the The frequency and duration of storms should be based on field data and weather service records.

(f) **Air Aeration requirements.** Aeration may be Where oxygen is
required to prevent the wastewater from becoming anaerobic. To maintain aerobic conditions, air requirements are provide air at the rate of 1.25 to 2.0 CFM per 1,000 gallons basin volume. Where mechanical aerators are used, 7.5 horsepower per million gallons of basin capacity is required.

(g) **Pumps and flow control methods.** Controls are required to regulate flow to the basin and return flow to the plant. Adequate controls and with measuring devices are required to divert all flow in excess of the plant hydraulic capacity to the basin. Provisions and controls are required to return the basin contents to the plant after the wet weather event has passed and influent flow returned to normal. Return flow may be manual or automatic, but sufficient flow measurement and instrumentation devices must be included to determine the actual flow to the first treatment unit. Where automatic flow return is provided, control equipment must limit the normal influent flow to the plant plus the return flow to the hydraulic capacity of the plant. Where basin return flow is automatic, control equipment must limit the combination of plant influent plus the basin return flow to the hydraulic capacity of the plant.

SUBCHAPTER 15. BIOLOGICAL TREATMENT STANDARDS [REVOKED]

252:656-15-1. **Suspended growth systems** [REVOKED]

(a) **Return sludge equipment.**

(1) **Return rate.** Design all the **return pumping** systems for the capability to be operated at the following return rates:

- **Standard Rate:**
  - (i) 15% minimum
  - (ii) 75% maximum

- **Carbonaceous Stage of Separate Stage Nitrification:**
  - (i) 15% minimum
  - (ii) 75% maximum

- **Step Aeration:**
  - (i) 15% minimum
  - (ii) 75% maximum

- **Extended Aeration:**
  - (i) 50% minimum
  - (ii) 150 maximum

- **Nitrification Stage of Separate Stage Nitrification:**
  - (i) 50% minimum
  - (ii) 200% maximum

(2) **Return pumps.** Where multiple pumps are used, maintain the maximum return sludge requirement with the largest pump out of service. Provide a positive head on pump suction with at least 3-inch suction and discharge openings. Provide a positive head on all pumps suction under all operating conditions. Provide a minimum pumps suction & discharge opening of at least 3-inches. Air lift systems must be at least 3 inches in diameter. Further, air compressors must be of sufficient capacity to supply design air requirements plus a 25% safety factor.

(3) **Return piping.** Provide 4-inch discharge piping designed to
maintain a minimum velocity of 2 fps at normal return rates. Provide mechanisms for observing, sampling and controlling return sludge flow from each settling tank.

(b) Waste sludge facilities. Discharge waste sludge to any one or combination of thickening tanks, primary settling tanks, digesters, vacuum filters or belt presses. Design all waste sludge control facilities to handle at least 25% of the average sewage flow and to function at rates of 0.5% of average sewage flow or a minimum of 10 gpm, whichever is larger. Provide a means for observing, measuring, sampling, and controlling the flow.

(c) Measuring devices. Install a means to measure flow rates of raw sewage, primary effluent, waste sludge, return sludge, and air to each tank unit.

(d) Activated sludge. Submit a complete design analysis to the DEQ for review. Contact stabilization is not recommended as the only secondary treatment process, but may be considered where equalization of flow is provided or where other treatment units follow.

(1) Pretreatment. For plants with primary settling, provide a method to discharge raw sewage directly to the aeration tanks to facilitate plant start-up and operation during the initial stages of the plant's design life. If primary settling tanks are not used, provide a means to remove grit, debris, excessive oil and grease, and comminution or screening of solids ahead of the activated sludge process.

(2) Design calculations. Submit a comprehensive discussion of all functional design calculations used to size activated sludge treatment facilities. Include the following:
(A) influent wastewater characteristics,
(B) temperature range of wastewater,
(C) pretreatment of the waste,
(D) hydraulic and organic loading applied to the aeration basin,
(E) anticipated mixed liquor suspended solids level to be maintained in the aeration basin,
(F) aeration time,
(G) oxygen and mixing requirements for average and peak flows,
(H) recirculation and sludge wasting,
(I) degree of treatment anticipated and
(J) equation(s) used to compute treatment efficiency.

(3) Aeration tanks.
(A) Capacities and permissible loadings. The minimum design criteria for design activated sludge systems are listed in Appendix A, Design Tables.

(B) Arrangement of aeration tanks.
(i) Tank dimensions. Design each unit to:
(1) Maintain effective mixture and use of air.
(2) Prevent unaerated sections and noticeable channeling.
(3) Maintain velocities sufficient to prevent deposition of solids.
(4) Restrict short circuiting through the tank.
(ii) Tank lining. Line earthen aeration tanks with concrete, asphalt or equivalent material below the maximum water elevation. Do not use plastic liners in aeration tanks.
(iii) Number of units. Divide the total aeration tank volume
into at least two units, capable of independent operation.

(iv) Inlets and outlets.
(I) Controls. Provide inlet and outlet devices to control flow and maintain constant water level in all aeration tanks. Design the system to allow for the maximum instantaneous hydraulic load to be carried with any single unit out of service.

(II) Channels. Design channels and pipes to maintain sufficient velocity of solids in suspension or provide a mechanical means to hold solids. Provide for draining each channel when it is not being used.

(v) Freeboard. Provide at least 18 inches of freeboard.

(C) Aeration equipment.
(i) Common elements. Aeration equipment must be capable of maintaining at least 2.0 mg/l of dissolved oxygen in the mixed liquor at all times and provide thorough mixing.

(I) Carbonaceous BOD removal. Where data is not available, the design oxygen requirement for the activated sludge process is 1.1 lb O₂/lb peak BOD₅ applied to the aeration tanks. For the extended aeration process, the requirement is established as 1.6 lb O₂/lb peak BOD₅.

(II) Nitrification. For nitrification the oxygen requirement for oxidizing ammonia must be added to the requirement for carbonaceous BOD removal. The nitrogen oxygen demand (NOD) shall be taken as 4.6 times the diurnal peak TKN content of the influent.

(ii) Diffused air systems.
(I) Common elements. Normal air requirements for all activated sludge processes, except extended aeration, is 1,500 ft³/lb peak BOD₅ for aeration tank loading. For the extended aeration process the value is 2,000 ft³/lb peak BOD₅ loading.

(II) Blowers. Design the blower system to account for temperature extremes ranging from 4°F to 104°F.

(III) Multiple units. Provide multiple units with enough capacity to meet the maximum air demand with the largest unit out of service. The design must also allow the volume of air delivered to be varied in proportion to the load demand of the plant.

(IV) Diffusers. Systems must be capable of providing the diurnal peak oxygen demand or 200% of the design average oxygen demand, whichever is larger. Design air piping systems where the total head loss from blower outlet (or silencer outlet where used) to the diffuser inlet does not exceed 0.5 psi at average operating conditions. The spacing of diffusers must be in accordance with the oxygen requirements through the length of the channel or tank, and designed to allow spacing adjustment without major revisions to the air header piping. All plants using less than four aeration tanks must be designed to incorporate removable diffusers that can be serviced and/or replaced without dewatering the tank.

(V) Filters. Provide all blowers with air filters.

(iii) Mechanical aeration systems. The design requirements of a mechanical aeration system shall meet the following:
(I) Maintain a minimum of 2.0 mg/l of dissolved oxygen in the mixed liquor at all times throughout the tank or basin;
(II) Maintain all biological solids in suspension;
(III) Meet maximum oxygen demand and maintain process performance with the largest unit out of service a minimum of two units shall be provided;
(IV) Provide for varying the amount of oxygen transferred in proportion to the load demand on the plant, and
(V) If depth of submersion is an important criteria, be adjustable or the basin levels be readily controllable with regard to depth.

e) Sequencing batch reactor systems.
(1) Pretreatment. Provide bar screens and/or comminutors. Provide a grit chamber if large amounts of grit are present or anticipated in the raw sewage.
(2) Flow equalization. Separate flow equalization basins are required for large amounts of wet weather flow or I/I problems.
(3) Reactor design. Provide at least two reactors. Design each reactor to operate in a cyclic mode with sufficient time to fill, aerate, settle and remove the clarified liquid.
(A) The volume of each reactor must be between 50% and 200% of the average flow. Organic loading must be between 5 to 20 pounds of BOD per thousand cubic feet per day. Design the system using food to mass (F/M) ratios of 0.05 to 0.30. The total reactor volume must provide at least 18 hours of hydraulic detention. Size the reactor volume on the hydraulic detention time and decant volume.
(B) The design operating levels shall be 10 to 20 feet with at least two feet of freeboard.
(C) No more than four operating cycles per day per reactor at average design flow.
(D) Sludge production depends on the mode of operation. For extended aeration mode (24 hours retention time), base sludge handling design on a minimum sludge production of 0.5 lbs. per lb. of BOD removed. For conventional activated sludge mode, or for systems using more than two cycles per day, base sludge production on 0.75 to 0.95 lbs. per lb. of BOD.
(E) Base sludge storage requirements on a concentration of 0,000 mg/l with a density of 1.02 for the settled sludge. Base the calculated sludge volume on the liquid depth after decanting.
(4) Aeration equipment. Aeration equipment must provide at least 1.4 lbs. of oxygen per lb. of BOD removed at a residual dissolved oxygen level of 2.0 mg/l during the aeration period. Where nitrification is required, the aeration equipment shall have the capacity to provide an additional 4.6 lbs. of oxygen per lb. of ammonia nitrogen.
(5) Decanter systems. Design the decanter system to draw effluent from 12 to 10 inches below the surface and to prohibit floating scum from entering the system during fill and aeration periods. The design must not create currents that pull solids from the settled zone at the lowest point in the cycle. The entrance velocities into the decanter shall not exceed 1.0 fps at the maximum design flow condition.
(6) Scum management. Provide resuspension or removal equipment to control excessive scum build up.
(f) Oxidation ditches. An oxidation ditch may take any linear
shape as long as it forms a closed circuit, and does not produce any eddies or dead spots. 

(1) **Pretreatment.** Bar screens and comminutors are required to protect the mechanical equipment. Primary settling is not necessary except for high strength waste. 

(2) **Aeration basin.**  

(A) The volume of the oxidation ditch must provide 18 to 24 hours retention time at average dry weather flow. Organic loading may range from 12 to 15 pounds BOD, per 1,000 ft$^3$/day.  

(B) Depth must be at least 3 feet.  

(C) Freeboard must be at least one foot at maximum water depths.  

(D) Aeration equipment must maintain at least 1 fps velocity throughout the ditch.  

(E) Construct the ditch with reinforced concrete at least 4 inches thick for ditches up to 5 feet deep, and 6 inches thick where deeper.  

(F) Rotor weight must not be supported directly by gear reduction or motor equipment. Protect motors, gear reduction equipment and bearings from inundation and rotor spray. 

(3) **Rotor aerators.**  

(A) Install at least two complete rotor units. Design the system so a single rotor can provide the average design oxygen demand and minimum velocity of 1 fps throughout the basin.  

(B) Place rotors before a long, straight ditch section.  

(C) Provide a method to control rotor submergence.  

(4) **Miscellaneous.**  

(A) Introduce raw sewage and returned sludge immediately upstream of the rotor that is farthest from the effluent control weir.  

(B) Provide elevated walkways for rotor maintenance.  

252:656-15-2. **Attached growth systems [REVOKED]**  

(a) **Rotating biological contactors (RBC).**  

(1) **Applicability.** RBCs are suitable for removal of carbonaceous and/or nitrogenous oxygen demand.  

(2) (1) **Winter protection.** Enclose RBC units in a corrosion resistant structure to protect biological growth from cold temperatures and excessive heat loss.  

(3) (2) **Pretreatment.** Provide primary settling tanks equipped with scum and grease collecting devices. Bar screening and/or comminution alone are not suitable pretreatment.  

(4) (3) **Staging.** Provide at least four stages for secondary treatment applications, with more stages for greater nitrification and BOD removal.  

(5) (4) **Loading.**  

(A) **Hydraulic.** Equalize flow where the ratio of peak flow to average flow is 2.5 or greater. For secondary treatment hydraulic loading shall be from 2 to 4 gpd/ft$^2$ and shall not exceed 0.75 to 2.0 gpd/ft$^2$ where nitrification is required.  

(B) **Organic.** First stage loading rates shall be from 2.5 to 4.0 lbs. of soluble BOD/day/1,000 ft$^3$, and 3.0 lbs. is recommended.  

(6) (5) **Tanks.** Provide at least 0.12 gal/ft$^2$ of media for RBC tanks to maintain a hydraulic load of 2 gpd/ft$^2$. Provide a side water depth of 5 feet or submerge the media at least 40%.  

(7) **Structure.** Show that the structure is designed to handle the
weight.
(b) **Trickling filters.** Trickling filters may only be installed to pretreat high-strength waste only, or to add to or replace existing trickling filters. Provide sedimentation tanks with scum and grease collecting devices before the filters so the influent will be relatively free from settleable, floating, or suspended matter.

(1) **Design basis.** Filters are termed standard or high rate on the basis of hydraulic and biological loading. High rate filters may be used to pretreat wastewater before further biological treatment. High rate systems can withstand highly variable hydraulic overload conditions without significant deterioration of the biological growth. See Appendix A, Design Tables.

(2) **Hydraulics.** Sewage application shall be continuous. Provide all pump stations with a backup.
   (A) **Head requirements.** For reaction type distributors, a minimum head of 24 inches above the center of the arms is required to be uniformly distributed over at least 90% of the surface area.
   (B) **Clearance.** Provide at least 6 inches of clearance between the media and distributor arms.
   (C) **Piping system.** Design the piping system, including dosing equipment and distributor, for the peak hourly flow rate, including recirculation.

(3) **Media.**
   (A) **Quality.** All media must be resistant to spilling and flaking, and be relatively insoluble in sewage. Manufactured media must also be resistant to ultraviolet degradation, disintegration, erosion, aging, common acids and alkalies, organic compounds, and fungus and biological attack.
   (B) **Depth.** Media must be 10 to 30 feet deep unless justified by a pilot study.

(4) **Underdrain system.** The underdrain system must cover the entire floor of the filter. Inlet openings into the underdrains must have an unsubmerged gross combined area at least 15 percent of the surface area of the filter.
   (A) **Hydraulic capacity and ventilation.** Underdrains must slope at least 1%. Design effluent channels to produce a minimum velocity of 2 fps of the average daily application rate. Design the underdrain system, effluent channels and effluent pipe to allow free air passage. Not more than 50% of the cross sectional area for all drains, channels and pipe may be submerged under the design hydraulic loading.
   (B) **Flush.** Design the underdrains to be flushed.

(5) **Freeboard.** Provide two feet of freeboard to prevent splashing and to protect the distributor. Structures taller than 25 feet shall have 4 feet of freeboard to contain windblown spray.

(6) **Recirculation.** Recirculate effluent to maintain an active biological growth and to increase overall efficiency. Provide a standby unit when dosing intervals longer than three hours would occur without recirculation.


(a) **Purpose.** Processes for nutrient removal in wastewater include conversion of ammonia and organic nitrogen to nitrate nitrogen (nitrification), the conversion of nitrate nitrogen to nitrogen gas
(denitrification) and removal of phosphorus.

(b) Single stage (combined carbonaceous BOD removal and nitrification).

(1) Suspended growth. The following factors will have a significant impact on the nitrification process: ammonia and nitrite concentrations, BOD/TKN ratio, dissolved oxygen concentration, temperature and pH. The following steps should be considered in the design of the suspended growth reactor and the resulting calculations submitted to the DEQ for review. If actual kinetic coefficients cannot be obtained, textbook values may be used for design.

(A) Select an appropriate safety factor to handle peak, diurnal and transient loadings (a minimum safety factor of 2.0 applied to design mean cell residence time is required).

(B) Select the mixed liquor dissolved oxygen (DO) concentration. The minimum acceptable level is 2.0 mg/l. Determine the amount of oxygen required to satisfy the nitrogenous oxygen demand.

(C) Evaluate the requirement for pH control. Every mg/l of NH₄ nitrogen oxidized will result in the destruction of 7.14 mg/l alkalinity.

(D) Estimate the maximum growth rate of nitrifying bacteria under the most adverse DO, pH and temperature conditions.

(E) Determine the design mean cell residence time with the safety factor (10 day is recommended).

(F) Predict the effluent nitrogen concentration.

(G) Determine the hydraulic retention time to achieve the necessary nitrogen concentration. A 10-hour retention time is needed to compensate for lower nitrification rates when wastewater temperatures are below 50°F.

(2) Attached-growth processes. Typical loading data are in Appendix A, Design Tables.

(c) Separate-stage nitrification.

(1) Suspended growth. Separate-stage suspended growth nitrification processes are similar in design to the activated sludge process. Show the process factors, considering the following:

(A) Experimentally measured nitrification rates are more appropriate than theoretical rates.

(B) Nitrification rates increase as the temperature increases.

(C) Nitrification rates increase as the BOD/TKN ratio decreases.

(D) Nitrification rates are affected by pH.

(E) Nitrification rates vary from 0.05 to 0.6 lbs. NH₄-N oxidized per pound MLVSS.

(2) Attached-growth. Separate-stage attached-growth nitrification can be achieved in trickling filters or rotating biological contractor (RBC). Show the design factors, considering:

(A) Hydraulic loading should not exceed 0.75 GPM per ft².

(B) Influent ammonia nitrogen of 18 mg/l or less.

(C) Effects of recycling (up to 100%).

(D) Wastewater temperature.

(d) Biological phosphorus removal. Design proprietary processes according to the manufacturer’s recommendations or recognized engineering references.
252:656-16-1. Suspended growth systems [NEW]

(a) General. Suspended growth wastewater treatment systems generally consist of one or more basins where incoming wastewater is mixed with biological solids and aerated for a period of time. The biological solids are then separated from the mixture where a portion is returned to the mixing basin and the remainder diverted to other units for additional treatment before beneficial re-use by land application or landfill disposal. The liquid after separation from the solid is discharged or diverted to other units for additional treatment before discharge. Suspended growth systems covered by these standards are commonly known as the Activated Sludge process including the Sequencing Batch Reactor ("SBR") process. The activated sludge process includes several modifications. The most common is the extended aeration process which includes the oxidation ditch and SBR variations. Submit a complete design analysis for all suspended growth systems to DEQ for review. Contact stabilization is not recommended as the only secondary treatment process, but may be considered where equalization of flow is provided or where other treatment units follow.

(b) Primary treatment. The conventional activated sludge process shall be preceded by primary treatment in the form of a primary settling tank(s). Provide equipment necessary to adequately remove sludge as it accumulates and transport it to sludge treatment facilities.

(c) System Design. Submit a comprehensive discussion of all functional design calculations used to size activated sludge treatment facilities. Include the following:

1. influent wastewater characteristics,
2. temperature range of wastewater,
3. primary treatment of the waste,
4. hydraulic and organic loading applied to the aeration basin,
5. anticipated mixed liquor suspended solids level to be maintained in the aeration basin,
6. aeration time,
7. oxygen and mixing requirements for average and peak flows,
8. recirculation and sludge wasting,
9. degree of treatment anticipated and
10. equation(s) used to compute treatment efficiency.

(d) Aeration tanks.

1. Capacities and permissible loadings. The minimum design criteria for activated sludge systems are listed in Appendix A, Design Tables.

2. Arrangement of aeration tanks.

   (A) Tank dimensions. Design each unit to:

   (i) Maintain effective mixture and use of air.
   (ii) Prevent unaerated sections and noticeable channeling.
   (iii) Maintain velocities sufficient to prevent deposition of solids.
(iv) Restrict short-circuiting through the tank.
(B) **Tank lining.** Line earthen aeration tanks with concrete, asphalt or equivalent material below the maximum water elevation. Do not use plastic liners in aeration tanks.
(C) **Number of units.** Divide the total aeration tank volume into at least two units, capable of independent operation.
(D) **Inlets and outlets.**
   (i) **Controls.** Provide inlet and outlet devices to control flow and maintain constant water level in all aeration tanks. Design the system to allow for the maximum instantaneous hydraulic load with any single unit out of service.
   (ii) **Channels.** Design channels and pipes to maintain a velocity sufficient to hold solids in suspension or provide a mechanical means for suspending the solids. Provide for draining each channel when it is not being used.
(E) **Freeboard.** Provide at least 18 inches of freeboard.
(e) **Aeration equipment.**
   (1) **Common elements.** Aeration equipment must be capable of maintaining at least 2.0 mg/l of dissolved oxygen in the mixed liquor at all times and provide thorough mixing.
      (A) **Carbonaceous BOD removal.** Where data is not available, the design oxygen requirement for the activated sludge process is 1.1 lb O$_2$/lb peak BOD$_5$ applied to the aeration tanks. For the extended aeration process, the requirement is established as 1.8 lb O$_2$/lb peak BOD$_5$.
      (B) **Nitrification.** For nitrification the oxygen requirement for oxidizing ammonia must be added to the requirement for carbonaceous BOD removal. The nitrogen oxygen demand (NOD) shall be taken as 4.6 lb O$_2$/lb NH$_3$, diurnal peak TKN content of the influent.
   (2) **Diffused air systems.**
      (A) **Common elements.** Normal air requirements for all activated sludge processes, except extended aeration, is 1,500 ft$^3$/lb peak BOD$_5$ for aeration tank loading. For the extended aeration process the value is 2,000 ft$^3$/lb peak BOD$_5$ loading.
      (B) **Blowers.** Design the blower system to account for temperature extremes ranging from 4 degrees F to 104 degrees F.
      (C) **Multiple units.** Provide multiple units with enough capacity to meet the maximum air demand with the largest unit out of service. The design must also allow the volume of air delivered to be varied in proportion to the load demand of the plant.
      (D) **Diffusers.** Systems must be capable of providing the diurnal peak oxygen demand or 200% of the design average oxygen demand, whichever is larger. Design air piping systems where the total head loss from blower outlet (or silencer outlet where used) to the diffuser inlet does not exceed 0.5 psi at average operating conditions. The spacing of diffusers must be in accordance with the oxygen requirements through the length of the channel or tank, and
designed to allow spacing adjustment without major revisions to the air header piping. All plants using less than four aeration tanks must be designed to incorporate removable diffusers that can be serviced and/or replaced without dewatering the tank.

(E) Filters. Provide all blowers with air filters.

(3) Mechanical aeration systems. The design requirements of a mechanical aeration system shall meet the following:

(A) Maintain all biological solids in suspension;
(B) Meet maximum oxygen demand and maintain process performance with the largest unit out of service. A minimum of two units shall be provided;
(C) Provide for varying the amount of oxygen transferred in proportion to the load demand on the plant; and
(D) If depth of submersion is an important criteria, the aerators must be adjustable or the basin liquid levels must be easily controlled with regard to depth.

(f) Sequencing batch reactor systems.

(1) Reactor design. Provide at least two reactors. Design each reactor to operate in a cyclic mode with sufficient time to fill, aerate, settle and remove the clarified liquid.

(A) The volume of each reactor must be between 50% and 200% of the average flow. Organic loading must be between 5 to 20 pounds of BOD per thousand cubic feet per day. Design the system using food to mass (F/M) ratios of 0.05 to 0.30. The total reactor volume must provide at least 18 hours of hydraulic detention time. Size the reactor volume on the hydraulic retention time and decant volume.

(B) The design operating levels shall be 10 to 20 feet with at least two feet of freeboard.

(C) Design for no more than four operating cycles per day per reactor at average design flow.

(D) Sludge production depends on the mode of operation. For extended aeration mode (24 hours retention time), base sludge handling design on a minimum sludge production of 0.5 lbs. per lb. of BOD removed. For conventional activated sludge mode, or for systems using more than two cycles per day, base sludge production on 0.75 to 0.95 lbs. per lb. of BOD.

(E) Base sludge storage requirements on a concentration of 8,000 mg/l with a density of 1.02 for the settled sludge. Base the calculated sludge volume on the liquid depth after decanting.

(2) Aeration equipment. Aeration equipment must provide at least 1.4 lbs. of oxygen per lb. of BOD removed at a residual dissolved oxygen level of 2.0 mg/l during the aeration period. Where nitrification is required, the aeration equipment shall have the capacity to provide an additional 4.6 lbs. of oxygen per lb. of ammonia nitrogen.

(3) Decanter systems. Design the decanter system to draw effluent from 12 to 18 inches below the surface and to prohibit floating scum from entering the system during fill and aeration periods. The design must not create currents that pull solids from the settled zone at the lowest point in the
cycle. The entrance velocities into the decanter shall not exceed 1.0 fps at the maximum design flow condition.

(4) **Scum management.** Provide resuspension or removal equipment to control excessive scum build-up.

(g) **Oxidation ditches.** An oxidation ditch may take any linear shape as long as it forms a closed circuit, and does not produce any eddies or dead spots.

(1) **Pretreatment.** Bar screens are required to protect the mechanical equipment. Primary settling is not necessary except for high strength waste.

(2) **Aeration basin.**

(A) The volume of the oxidation ditch must provide 18 to 24 hours retention time at average dry weather flow. Organic loading may range from 12 to 15 pounds BOD, per 1,000 ft$^3$/day.

(B) Depth must be at least 3 feet.

(C) Freeboard must be at least one foot at maximum water depths.

(D) Aeration equipment must maintain at least 1 fps velocity throughout the ditch.

(E) Construct the ditch with reinforced concrete at least 4 inches thick for ditches up to 5 feet deep, and 6 inches thick where deeper.

(F) Rotor weight must not be supported directly by gear reduction or motor equipment. Protect motors, gear reduction equipment and bearings from inundation and rotor spray.

(3) **Rotor aerators.**

(A) Install at least two complete rotor units. Design the system so a single rotor can provide the average design oxygen demand and minimum velocity of 1 fps throughout the basin.

(B) Place rotors before a long, straight ditch section.

(C) Provide a method to control rotor submergence.

(4) **Miscellaneous.**

(A) Introduce raw sewage and returned sludge immediately upstream of the rotor that is farthest from the effluent control weir.

(B) Provide elevated walkways for rotor maintenance.

(g) **Return sludge equipment.**

(1) **Return rate.** Design all return pumping systems for the capability to be operated at the following return rates:

(A) **Standard Rate:**

   (i) 15% minimum  
   (ii) 75% maximum

(B) **Carbonaceous Stage of Separate Stage Nitrification:**

   (i) 15% minimum  
   (ii) 75% maximum

(C) **Step Aeration:**

   (i) 15% minimum  
   (ii) 75% maximum

(D) **Extended Aeration:**

   (i) 50% minimum  
   (ii) 150% maximum

(E) **Nitrification Stage of Separate Stage Nitrification:**
(i) 50% minimum
(ii) 200% maximum.

(2) **Return pumps.** Maintain the maximum return sludge requirement with the largest pump out of service. Provide a positive head on all pumps’ suctions under all operating conditions. Provide a minimum pump’s suction and discharge opening of at least 3 inches. Air lift systems must be at least 3 inches in diameter. Further, air compressors must be of sufficient capacity to supply design air requirements plus a 25% safety factor.

(3) **Return piping.** Provide 4-inch discharge piping designed to maintain a minimum velocity of 2 fps at normal return rates. Provide mechanisms for observing, sampling and controlling return sludge flow from each settling tank.

(h) **Waste sludge facilities.** Discharge waste sludge to any one or combination of thickening tanks, primary settling tanks, digesters, vacuum filters or belt presses. Design all waste sludge control facilities to handle at least 25% of the average sewage flow and to function at rates of 0.5% of average sewage flow or a minimum of 10 gpm, whichever is larger. Provide a means for observing, measuring, sampling, and controlling the flow.

(i) **Measuring devices.** Install a means to measure flow rates of raw sewage, primary effluent, waste sludge, return sludge, and air to each tank unit.

252:656-16-2. **Attached growth systems** [NEW]

(a) **Rotating biological contactors (RBC).**

(1) **Winter protection.** Enclose RBC units in a corrosion resistant structure to protect biological growth from cold temperatures and excessive heat loss.

(2) **Pretreatment.** Provide primary settling tanks equipped with scum and grease collecting devices. Bar screening and/or comminution alone are not suitable pretreatment.

(3) **Staging.** Provide at least four stages for secondary treatment applications, with more stages for greater nitrification and BOD removal.

(4) **Loading.**

(A) **Hydraulic.** Equalize flow where the ratio of peak flow to average flow is 2.5 or greater. For secondary treatment hydraulic loading shall be from 2 to 4 gpd/ft$^2$ and shall not exceed 0.75 to 2.0 gpd/ft$^2$ where nitrification is required

(B) **Organic.** First stage loading rates shall be from 2.5 to 4.0 lbs. of soluble BOD/day/1,000 ft$^2$. 3.0 lbs. is recommended.

(5) **Tanks.** Provide at least 0.12 gal/ft$^2$ of media for RBC tanks to maintain a hydraulic load of 2 gpd/ft$^2$. Provide a side water depth of 5 feet or submerge the media at least 40%.

(b) **Trickling filters.** Trickling filters may only be installed to pretreat high-strength waste only, or to add to or replace existing trickling filters. Provide sedimentation tanks with scum and grease collecting devices before filters so the influent will be relatively free from settleable, floating, or suspended
(1) **Design basis.** Filters are termed standard or high rate on the basis of hydraulic and biological loading. High rate filters may be used to pretreat wastewater before further biological treatment. High rate systems can withstand highly variable hydraulic overload conditions without significant deterioration of the biological growth. See Appendix A, Design Tables.

(2) **Hydraulics.** Sewage application shall be continuous. Provide all pump stations with a backup.

   (A) **Head requirements.** For reaction type distributors, a minimum head of 24 inches above the center of the arms is required. Design distributors to uniformly distribute wastewater over at least 90% of the surface area.

   (B) **Clearance.** Provide at least 6 inches of clearance between the media and distributor arms.

   (C) **Piping system.** Design the piping system, including dosing equipment and distributor, for the peak hourly flow rate, including recirculation.

(3) **Media.**

   (A) **Quality.** All media must be resistant to spalling and flaking, and be relatively insoluble in sewage. Manufactured media must also be resistant to ultraviolet degradation, disintegration, erosion, aging, common acids and alkalies, organic compounds, and fungus and biological attack.

   (B) **Depth.** Media must be 10 to 30 feet deep unless otherwise justified by a pilot study.

(4) **Underdrain system.** The underdrain system must cover the entire floor of the filter. Inlet openings into the underdrains must have an unsubmerged gross combined area at least 15 percent of the surface area of the filter.

   (A) **Hydraulic capacity and ventilation.** Underdrains must slope at least 1%. Design effluent channels to produce a minimum velocity of 2 fps of the average daily application rate. Design the underdrain system, effluent channels and effluent pipe to allow free air passage. Not more than 50% of the cross sectional area for all drains, channels and pipe may be submerged under the design hydraulic loading.

   (B) **Flushing.** Design the underdrains to be flushed.

(5) **Freeboard.** Provide two feet of freeboard to prevent splashing and to protect the distributor. Structures taller than 25 feet shall have 4 feet of freeboard to contain windblown spray.

(6) **Recirculation.** Recirculate effluent to maintain an active biological growth and to increase overall efficiency. Provide a standby unit when dosing intervals longer than three hours would occur without recirculation.

**252:656-16-3. Biological nutrient removal** [NEW]

(a) **Purpose.** Processes for nutrient removal in wastewater include conversion of ammonia and organic nitrogen to nitrate nitrogen.
(nitrification), the conversion of nitrate nitrogen to nitrogen gas (denitrification) and removal of phosphorus.

(b) Single stage (combined carbonaceous BOD removal and nitrification).

(1) Suspended growth. The following factors will have a significant impact on the nitrification process: ammonia and nitrite concentrations, BOD₅/TKN ratio, dissolved oxygen concentration, temperature and pH. The following steps should be considered in the design of the suspended growth reactor and the resulting calculations submitted to the DEQ for review. If actual kinetic coefficients cannot be obtained, textbook values may be used for design.

(A) Select an appropriate safety factor to handle peak, diurnal and transient loadings (a minimum safety factor of 2.0 applied to design mean cell residence time is required).

(B) Select the mixed liquor dissolved oxygen (DO) concentration. The minimum acceptable level is 2.0 mg/l. Determine the amount of oxygen required to satisfy the nitrogenous oxygen demand. Provide a minimum of 4.6 mg O₂/mg N oxidized.

(C) Evaluate the requirement for pH control. Every mg/l of NH₄-nitrogen oxidized will result in the destruction of 7.14 mg/l alkalinity.

(D) Estimate the maximum growth rate of nitrifying bacteria under the most adverse DO, pH and temperature conditions.

(E) Determine the design mean cell residence time with the safety factor (10-day is recommended).

(F) Predict the effluent nitrogen concentration.

(G) Determine the hydraulic retention time to achieve the necessary nitrogen concentration. A 10-hour retention time is needed to compensate for lower nitrification rates when wastewater temperatures are below 50 degrees F.

(2) Attached-growth processes. Typical loading data are in Appendix A, Design Tables.

(c) Separate-stage nitrification.

(1) Suspended growth. Separate-stage suspended growth nitrification processes are similar in design to the activated sludge process. Show the process factors, considering the following:

(A) Experimentally measured nitrification rates are more appropriate than theoretical rates.

(B) Nitrification rates increase as the temperature increases.

(C) Nitrification rates increase as the BOD₅/TKN ratio decreases.

(D) Nitrification rates are affected by pH.

(E) Nitrification rates vary from 0.05 to 0.6 lbs. NH₄-N oxidized per pound MLVSS.

(2) Attached-growth. Separate-stage attached-growth nitrification can be achieved in trickling filters or rotating biological contractor (RBC). Show the design
factors, considering:
(A) Hydraulic loading should not exceed 0.75 GPM per ft².
(B) Influent ammonia nitrogen of 18 mg/l or less.
(C) Effects of recycling (up to 100%).
(D) Wastewater temperature.

(d) Biological phosphorus removal. Design proprietary processes according to the manufacturer's recommendations or recognized engineering references.
(e) Chemical phosphorus removal.
(1) Preliminary Testing. Laboratory, pilot, or full scale studies of various chemical feed systems and treatment processes are recommended for existing plant facilities to determine the achievable performance level, cost-effective design criteria, and ranges of required chemical dosages.
(2) System Flexibility. Systems shall be designed with sufficient flexibility to allow for several operational adjustments in chemical feed location, chemical feed rates, and for feeding alternate chemical compounds.
(3) Dosage. The design chemical dosage shall include the amount needed to react with the phosphorus in the wastewater, the amount required to drive the chemical reaction to the desired state of completion, and the amount required due to inefficiencies in mixing or dispersion. Excessive chemical dosage should be avoided.
(4) Chemical feed points. Selection of chemical feed points shall include consideration of the chemicals used in the process, necessary reaction times between chemical and polyelectrolyte additions, and the wastewater treatment processes and components utilized. Flexibility in feed locations shall be provided to optimize chemical usage.
(5) Flash Mixing. Each chemical must be mixed rapidly and uniformly with the flow stream. Where separate mixing basins are provided, they should be equipped with mechanical mixing devices. The detention period should be at least 30 seconds.
(6) Flocculation. The particle size of the precipitate formed by chemical treatment may be very small. Consideration should be given in the process design to the addition of synthetic polyelectrolytes to aid settling. The flocculation equipment should be adjustable in order to obtain optimum floc growth, control deposition of solids, and prevent floc destruction.
(7) Liquid-solids Separation. The velocity through pipes or conduits from flocculation basins to settling basins should not exceed 1.5 feet per second in order to minimize floc destruction. Entrance works to settling basins should also be designed to minimize floc shear.
(8) Sludge Handling. For design of the sludge handling system, special consideration should be given to the type and volume of sludge generated in the phosphorus removal process.
(9) Filtration. Effluent filtration shall be considered where effluent phosphors concentrations of 1 mg/l or less must be achieved.

SUBCHAPTER 17. CLARIFIER STANDARDS
252:656-17-1. General considerations [REVOKED]
(a) Multiple tanks units. All plants that serve a population equivalent of 10,000 or greater shall have multiple settling tanks designed to provide for individual operation. Single units will not be allowed if maintenance will degrade the effluent to impair the receiving stream.
(b) Submerged surfaces. The tops of troughs, beams, and other submerged construction features shall have a minimum slope of 1.4 vertical to 1 horizontal. The underside of such features should have a slope of 1 to 1 to prevent accumulation of scum and septic solids.
(c) Flow distribution. Where multiple units are proposed, suitable diversion structures shall be included to proportionally divide the flow. Provide suitable measuring devices.

252:656-17-2. Clarifier design considerations
(a) Flow distribution. Effective flow splitting devices and control appurtenances (i.e. gates, splitter boxes, etc.) shall be provided to permit proper proportioning of flow and solids loading to each unit, throughout the expected range of flows.
(b) Settling tank Primary clarifier design criteria. The maximum hydraulic overflow rate shall not exceed 1,000 gal/ft²/day at design average flows. Primary clarifiers shall be placed downstream of flow distribution devices. Surface settling rates for primary tanks shall not exceed 1,000 gal/ft²/day at design average flows or 1,500 gal/ft²/day for peak hourly flows. Peak hourly flow is based upon a 2-hour sustained peak, as defined by Wastewater Engineering: Treatment, Disposal & Reuse, Metcalf & Eddy, Inc. (2003). Clarifier sizing shall be calculated for both flow conditions and the larger surface area determined shall be used. Primary settling of normal domestic sewage can be expected to remove 30 to 35% of the influent BOD. However, anticipated BOD removal for sewage containing appreciable quantities of industrial wastes (or chemical additions to be used) should be determined by laboratory tests and consideration of the quantity and character of the wastes. Design settling tanks to meet the criteria of Appendix B.
(c) Secondary clarifier design criteria. See Table 2 (Appendix B)
(d) Inlet structures. Design inlets to prevent short-circuiting, to dissipate velocity and diffuse flow equally across the entire cross-section of the settling chamber. Design channels to maintain a velocity of at least 1 fps at one-half design flow.
(e) Weirs. Overflow weirs shall be adjustable and level.
   (1) Location. Locate overflow weirs to optimize hydraulic retention time and minimize short-circuiting.
   (2) Design rates. Weir loadings shall not exceed 10,000 gal/lineal foot/day for plants designed for average flows of 1.0 mgd or less. Higher weir loadings may be used for plants designed for larger average flows, but should not exceed 15,000 gal/lineal foot/day. Where the flow is pumped to the clarifier, the weir length shall be based on the average pump delivery rates to avoid short-circuiting.
(3) **Weir troughs.** Design weir troughs to prevent submergence at maximum design flow, and to maintain a velocity of at least 1 fps at one-half design flow.

(4) **Dewatering.** Provide necessary piping to permit dewatering and bypassing individual units for maintenance and repair.

(4) **Freeboard.** Walls shall extend at least 6 inches above the surrounding ground surface and provide at least 12 inches of freeboard. Provide additional freeboard or wind screens for larger settling tanks subject to high velocity wind currents that would cause tank surface waves and inhibit scum removal.

252:656-17-3. Sludge and scum removal

(a) **Scum removal.** Provide scum collection and removal facilities, including baffling, for all settling tanks.

(b) **Sludge removal.** Design collection and withdrawal facilities for rapid sludge removal.

(1) **Sludge hopper.** The minimum slope of the sidewalls of sludge hoppers shall be 1.7 vertical to 1.0 horizontal. Hopper floors shall not be larger than 2 feet in dimension. Hopper wall surfaces shall be made smooth with rounded corners to aid in sludge removal.

(2) **Sludge removal piping.** Each hopper shall have an individually-valved sludge withdrawal line at least 6 inches in diameter for gravity withdrawal or pump suction. Design sludge withdrawal to maintain a 3 fps velocity in the withdrawal pipe. Provide for rodding or back-flushing individual pipe runs.

(3) **Sludge removal control.** Provide equipment to view, sample and control the rate of sludge withdrawal. Provide a means of measuring the sludge removal rate. Air lift type of sludge removal will not be approved for removal of primary sludges. Include time clocks and valve activators to regulate the duration and sequencing of sludge removal for sludge pump motor control systems.

**SUBCHAPTER 19. SLUDGE FACILITY STANDARDS**

252:656-19-1. Design considerations

This Subchapter establishes design criteria for producing sludge from municipal wastewater treatment processes that will meet at least one of the processes to significantly reduce pathogens ("PSRPs") (Class B) State and Federal requirements for land application and landfilling. Sludge may ultimately be beneficially reused or disposed in a landfill. All methods of off-site and on-site sludge reuse and disposal are subject to 40 CFR Part 503 as adopted by reference in OAC 252:606, and to OAC 252:520 if landfilled. Processes to further reduce pathogens ("PFRPs") (Class A) may be proposed and will be evaluated and approved on a case by case basis. A sludge management plan must be submitted before any construction permit for a new or upgraded wastewater treatment facility can be issued. On-site sludge dewatering facilities shall be provided for all plants although the following requirements may be reduced with on-site liquid sludge storage facilities or approved off-site sludge disposal. For calculating design sludge
handling and disposal needs for sludge stabilization processes, a rational basis of design for sludge production values shall be developed and provided to the reviewing authority for approval on a case-by-case basis.

Equivalency processes will be approved on a case by case basis. A pilot study may be required.

252:656-19-2. Anaerobic sludge digestion
(a) Tanks.
   (1) Multiple units. Provide dual units or alternate methods of sludge processing or emergency storage to maintain continuity of service.
   (2) Depth. Provide a sidewater depth of at least 20 feet.
   (3) Slope. Slope the tank bottoms towards the withdrawal piping. The bottom slope must be at least 1:12 for mechanical removal, or 1:4 for gravity removal.
   (4) Manholes. Provide at least two 36-inch diameter manholes in the top of the digester in addition to the gas dome. At least one opening must be large enough for equipment to remove grit and sand. Provide stairways to reach the access manholes.
(b) Sludge inlets and outlets. Provide for sludge recirculation. Provide multiple recirculation withdrawal and return points unless mixing facilities are incorporated within the digester(s). Returns Return flow must discharge above the liquid level near tank center. Discharge raw sludge to the digester through the sludge heater recirculation return piping unless internal mixing facilities are provided.
(c) Tank capacity. Determine total tank(s) capacity by rational calculations based on such factors as volume of sludge added, its percent solids and character, the temperature to be maintained in the digesters, type of mixing provided, the degree of volatile solids reduction and pathogen reduction requirements. Provide Submit all calculations and design assumptions for review. For design purposes, use the following assumptions:
   (1) The raw sludge is derived from ordinary domestic wastewater.
   (2) The sludge will be maintained at between 35 deg. C to 55 deg. C (95 deg F to 131 deg F) for 15 days or at 20 deg. C (68 deg F) for 60 days.
   (3) That 40 to 50% volatile matter will be maintained in the digested sludge.

The following design requirements are based on these assumptions: the raw sludge is from ordinary domestic wastewater; temperature in digesters units will be maintained from 68? to 131? F; 40 to 50% of volatile matter will be maintained in the digested sludge; digested sludge will be removed from the system.
   (A) Completely-mixed systems. Provide sufficient mixing to prevent stratification and to assure homogeneity of digester content. Active digestion unit systems units may be loaded with volatile solids at a rate up to 80 lb/1,000 ft³ tank volume/day.
Moderately-mixed systems. For systems where mixing is accomplished only by circulating sludge circulated through an external heat exchanger, the unit system may be loaded at a rate up to 40 lb/1,000 ft$^3$ tank volume/day. Where actual data are not available, the following unit capacities may be used for plants treating domestic sewage:

(i) Primary facility - 3 ft$^3$/PE heated or 4 ft$^3$/PE unheated
(ii) Primary and standard rate filter facility - 4 ft$^3$/PE heated or 5 ft$^3$/PE unheated
(iii) Primary and high rate filter facility - 4 ft$^3$/PE heated or 5.5 ft$^3$/PE unheated

(A) Primary plant:
(i) 3 heated cubic feet per capita
(ii) 4 unheated cubic feet per capita
(B) Primary & standard filter plant:
(i) 4 heated cubic feet per capita
(ii) 5 unheated cubic feet per capita
(C) Primary & high rate filter plant:
(i) 4 heated cubic feet per capita
(ii) 5.5 unheated cubic feet per capita

(E) Activated sludge plant:
(i) 4 heated cubic feet per capita
(ii) 6 unheated cubic feet per capita

(d) Gas collection, piping and appurtenances.

(1) Gas collection and containment. Design all portions of the gas system, including the space above the digester liquor to operate under pressure. Mechanically ventilate all areas where gas leakage might occur and separate from areas where extraneous sparks or fire might occur.

(2) Safety equipment. Where gas is produced, provide pressure and vacuum relief valves and flame traps, together with automatic safety shut-off valves. Water seal equipment shall not be installed. House gas safety equipment and gas compressors in a separate room with an exterior entrance.

(1) (3) Gas piping and condensate. Gas piping must be at least 2 inches in diameter, of wrought iron, and shall slope to condensation traps at low points. Float-controlled condensate traps are not permitted.

(2) (4) Gas utilization equipment. All gas burning boilers and engines must be located at ground level and in well ventilated rooms. Gas lines to these units must have suitable flame traps.

(3) (5) Waste gas. Waste gas burners must have automatic ignition and be located at least 50 feet away from all digesters and suitably isolated from any other plant structure.

(4) (6) Meter. Provide a gas meter with bypass to measure total gas production.

(e) Supernatant withdrawal.

(1) Piping size. Supernatant piping must be at least 6
inches in diameter.

(2) **Withdrawal levels.** Arrange withdrawal piping to allow for at least three levels of sludge withdrawal. Provide a positive unvalved emergency overflow.

(3) **Supernatant withdrawal.** Provide at least one draw-off point that is located in the supernatant zone of the tank. On fixed-cover digesters, provide means to adjust the supernatant withdrawal level.

(4) **Sampling.** Provide a means to sample each supernatant draw-off level. Sampling pipes must be at least 1.5 inches in diameter with a quick-acting valve.

(f) **Temperature measurement.** Provide a temperature probe and recording device to continuously record digester temperature.

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252:656-19-3. **Aerobic sludge digestion**

(a) **General.** Provide design analysis showing factors for effective air mixing, reducing organic matter, separating supernatant and concentrating sludge under controlled conditions. Aerobic digestion can be used to stabilize primary sludge, secondary sludge or a combination of the two. Multiple units are required at treatment facilities with a capacity of 10,000 P.E. or more. Small treatment plants may use a single unit if adequate provisions are made for sludge handling.

(b) **Mixing and air requirements.** Provide sufficient air to keep the solids in suspension and maintain dissolved oxygen between 1 and 2 mg/l. A minimum mixing and air requirement of 30 ft³/min/1,000 ft³ tank volume shall be of air must be maintained with even when the largest blower is out of service.

(c) **Tank capacity.** Determine total tank(s) capacity by rational calculations based on such factors as volume of sludge added, sludge characteristics, time of aeration, sludge temperature and ultimate disposal methods. Submit all calculations and design assumptions for review.

(d) **Volatile solids loading.** Volatile suspended solids loading must not exceed 100 lb/1,000 ft³ tank volume per day.

(e) **Temperature recording.** Install a temperature probe and recording device to continuously record digester temperature.

(f) **Supernatant separation.** Provide for separation and withdrawal of supernatant and for collection and removal of scum and grease.

(1) **Supernatant withdrawal.** Design for supernatant withdrawal at least 6 inches below the liquid surface level after a minimum one-hour settling period. Return supernatant to the head of the plant.

(2) **Sampling facilities.** Provide a sampling line (at least 1.5 inches in diameter) with a quick-closing valve no more than 1 foot from the tank bottom.

(3) **Maintenance provisions.** Slope the tank bottoms toward the sludge withdrawal pipe. Minimum slope to be at least \( \frac{3}{4} \) feet 1 foot vertical to \( \frac{12}{4} \) feet horizontal.

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252:656-19-4. **Sludge pumps and piping**

(a) **Sludge pumps.**

(1) **Duplicate units.** Provide capability to assure that pump
failure does not affect plant operation duplicate units.

(2) **Minimum head.** Pumps must provide at least 24 inches of positive head.

(3) **Sampling facilities.** Provide a means to sample sludge. All sampling pipes and valves must be at least 1.5 inches.

(b) **Sludge piping.** Sludge withdrawal piping must be at least 8 inches in diameter for gravity systems and 6 inches for pump suction and discharge lines. A minimum velocity of 3.0 fps for gravity lines is required.

252:656-19-5. Sludge dewatering

An onsite sludge dewatering facility shall be provided at all plants and, at a minimum, shall provide the following:

(a) (1) **Sludge drying beds.**

   (A) **Area.** Provide all design analyses for dewatering systems. Minimum design requirements for landfill disposal drying beds are in Appendix A, Design Tables. Where drying is the selected method for production of a PSRP sludge, provide at least 3 months holding time, 2 months of which the holding temperature must average above 0 deg. C. A temperature recording device must be installed to continuously record the ambient temperature at the plant site.

   (B) **Media-percolation type.** Provide a minimum 9 inch layer of clean coarse sand supported by a minimum 12 inch layer of gravel and crushed rock.

      (i) **Gravel.** Maintain lower gravel course to at least 6 inches above the top of underdrains. Provide at least 12 inches of coarse gravel around the underdrains. Place the gravel in layers and extend at least 6 inches above the top of the underdrains. The top layer must consist of at least 3 inches of gravel from 1/8 to 1/4-inch in size.

      (ii) **Sand.** The top course shall consist of at least 9 inches of clean coarse sand. The sand shall have an effective size of 0.3 to 1.2 and a uniformity coefficient of less than 5.0.

      (B) **(iii) Underdrains.** Perforated PVC sewer pipe at least 6 inches in diameter spaced not more than 10 feet apart on center must be used.

      (C) **Truck tracks.** Provide concrete truck tracks for all percolation-type sludge beds. Pairs of tracks for the percolation-type beds should be on 20-foot centers.

   (2) **Partially paved type.** Provide for the removal of dried sludge with mechanical equipment.

   (3) **(C) Partially paved type.** Provide for the removal of dried sludge with mechanical equipment.

   (4) **(D) Walls.** Walls must be watertight and extend 15 to 18 inches above and at least 6 inches below the sand surface. Outer walls must extend at least 6 inches above the surrounding ground elevation.

   (5) **(E) Sludge removal.** A minimum of two beds must be provided in all cases. Provide concrete truck tracks for all percolation-type sludge beds. Pairs of tracks for the percolations-type beds should be on 20-foot centers.

   (6) **(F) Sludge influent.** Sludge piping must terminate at least 12 inches above the sand surface and be sloped for drainage.
Provide a concrete splash pad at sludge discharge points. Piping must allow control flexibility to discharge sludge to any drying bed.

(2) **Mechanical dewatering facilities.** Provide sufficient capacity for mechanical dewatering facilities to dewater all sludge produced with the largest unit out of service. Provide adequate storage facilities unless other standby facilities are available.

- (A) **Ventilation.** Provide adequate ventilation for the dewatering area.
- (B) **Chemical handling enclosures.** Enclose all lime-mixing facilities.

(3) **Liquid return.** Provide for the return of all drainage from beds or filtrate from dewatering units to plant head works.

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**252:656-19-5.1. Lime Stabilization**

Alkaline material may be added to liquid primary or secondary sludges for sludge stabilization in lieu of digestion facilities; to supplement existing digestions facilities; or for interim sludge handling. The design of the lime stabilization system shall account for the increased sludge quantities for storage, handling, transportation, and disposal methods and associated costs.

(1) **Operational criteria.** Sufficient alkaline material shall be added to liquid sludge in order to maintain a homogeneous mixture with a minimum pH of 12 after 2 hours of vigorous mixing. Facilities for adding supplemental alkaline material shall be provided to maintain the pH of the sludge during interim sludge storage periods.

(2) **Odor Control and Ventilation.** Odor control facilities shall be provided for sludge mixing and treated sludge storage tanks. Ventilation is required for indoor sludge mixing, storage and processing facilities. Provide 12 complete air changes per hour.

(3) **Tanks.** Mixing tanks may be designed to operate as either a batch or continuous flow process. The following items shall also be considered in determining the number and size of tanks:

- A) peak sludge flow rates;
- B) storage between batches;
- C) dewatering or thickening performed in tanks;
- D) repeating sludge treatment due to pH decay of stored sludge;
- E) sludge thickening prior to sludge treatment; and
- F) type of mixing device used and associated maintenance or repair requirements.

(4) **Equipment.** Mixing equipment shall be designed to provide vigorous agitation within the mixing tank, maintain solids in suspension and provide for a homogeneous mixture of the sludge solids and alkaline material. Mixing may be accomplished either by diffused air or mechanical mixers. If diffused aeration is used, an air supply of 30 cfm per 1,000 cubic feet of mixing tank volume shall be provided with the largest blower out of service. When diffusers are used, the nonclog type is recommended, and they should be designed to permit continuity of service. If mechanical mixers are used, the impellers shall be designed to minimize fouling with debris in the sludge and consideration shall be made to provide continuity of service during freezing weather conditions.
Feed and Slaking Equipment. Feed and slaking equipment shall be sized to handle a minimum of 150% of the peak sludge flow rate including sludge that may need to be retreated due to pH decay.

252:656-19-6. Stabilized sludge holding facilities
Design. For systems that land apply biosolids, design on-site temporary sludge storage facilities to hold the sludge volume produced during a three-month period. Except facilities permitted by the DEQ (excluding transfer stations), biosolids shall not be stored for greater than six (6) months without prior written approval from the DEQ and in no case longer than one (1) year.

1. Vacuum filtered sludge. Provide concrete or equivalent-surfaced facilities with appropriate drainage systems to store treated sludge. For dewatered sludge, provide concrete or equivalent surfaced facilities with appropriate drainage systems to store treated sludge. Drainage systems must return supernatant or other liquids to the treatment system.

2. Liquid sludge. Anaerobically digested sludge may be temporarily stored in facultative sludge lagoons. Provide sufficient mixing for uniformity of solids concentration. Construct temporary storage lagoons according to Subchapter 11 with the following exceptions: sludge depth may vary between 10 to 15 feet; the bottom and dike seal must have a 1 foot soil barrier or equivalent; organic loadings must not exceed 20 lbs volatile solids/1,000 ft² surface area/day; and provide aeration equipment to maintain a minimum of 0.5 mg/l dissolved oxygen.

Sludge storage must accommodate daily sludge production volumes and function as an operational buffer for unit outage and adverse weather conditions. Designs utilizing increased sludge age in the activated sludge system as a means of storage are not acceptable. On-site storage of dewatered high pH stabilized sludge shall be limited to 30 days. Provisions for rapid retreatment or disposal of dewatered sludge stored on-site shall also be made in case of sludge pH decay.

SUBCHAPTER 21. DISINFECTION STANDARDS

252:656-21-1. Disinfection criteria
(a) Design considerations. Disinfection may be required to meet coliform limits in the Water Quality Standards. Ultra-violet light and chlorination are the most commonly used methods for wastewater disinfection. Other disinfectants may be individually approved, such as chlorine dioxide or bromine. The standards in this section apply to all disinfection systems.
(b) Piping. Show the piping is appropriate and compatible for the disinfectant. Support and protect piping from temperature extremes. Steel is suitable for use with dry chlorine when the correct thickness or weight is specified. Low-pressure lines made of hard rubber, saran-lined, rubber-lined, polyethylene, polyvinyl chloride (PVC), or Uscolite materials are satisfactory for liquid chlorine. Unplasticized PVC, Type I, may be used in submerged piping if the gas pressure is low and the temperature is below 140 degrees F.
(c) Alarms. Provide alarms to warn of equipment failures and
leaks.
(d) **Backups.** Provide standby equipment to replace the largest unit. Provide spares for all parts that may break or wear.
(e) **Chlorine and ozone mixing.**
   (1) **Mixing.** Mix the disinfectant as rapidly as possible, mixing completely in three seconds or less.
   (2) **Contact period.** For chlorination systems, provide a minimum contact period of 15 minutes at peak hourly wastewater flow or maximum pumping rate after mixing. For ozone, meet the equipment manufacturer's recommendations.
   (3) **Contact tank.** Construct chlorine or ozone contact tanks to minimize short-circuiting. Provide "over-and-under" or "end-around" baffling shall be provided to reduce short-circuiting. Design the tanks for easy maintenance and cleaning without harming the reducing the effectiveness of disinfection. Provide duplicate tanks, mechanical scrapers or portable deck-level vacuum cleaning equipment. Provide skimming devices on all contact tanks, and provide for draining the tanks. **Tank covers** Covered tanks are discouraged.
(f) **Chlorine and ozone equipment rooms.**
   (1) **Separation.** If the building is used for other purposes, provide a gas-tight room to separate gas chlorination equipment, chlorine cylinders and ozone generation equipment from other parts of the building. Do not connect floor drains from the chlorine room to floor drains from other rooms. Doors to this room must open only to the outside of the building, with panic hardware, at ground level and allow easy access to all equipment. Separate For one (1) ton chlorine cylinders separate the storage area from the feed area. Locate chlorination equipment as close to the application point as is reasonably possible. Certify the installation will meet OSHA standards, and that the doors and emergency equipment are compatible with chlorine.
   (2) **Inspection window.** Install a clear glass, gas-tight window in an exterior door or interior wall of the chlorinator or ozone generator room so the units can be viewed without entering the room.
   (3) **Heating.** Heat disinfection equipment rooms to maintain at least 60 degrees F (16 degrees C). Ozone generation rooms must stay above 35 degrees F (2 degrees C). Protect from excess heat, and maintain cylinders at essentially room temperature.
   (4) **Ventilation.** Provide mechanical ventilation capable of one air change per minute for chlorine, and six air changes per hour for ozone. The entrance to the room exhaust duct must be near the floor, and the point of discharge must not contaminate inhabited areas or the air inlet to any buildings. Locate fresh air inlets to provide cross ventilation with air and at a temperature that will not adversely affect the chlorination or ozone equipment. Discharge the chlorinator vent hose above-grade to the outside atmosphere.
   (5) **Electrical controls.** Locate fan and light switches outside, at the room entrance. Include a signal light to
indicate whether the ventilation system is operating. A labeled signal light indicating fan operation shall be provided at each entrance if the fan can be controlled from more than one point.

252:656-21-2. Chlorine disinfection
(a) Equipment capacity. The following guide is for sizing chlorination of domestic sewage chlorination. The equipment must be capable of supplying the following dosage:
   (1) Trickling filter plant effluent treatment - 10 mg/l dosage;
   (2) Activated sludge plant effluent treatment - 8 mg/l dosage;
   (3) Tertiary filtration effluent - 6 mg/l dosage;
   (4) Nitrified effluent - 6 mg/l dosage.
(b) Water supply. Provide an ample supply of water to operate the chlorinator, and protect it according to 9-2(b) OAC 252:656-9-2(b). Back up any booster pumps, according to the power requirements of 252:656-9-2(a).
(c) Scales. Provide corrosion-resistant scales to weigh chlorine gas cylinders. Provide at least a platform scale. Indicating and recording scales are recommended for large installations.
(d) Containers. Consider using one-ton containers if more than 150 pounds of chlorine per day is needed. Limit the withdrawal rate to 40 pounds per day per cylinder for cylinders up to 150 pounds, and to 400 pounds per day for one-ton cylinders.
(e) Handling equipment. For cylinders up to 150 pounds, provide securing restraints and a hand-truck designed for the cylinders. For one-ton cylinders, provide:
   (1) Hoist with 4,000 lb. capacity;
   (2) Cylinder lifting bar;
   (3) Monorail or hoist with sufficient lifting height to pass one cylinder over another; and
   (4) Cylinder trunnions to allow exchanging the cylinders for proper connection.
(f) Manifolds. Gaseous chlorine cylinders may be connected to a manifold, if all cylinders are maintained at the same temperature or the system is designed for gas transfer from a warm container to a cooler one. Do not connect liquid chlorine cylinders to a manifold.
(g) Leak detection and controls. Provide an emergency response plan for chlorine leaks. Provide a bottle of 56% ammonium hydroxide solution for detecting chlorine leaks. Where one-ton containers are used, provide a leak repair kit approved by the Chlorine Institute and include caustic soda solution reaction tanks to absorb leaks. At large chlorination installations, provide automatic gas detection and related alarm equipment. Air Pollution Control regulations may also require air scrubbing equipment.
(h) Evaporators. Demonstrate the required volume of chlorine can be supplied.
(i) Respiratory protection. Where chlorine gas is handled, provide respiratory air-pac protection equipment that meets the National Institute for Occupational Safety and Health (NIOSH) standards. Store the equipment and operating instructions at a convenient location outside the room where chlorine is used or stored. The units must use compressed air, with at least a
30-minute capacity, and be compatible with units used by the local fire department. In the emergency response plan, describe how to maintain the equipment.

(j) **Sodium hypochlorite.** Follow equipment standards in OAC 252:626.

(k) **Dechlorination.** All chlorinated effluent must be dechlorinated and discharges can not exceed must be less than 0.1 mg/l total residual chlorine.

1. **Equipment.** The same type of feeding equipment used for chlorine gas may be used for sulfur dioxide gas, with minor modifications as recommended by the manufacturer. Do not chlorinate and dechlorinate with the same units. Handle aqueous solutions of sulphite or bisulfite with positive displacement pumps. Sulfur dioxide feed equipment must account for the property of the gas to easily liquefy. With one-ton containers, take special precautions to prevent chemicals from liquefying. Where necessary, provide multiple units to meet the operating requirements between the minimum and maximum wastewater flow rates and to avoid depleting dissolved oxygen in receiving waters.

2. **Mixing.** Show how mixing will occur. Mechanical mixers are required unless the design will provide hydraulic turbulence to assure thorough and complete mixing.

3. **Sulfonator water supply.** Same as for chlorination systems.

4. **Housing.** Storage and feed equipment for SO₂ should be in a separate room from chlorine gas storage and feed equipment. The same storage requirements apply to SO₂ as for chlorine gas. Mixing, storage, and feed equipment areas must be designed to contain spillage or leakage or to route it to an appropriate containment unit.

5. **Respiratory protection.** Same as for chlorine gas.

252:656-21-3. **Ultra-violet Ultraviolet radiation disinfection**

(a) **Application.** Suspended solids interfere with UV disinfection. For best results, the effluent to be disinfected should not exceed 15 mg/l TSS. This process shall be limited to a high quality effluent having at least 65% ultraviolet radiation transmittance at 254 nanometers wave length, and BOD and suspended solids concentrations no greater than 30 mg/l at any time. System sizing for an activated sludge effluent with the preceding characteristics at the design peak hourly flow, a UV radiation dosage not less than 30,000 uWsec/cm² shall be used after adjustments for maximum tube fouling, lamp output reduction after 8,760 hours of operation, and other energy absorption losses.

(b) **Equipment design.** Follow recommendations of equipment manufacturers for specific construction, cleaning and design requirements.

(c) **Control system.** Provide the UV system with controls capable of switching banks of lamps on or off to achieve the necessary dose proportional to flow. A slave lamp operating to check wastewater quality absorbance effluent absorbance is recommended required. Include appropriate alarms, power meters, on/off indicators, elapsed time monitor, lamp output monitor, intensity, and lamp and ballast panel temperature indicators. Provide for measuring the
wastewater flow through each unit for adequate disinfection.
(d) **Maintenance.** Equip reactors with a drain and the ability to isolate modules. Provide a backup reactor so that efficiency will not be impaired during either routine or emergency maintenance. Lamps and ballast must be accessible.
(e) **Safety.** Provide safety equipment for protection from UV radiation, such as proper goggles and clothing.
(f) **Reliability.** The performance of a UV reactor is dependent upon its power supply and functioning lamps; therefore a separate, backup power supply must be provided.

252:656-21-4. **Ozone disinfection**

Ozone dissolution is accomplished through the use of conventional gas diffusion equipment, with appropriate consideration of materials. If ozone is produced from air, then gas preparation equipment (dryers, filters, compressors) is required.
(1) Provide automatic controls for generation units to adjust ozone production to meet disinfection requirements.
(2) Specify only ozone piping materials at least as corrosion-resistant to ozone as Grade 304 L stainless steel in non-submerged applications. Avoid copper or aluminum alloys.
(3) Provide leak detection equipment.

**SUBCHAPTER 23. SUPPLEMENTAL TREATMENT STANDARDS**

252:656-23-1. **High-rate effluent filtration**

(a) **General.** Filtering lagoon effluent is not recommended. Granular media filters may be used for tertiary treatment to remove suspended solids from secondary effluents. Provide flow equalization facilities to maintain a constant filtration rate. Precede filter units with a pre-treatment process such as chemical coagulation and sedimentation or other acceptable process where:
   (1) permit requirements for suspended solids are less than 10 mg/l,
   (2) effluent quality can be expected to fluctuate significantly, or
   (3) significant amounts of algae will be present.
(b) **Filter types.** Filters may be either gravity or pressure. Provide pressure filters with convenient access to the media for treatment or cleaning. Use gravity filters where greases or similar solids are expected.
(c) **Filtration rates.** Filtration rates shall not exceed 5 gpm/ft² at the maximum hydraulic design. Provide at least two units, with the capacity to handle the maximum wastewater flow with the largest unit out of service.
(d) **Backwash.**
   (1) **Backwash rate.** The backwash rate shall be adequate to fluidize and expand each media layer a minimum of 20%. The backwash system shall provide a variable backwash rate of at least 20 gpm/ft² for 10 minutes.
   (2) **Backwash.** Design the backwash filter unit pumps to backwash any filter with the largest pump out of service. Backwash with filtered water and treat the waste return the wastewater to the headworks.
(e) **Filter media.**

1. **Selection.** Media size will depend on the filtration rate, treatment prior to filtration, filter configuration, and effluent quality requirements.

2. **Specifications.** Minimum media depths and media sizes [shown in brackets], with a uniformity coefficient of 1.7 or less, are:

   **(A) Anthracite**
   - (i) Single-medium - none
   - (ii) Dual-media - 20 in. [1.0-2.0 mm]
   - (iii) Multi-media - 20 in. [1.0-2.0 mm]

   **(B) Sand**
   - (i) Single-medium - 48 in. [1.0-4.0 mm]
   - (ii) Dual-media - 12 in. [0.5-1.0 mm]
   - (iii) Multi-media - 10 in. [0.6-0.8 mm]

   **(C) Garnet or similar**
   - (i) Single-medium - none
   - (ii) Dual-media - none
   - (iii) Multi-media - 2 in. [0.3-0.6 mm]

(f) **Filter appurtenances.** Equip filters with:

1. washwater troughs,
2. surface wash or air scouring equipment,
3. effluent rate of flow control,
4. measurement and positive control of backwash rate,
5. capability to measure filter head loss,
6. positive means to shut off flow to filter during backwash and,
7. filter influent and effluent sampling points.

Provide a manual override for automatic controls and each individual valve essential to the filter operation. Design the underdrain system to uniformly distribute backwash water (and air, if provided) without clogging from solids in the backwash water. Provide for periodic chlorination of the filter influent or backwash water to control slime growths.

(g) **Reliability.** Design each filter unit for convenient access to all components and the media surface for inspection and maintenance without taking other units out of service. The need for housing filter units will depend on expected climatic conditions at the treatment plant site. Enclose all controls and equipment with heating and ventilation equipment to control humidity.

(h) **Backwash surge control.** The return rate of backwash water to treatment units shall not exceed 15% of the wastewater design daily average flow rate to the treatment units. Consider the hydraulic and organic load from waste backwash water in the overall design of the treatment plant. Surge tanks must hold at least two backwash volumes, and consider more for operational flexibility. Where backwash water is pump-returned for treatment, required pumping capacity shall be maintained with the largest unit out of service.

(i) **Backwash water storage.** Provide backwash water storage capacity for two complete backwash cycles.

(j) **Slow rate filtration.** Show conformance to widely recognized engineering references.
252:656-23-2. Submerged rock filters

(a) General. Submerged rock filters may be used to reduce total suspended solids and BOD from waste stabilization from lagoon effluents. An intermediate lagoon is required between aerated cells and the filter when used with aerated systems.

(b) Rock type. Rock media shall be five to six feet deep, and consist of durable rocks free of fine material and be relatively insoluble in sewage. Gypsum and flat rocks are not acceptable.

(c) Rock size. At least 90% of the rock shall be in the 3 to 6-inch range with no more than 5% smaller than 2 inches (a void ratio of about 42 to 45%).

(d) Installation. Installation is critical to maintain the void spaces within the rock. The engineer must specify the media be placed on a dry subgrade, without the use of heavy equipment on the media to avoid compaction.

(e) Erosion control. Protect the media from dike erosion before the media is installed. A sod or synthetic liner (40 mil minimum) shall be sod, plastic or silt fence may be used. When a sod liner is used, a 4 inch thick apron of concrete from one foot above the high water elevation to the bottom of the media is recommended.

(f) Influent. Draw influent from 18 to 24 inches below the surface of the last lagoon and distribute it evenly over the filter.

(g) Underdrain. The underdrain system must withdraw filtered water uniformly across the filter bottom. The use of 12-inch perforated pipe placed 10 feet on centers spaced evenly along the filter bottom is recommended.

(h) Recirculation. Provide positive recirculation of the effluent over the filter, at least five times the design average flow. Air lift low-head, high-volume pumps may be used. Draft tube aeration or any mechanical mixing devices for intra-recirculation will not be approved.

(i) Hydraulic loading rate. Submerged rock filters operate at peak efficiency during the summer and early fall and may be loaded at 6 gallons/ft³/day or 30 gallons/ft²/day. Winter temperatures reduce biological activity and the loading rate must be reduced to not more than 3 gallons/ft³/day or 15 gallons/ft²/day. Provide two filter basins of equal size with the total filter area based on the winter a loading rate of 3 gallons/ft³/day. Piping must allow individual operation of the basins. Use an average design influent flow to calculate the required filter area. Control flow to the filter during wet weather conditions. Provide sufficient capacity to store excessive wet weather flow to prevent overloading the rock filter.

(j) Organic loading rate. Limit organic loading to 5.0 lbs. of BODs per day per 1,000 cubic feet of rock media.

252:656-23-3. Post-aeration

(a) General. Most wastewater treatment processes operate satisfactorily with dissolved oxygen levels as low as 2 mg/l. Post aeration may be necessary to raise the dissolved oxygen levels to meet stream standards. Water Quality Standards. The common methods are cascade, mechanical and diffused air.
(b) **Cascade aeration.** Cascade aeration is the most cost-effective process and may be used where site topography permits. Air is entrained into the wastewater by turbulence created as the water flows over the cascade. Head requirements will vary from three to ten feet, depending on the initial DO, temperature of the wastewater and the required DO level before discharge. The formulas used to determine the required cascade height are listed in Appendix C.

(c) **Mechanical aeration.** See Appendix C.

**SUBCHAPTER 25. WASTEWATER LAND APPLICATION SYSTEMS**

252:656-25-2. Slow rate system design

(a) **Treatment.** Primary treatment is required. Do not land apply from the primary cell.

(b) **Loading rates.** Hydraulic loading, BOD, suspended solids, nitrogen, phosphorus and crop selection must all be considered in the process design of land applications systems. Typically loading rates of BOD and SS for municipal wastewater are far below the loading rates determined by other parameters and will not be a concern in system design.

(c) **Land area.** The total area required for a wastewater land application system includes the field area (application site), treatment and storage site (normally primary treatment lagoons and storage ponds), buffer zones and service roads.

(d) **Control.** The applicant must show they have the right to control the use of the land application site. A long-term contract for a minimum of 20 years is required.

(e) **Buffer zone.** A buffer zone of at least 100 feet in width shall be provided between the land application site and adjacent property. Additional distance may be required where prevailing winds could cause aerosols to drift into residential areas. The buffer zone shall be a part of the permitted site.

(f) **Public contact.** Chlorinate the wastewater if it is to be applied to public contact areas.

(g) **Storage.** Storage of wastewater is required for periods when available wastewater exceeds design hydraulic loading rate, and when the ground is saturated or frozen. A water balance computation is used to estimate the storage requirement. Provide water balance computations of the estimated storage needs. There must be at least 90 days of storage above that required for primary treatment. The monthly available wastewater for each month may be determined by equation (25-5) in Appendix D.

(h) **Flow measurement.** Provide for the measurement of wastewater to be land-applied. Flow measurement may be satisfied by calibration of pumps and installation of run-time meters.