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TITLE 252. DEPARTMENT OF ENVIRONMENTAL QUALITY
CHAPTER 656. WATER POLLUTION CONTROL FACILITY CONSTRUCTION STANDARDS

Subchapter

SUBCHAPTER 1. INTRODUCTION

252:656-1-1. Applicability

(a) This chapter sets the permit and construction standards for wastewater collection systems and treatment works. It does not apply to innovative technology (see 27A O.S. § 2-6-401), to small public sewage systems as defined in 27A O.S. § 2-6-101 (also see OAC 252:641, Individual and Small Public On-Site Sewage Treatment Systems), nor does it apply to industrial wastewater (see OAC 252:606, Oklahoma Pollutant Discharge Elimination System (OPDES) Standards and OAC 252:616, Industrial Wastewater Systems). There are other rules that also may govern wastewater systems, such as OAC 252:621, Non-Industrial Flow-Through and Public Water Supply Impoundments including Land Application; OAC 252:619, Operation and Maintenance of Non-Industrial Total Retention Lagoon Systems and Land Application; OAC 252:515, Management of Solid Waste; 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:

(1) a small public sewage system as defined in 27A O.S. § 2-6-101, or

(2) 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:

"208 plan" means an areawide wastewater treatment management plan that states are required to submit to EPA for approval pursuant to section 208 of the Clean Water Act, 33 U.S.C. § 1288.

"ASTM" means the American Standard Testing Method and Material.

"Biosolids" means 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). Biosolids are divided into the following classes:

(A) Class A Biosolids meets the pathogen reduction requirements of 40 CFR § 503.32 (a);

(B) Class B Biosolids meets the pathogen reduction requirements of 40 CFR § 503.32 (b).

"BOD" means total 5-day biochemical oxygen demand.

"Bypass" means the intentional or unintentional diversion of a waste stream from any portion of a wastewater treatment system.

"CBOD" means 5-day carbonaceous biochemical oxygen demand.

"Cell" means an individual basin of a lagoon system.

"cfm" means cubic feet per minute.

"Collection system" means pipelines or conduits, pumping stations, force mains and all other facilities used to collect or conduct wastewater to a treatment works.

"DEQ" means the Oklahoma Department of Environmental Quality.

"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.

"fps" means feet per second.

"Freeboard" means the vertical distance from the surface water level to the overflow elevation in a treatment unit.

"GPM" means gallons per minute.

"Land application" means the controlled application of treated wastewater onto the land surface for beneficial use.

"MGD" or "mgd" means million gallons per day.

"MLSS" means mixed liquor suspended solids.

"MLVSS" means mixed liquor volatile suspended solids.

"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.

"NPDES" means the National Pollution Discharge Elimination System.

"OAC" means Oklahoma Administrative Code.

"OSHA" means the Occupational Health and Safety Administration.

"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.

"PSRP" means process to significantly reduce pathogens.

"PVC" means polyvinyl chloride.

"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).

"Rip-rap" means a permanent, erosion resistant ground cover that consists of hard, sound durable stones that average in weight between thirty to fifty pounds (30-50 lbs), with no more than twenty percent (20%) weighing less than twenty pounds (20 lbs).

"Service line" means a wastewater line that connects an individual home, building or business to a permitted collection system.

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

"Total Kjeldahl nitrogen (TKN)" means the total of the organic and ammonia nitrogen.

"U.S.C." means United States Code.

"Wastewater system" means a collection system and treatment works.

SUBCHAPTER 3. PERMIT PROCEDURES

Section

252:656-3-1. Permitting process

(a) This subchapter implements the permitting process of Part 4, Water and Wastewater Treatment Systems, 27A O.S. § 2-6-401 *et seq*, the Uniform Permitting Act, Title 27A O.S. § 2-14-101 and the rules promulgated pursuant thereto.

(b) A permit is required for the construction or modification of a non-industrial wastewater system.

(c) The permit application is a two-step process:

(1) The first step is the submission of an engineering report (as described in OAC 252:656-3-4); and

(2) The second step is the submission of the final design report along with the required

application forms and fees. The final design report shall:

(A) include two (2) sets of plans and specifications, and

(B) reflect any changes from the approved engineering report.

(d) Unless an extension is granted, a construction permit expires if construction does not begin within one (1) year from the date the permit is issued.

(e) Permits to construct or modify non-industrial wastewater systems shall only be issued to public entities unless all components of the proposed system, including all service lines, are located on property:

(1) owned by the applicant, or

(2) dedicated to the applicant through a recorded easement for the installation and operation of the system.

252:656-3-2. Applications

(a) The applicant shall submit complete and legible applications on forms provided by the DEQ and include:

(1) the type of entity that is applying for the permit,

(2) the legal description of the property where the system will be located,

(3) a minimum of two (2) sets of plans and specifications,

(4) a final design analysis,

(5) applicable fees, and

(6) a list of all applicable ASTM standards required for construction, installation and testing of the processes and equipment listed in the plans and specifications.

(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) If the proposed facility is to be located within a political subdivision, the applicant 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;

(C) that provisions have been made for continued existence of the operating entity for the expected life of the facility; and

(D) that all components of the non-industrial wastewater system, including service lines, are located on property under the control of the applicant through a recorded easement or ownership of the property. [See 27A O.S. § 2-6-401(A)].

(2) Financial accountability may be demonstrated in one of the following fashions:

(A) 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

(B) 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.

(g) Applicants must have adequate staff and procedures in place to assure construction does not:

(1) proceed before the plans and specifications are approved, or

(2) deviate from the approved plans and specifications.

252:656-3-3. Municipal exemptions

(a) Municipalities may be exempted from construction permits for gravity wastewater collection lines no larger than 12 inches in diameter if they:

(1) Adopt and enforce an ordinance requiring all wastewater systems within their corporate limits to comply with applicable DEQ rules.

(2) Adopt and enforce an ordinance withholding approval of sewer line extensions to wastewater treatment works, lift stations, and interceptor lines which have reached treatment or hydraulic capacities.

(3) Retain an adequate number of competent full-time staff to review and approve plans and specifications for sewage collection systems. Such staff must include at least one engineer, in responsible charge, who must approve and then sign plans authorizing construction to proceed according to the approved plans.

(4) Have adequate inspection and enforcement staff and procedures to assure construction does not proceed before approval of or deviate from approved plans and specifications.

(5) Submit a quarterly status report to the DEQ that describes the current design capacity, additional loading capacity, effluent quality and the extent of sewage bypasses.

(b) To obtain the exemption, municipalities must apply on DEQ forms.

(c) There are no exemptions for permits funded by the State Revolving Fund.

252:656-3-4. Engineering report

(a) Submit two copies of an engineering report for proposed new construction or modifications to sewage collection systems or treatment works at least thirty (30) days prior to the submittal of plans and specifications. For line extension and lift station construction, the submission of an Engineering Report Form, developed by the DEQ, signed and sealed by an engineer licensed by the State of Oklahoma, may be submitted to meet the requirements of the necessary engineering report, unless a full engineering report is required by the DEQ. Engineering reports must include:

(1) **Volume and strength of sewage flow.** Establish the existing and anticipated design average and design peak flows and waste load for the existing and ultimate conditions. Include the basis for projecting initial current and/or future dry and wet weather flows and waste load for the existing, or initial, service area, and the anticipated future service area. For discharging facilities, the report must demonstrate that the proposed project complies with the design flow in the 208 Plan and other applicable OPDES permit limits.

(2) **Existing system.** Describe the existing system, including the needs for the project related to health and safety, system operations and maintenance, and population growth. Issues that must be addressed include, but are not limited to, suitability of existing facilities for continued use, adequacy of water supply, history of compliance with state and federal requirements, and comparison of existing treatment units with state and federal design requirements.

(3) **Project description and alternatives**. The report must contain a description of the alternatives that were considered to meet the identified need. Provide a service area and project site map showing the existing and proposed systems. The information must describe legal and natural boundaries, major obstacles, elevations, and any other information necessary to properly evaluate the project. Describe the proposed project and, where two or more solutions exist, discuss the alternatives including cost analysis and discuss the reasons for selecting the one recommended. For each alternative considered, the report must provide the following:

(A) **Description.** A description of the collection system, pumping systems, treatment, and discharge facilities associated with each alternative as applicable.

(B) **Design criteria.** The design parameters used for evaluation purposes.

(C) **Schematic.** A schematic diagram(s) of all existing and proposed treatment processes.

(D) **Land requirements.** The identification of sites and easements that will be used and whether the sites:

(i) are currently owned or leased by the applicant, or

(ii) will be acquired or leased by the applicant.

(E) **Construction problems.** A discussion of concerns such as subsurface rock, high water table, limited access, or other conditions that may affect the cost of construction or the operation of the facility.

(F) **Advantages and disadvantages.** A description of the ability of each alternative to meet the owner's needs, address violations cited in any enforcement orders, satisfy public and environmental concerns, and comply with regulatory requirements. The report must demonstrate the compatibility of each alternative with existing, comprehensive, and area-wide development plans. Provide a short description of environmental impacts that may preclude any alternatives.

(G) **Selected alternative.** A complete description of the proposed project based on the general description presented in the evaluation of alternatives. The report must show that the proposed project will comply with all the requirements of this Chapter. At a minimum, the following information must be included:

(i) **Treatment**. A description of the processes, including biosolids management, in detail and the identification of the location of the plant and the site of any discharges; a status of compliance with the 208 Plan, and if applicable, include current revisions with copy of DEQ approval letter, if approved in the current 208 Plan.

(ii) **Pumping stations**. The size, type, location and any special power requirements, including provisions for emergency operations, of all pumping stations.

(iii) **Collection system layout**. Identify general location of line improvements, including: lengths, sizes and key components.

(iv) **Calculations**. Provide supporting calculations in sufficient detail to demonstrate compliance with DEQ design requirements to assure adequate capacity for the collection and treatment system as a whole to transport and treat the wastewater. For collection system projects, the submittal must include a map with a list of manholes and pipes and the associated characteristics, such as elevation of inverts, pipe diameter, pipe segment length, and other information necessary to evaluate the project. The report must provide assurance that the receiving collection and treatment systems have adequate capacity.

(4) **Construction sequence.** A description of 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 the site consistent with approved plans. Include 6 months of data on the groundwater level. Provide soil boring information pursuant to OAC 252:656-11-3 (a) for projects that include lagoons or other non-industrial impoundments.

(6) **Water supply.** Identify surface water intakes within five (5) miles of the discharge and known public and private water wells within three hundred feet (300').

(7) **Receiving stream.** Identify the receiving stream and its wasteload requirements according to the Water Quality sections of OAC 252:606 and Oklahoma's Water Quality Management Plan (208 Plan).

(8) **Disposition of biosolids.** Discuss the available alternatives for biosolids reuse and/or disposal (OAC 252:606 and OAC 252:515). Submit a sludge management or sludge disposition plan. All biosolids that will be land applied and/or disposed in a landfill must comply, at a minimum, with the Class B pathogen reduction requirements contained at 40 CFR, Part 503, adopted by reference at OAC 252:606.

(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. Sewer capacities must be designed for the estimated ultimate population that will be served. Similarly, consideration must be given to the maximum anticipated loadings from institutions, industrial parks and other similarly situated facilities.

(11) **Financing.** Provide itemized cost estimates to build, operate and maintain the proposed project:including, but not limited to:

(A) development, construction, land and rights-of-way, legal services, engineering services, contingencies, refinancing, and any other factors associated with the proposed project;

(B) discuss financing methods;

(C) provide information regarding rate structures, annual operating and maintenance (O&M) cost, tabulation of users by monthly usage categories and revenue received for the last three fiscal years; and

(D) give status of existing debts and required reserve accounts. Include a schedule of short-lived assets and a recommended annual reserve deposit to fund replacement of short-lived assets such as pumps, paint and small equipment.

(12) **Enforcement orders.** Discuss all applicable enforcement orders, including the violations cited in the orders and how the project will eliminate said violations.

(13) **Conclusions and Recommendations.** Provide any additional findings and recommendations that must be considered in development of the project. This must include recommendations for a specific course of action to be undertaken, any special studies to be developed, highlight the need for special coordination, include a recommended plan of action to expedite project development, etc.

(14) **Project Schedule**. The report must propose a schedule to obtain funds to complete the proposed project, submit construction plans, specifications, and permit application(s), start construction, complete construction, and attain compliance with applicable OPDES discharge permits.

252:656-3-5. Plans and specifications

(a) **General layout.** Submit two copies of general plans that:

(1) **Plan view.** Include a 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. Provide a summary of quantities that includes, at a minimum, linear feet of trenching, number of manholes, size, materials and linear feet of piping, types of testing and number and size of pumps (if applicable).

(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 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 must be 11" x 17", one-sided and of adequate contrast sufficient for microfilming.

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

(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~~ must 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 a detailed summary of equipment and design data, with references to the applicable specific ASTM standards for construction, installation and testing of said equipment.

(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 treatment units and pumping equipment to provide for equipment maintenance and repair.

(f) **Maintenance and cleaning.** For maintenance and operational controls, all units must 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 mechanical units, 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 252:656-3-4(3)).

252:656-3-6. Revisions

(a) **Approved plans.**

(1) **Before contract is awarded.** Any changes from approved plans or specifications affecting capacity, flow or operation of units must be submitted to the DEQ as an addendum for review and approval. The DEQ must review and approve the submission before construction can commence based on the addendum.

(2) **After contract is awarded.** After a contract has been awarded, submit proposed changes

from approved plans or specifications in the form of a Change Order, signed and sealed by an engineer, licensed by the State of Oklahoma. The permittee and the contractor must sign Change Orders. The DEQ must review and approve the submission of the proposed changes before construction can commence based on the Change Order.

(b) **As-built plans.** File as-built plans (plans of record) for wastewater treatment works with the DEQ within six months after the project is completed, unless the engineer certifies that construction was completed according to the approved plans.

(c) **DEQ Inspection.** The applicant must notify the DEQ of construction completed pursuant to an Addendum or Change Order, a minimum of ten (10) days prior to the commencement of operations.

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

(a) The policy of DEQ is to encourage better wastewater treatment methods and equipment, including the use of new technology. DEQ may approve processes or equipment not specifically covered by the standards in this Chapter provided the permittee requests a variance. A variance from the standards in this Chapter may be allowed, upon request of the applicant, if the DEQ finds the variance will not increase the likelihood of a system failure. No variance will be allowed unless it is noted on the construction permit.

(b) The consulting engineer shall justify the requested variance by submitting data showing the proposed processes or equipment will equal or exceed the performance of a processess or equipment known to perform the same function according to the standards contained in this Chapter. Variance requests shall include the following:

(1) monitoring observations including:

(A) test results, and engineering evaluations, and

(B) data from existing installations that demonstrate the efficiency of the proposed processes or equipment;

(2) a detailed description of the test methods;

(3) other information as requested by DEQ. The DEQ may require that pilot studies and appropriate testing be conducted and evaluations be made under the supervision of a competent process engineer other than one employed by the manufacturer or developer;

(4) if required under (c) of this Section, a copy of the supplier's bond or warranty/guarantee; and

(5) if required under (d) of this Section, a copy of the supplier's bond or warranty/guarantee.

(c) **Suppliers' bonds and warranties/guarantees.** Suppliers of processes or equipment not covered by the standards in this Chapter shall be required to post a performance bond or provide a warranty or guarantee in the event that the processes or equipment fail.

(1) **Performance bonds.** Performance bonds shall:

(A) be made payable to the permittee in an amount equal to the contract price for the installed processes or equipment plus ten percent (10%); and

(B) remain in effect for at least one (1) year after the processes or equipment are placed into operation.

(2) **Warranties/guarantees.** Warranties and guarantees shall:

(A) be made payable to the permittee in an amount equal to the contract price for the installed processes or equipment plus ten percent (10%); and

(B) remain in effect for at least one (1) year after the processes or equipment are placed into operation.

(d) **Engineers' bond or contractual agreement.** Engineers proposing processes or equipment not covered by the standards in this Chapter will be required to either:

(1) post a performance bond made payable to the permittee in an amount sufficient to cover the cost of any engineering services necessary to replace the installed processes or equipment with processes or equipment that conform with the requirements of this Chapter; or

(2) enter into a contractual agreement with the permittee wherein the engineer agrees to provide engineering services necessary to replace any failed processes or equipment with processes or equipment that conform with the requirements of this Chapter.

252:656-3-8. Financial responsibility

(a) All applicants must demonstrate they have adequate financial, technical, and managerial capacity to comply with the requirements of this Chapter and to continuously maintain the wastewater treatment system.
(b) 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.

(c) Continued existence may be demonstrated in one of the following fashions:

(1) 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 treatment system for the expected life of the facility; or
(2) Other proof of financial viability, such as the issuance of a bond or insurance contract covering the operation and maintenance of the wastewater treatment system may be submitted to DEQ for approval.

(d) Costs for closure of the wastewater treatment 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 unless a monthly billing agreement with the DEQ and the permittee is current.
(b) Fees for treatment works construction are based on design flow and are as follows:

(1) New facilities ~~or~~ and major modifications that alter the original design or the design capacity:
(A) 1.0 MGD and greater $5,440.00
(B) 0.50 MGD - 0.99 MGD $4,080.00
(C) 0.10 MGD - 0.49 MGD $2,720.00
(D) 0.01 MGD - 0.09 MGD $1,360.00
(E) less than 0.01 MGD $680.00
(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 $1,360.00
(B) 0.50 MGD - 0.99 MGD $1,090.00
(C) 0.10 MGD - 0.49 MGD $814.00
(D) 0.01 MGD - 0.09 MGD $540.00
(E) less than 0.01 MGD-$270.00

(c) Collection system improvement fees are:

(1) Line extensions (rounded to the nearest one hundred feet (100'): $150.00 for the initial one to five hundred feet (1-500') plus $28.50 for each additional one hundred feet (100').
(2) Lift stations:$140.00 per 100 GPM for the peak capacity rating rounded to the nearest 100 GPM.
(3) Municipalities that are exempted from obtaining construction permits under OAC 252:656-3-3 shall submit payment to DEQ for twenty percent (20%) of the total fee calculated in this Subsection. This fee may be paid upon submission of plans, or on a monthly or quarterly basis.

(d) To assist in meeting rising costs to the Department for the non-industrial wastewater systems program, the fees set out in paragraphs (b) and (c) above shall be automatically adjusted on July 1st every year to correspond to the percentage, if any, by which the Consumer Price Index (CPI) for the most recent calendar year exceeds the CPI for the previous calendar year. The Department may round the adjusted fees up to the nearest dollar. The Department may waive collection of an automatic increase in a given year if it determines other revenues, including appropriated state general revenue funds, have increased sufficiently to make the funds generated by the automatic adjustment unnecessary in that year. A waiver does not affect future automatic adjustments.

(1) Any automatic fee adjustment under this subsection may be averted or eliminated, or the adjustment percentage may be modified, by rule promulgated pursuant to the Oklahoma Administrative Procedures Act. The rulemaking process may be initiated in any manner provided

by law, including a petition for rulemaking pursuant to 75 O.S. § 305 and OAC 252:4-5-3 by any person affected by the automatic fee adjustment.

(2) If the United States Department of Labor ceases to publish the CPI or revises the methodology or base years, no further automatic fee adjustments ~~shall~~ must occur until a new automatic fee adjustment rule is promulgated pursuant to the Oklahoma Administrative Procedures Act.

(3) For purposes of this subsection, "Consumer Price Index" or "CPI" means the Consumer Price Index - All Urban Consumers (U.S. All Items, Current Series, 1982-1984=100, CUUR0000SA0) published by the United States Department of Labor. The CPI for a calendar year is the figure denoted by the Department of Labor as the "Annual" index figure for that calendar year.

(e) 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).

(f) REAP (Rural Economic Assistance Program) Grant Projects are exempt from permit fees.

(g) The maximum fee for any one application will not exceed $5,825.00. 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.

OAC 252:656-3-10. Operation and Maintenance (O & M) Manual

Within ninety (90) days of the completion of the project, the applicant must submit to the DEQ an O & M Manual for the operation and maintenance of the wastewater treatment system. The O & M Manual must include at a minimum:

(1) System Treatment Requirements;
(2) Current NPDES Permit wasteload requirements to water quality sections of OAC 252:606 including 208 plan requirements;
(3) Description, Operation and Control of the Treatment Works;
(4) Control of Unit Processes;
(5) Laboratory Testing;
(6) Common Operating Problems;
(7) Start-Up Testing and Procedures;
(8) Normal Operating Procedures;
(9) Alternative and Emergency Operations;
(10) Emergency Shutdown Operations and Emergency Response;
(11) Records Control and Retention;
(12) Safety;
(13) Wastewater Treatment System Maintenance Requirements; and
(14) Spare Parts and Chemical Inventory.

SUBCHAPTER 5. SANITARY SEWER STANDARDS

Section

252:656-5-1. Design capacity

Design sewers for the 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 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.

(1) 4" sewer: 1.00 feet/100 feet
(2) 6" sewer: 0.50 feet/100 feet
(3) 8" sewer: 0.40 feet/100 feet
(4) 10" sewer: 0.29 feet/100 feet
(5) 12" sewer: 0.22 feet/100 feet
(6) 14" sewer: 0.17 feet/100 feet
(7) 15" sewer: 0.15 feet/100 feet
(8) 16" sewer: 0.14 feet/100 feet
(9) 18" sewer: 0.12 feet/100 feet
(10) 21" sewer: 0.10 feet/100 feet
(11) 24" sewer: 0.08 feet/100 feet

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

(1) **Pipe Diameter**. 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) **Privately-owned collection lines.** 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 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 in lieu of a septic tank.

(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 and anticipated trench loadings.

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

(D) **Tanks, pumps and service lines.** Septic tanks shall meet the design requirements of OAC 252:641 with routine maintenance. Septic tanks, pumps 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 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 a minimum of 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 pipes carrying settled effluent from septic tanks. 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 Treatment Systems, to separate solids.

(B) **Pumps.** Pump size must meet the volume and head conditions. Grinder pumps must be at least two-horsepower 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 applicable ASTM material class of bedding, which must be matched to the proper strength pipe to support the anticipated loads.

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

(d) **Manholes.** Specify the applicable ASTM standards for the manhole material, manhole installation and manhole testing to be used in the construction of the manholes. Bricks and/or concrete blocks will not be approved for manhole construction.

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. Install metal tracer wire and color code all pipe constructed.

(b) **Trench.** The width of the trench must 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 must be kept as nearly vertical as possible. When wider trenches are dug, appropriate bedding class and pipe strength must be used.

(2) Provide a minimum clearance of 4 inches between all pipe and any large stones, ledge rock, or boulders.

(3) Except for ductile iron pipe, provide 30 inches of soil cover as protection from traffic load damage to the pipe. Specify the applicable ASTM standards for ductile iron pipe.

(c) **Separation.** Sanitary sewers located in the street right-of-way 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); 300 feet from a public water supply well and 50 feet from a private water well; 10 feet from any existing or proposed water main; and 5 feet from electrical lines and petroleum lines. (See paragraph (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 as possible from the water mains.

(3) **Special conditions.** 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) **Stream crossings - aerial.** Support all joints in aerial crossings. Design 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 ductile iron pipe using mechanical joints. 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 shall 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 and cleanouts shall not be substituted for manholes nor installed at the end of laterals longer than 250 feet. See OAC 252:656-5-2(c)(4), Small diameter gravity sewers, 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. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert must be filleted to prevent solids deposition. For drop pipes constructed outside the manhole, the entire outside drop connection must be encased in concrete. Drop pipes constructed inside the manhole,

must be secured to the interior wall of the manhole and provide access for cleaning.

(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 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 gasket or other flexible watertight connection that allows for differential settlement of the pipe and manhole wall.

(5) **Watertight covers.** Use watertight covers on manholes that may become submerged.

(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 applicable ASTM standard for the test to be used.

(h) **Inverted siphons.** Inverted siphons must have at least two barrels with a pipe size at least 6 inches in diameter. Provide necessary appurtenances for convenient flushing and maintenance. 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 is diverted to one barrel and either barrel may be taken out of service for cleaning. The vertical alignment must 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 must 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. Tests must be performed without mechanical pulling devices. Specify the applicable ASTM standard for the test to be used.

(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 must not exceed 10 gallons per inch of pipe diameter per mile per day. Specify the applicable ASTM standard for the test to be used. The procedures listed in the *Handbook of PVC Pipe,* Uni-Bell PVC Pipe Association, 2001 may be used for PVC pipe. An air test result must assure a leakage limit equivalent to the hydrostatic test limit.

SUBCHAPTER 7. PUMP STATION STANDARDS

Section

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 252:656-7-4.

(2) **Separate wells.** Wet and dry wells ~~shall~~ must be completely separated, each with its own entrance.

(3) **Equipment accessibility and safety.** Provide a suitable stairway or ladder for dry wells and for wet wells with bar screens or mechanical equipment. Adequate provision must be made to effectively protect maintenance personnel from hazards. Equipment for confined space entry in accordance with OSHA and regulatory agency requirements must be provided for all wastewater pumping stations. The design of the system must 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 must prevent unauthorized access or vandalism to control system and equipment.

(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 and shall not be located in a flood way. Wastewater pumping stations shall remain fully operational and accessible during the 25 year flood. Regulations of state 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.
(8) **Pump station accessibility and security.** The pumping station must be readily accessible by maintenance vehicles during all weather conditions and must be located off the traffic ways of streets and alleys.

(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 is installed.
(3) **Pump openings.** Pumps, other than grinder type pumps, 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) **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) **Stream crossings.** Force main construction used for stream crossings must 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 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.
(9) **Valves.** Place suitable shutoff 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.

(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 the applicable ASTM standard specifications. The design working pressure of the pipe must not exceed 2/3 of the rated pressure of the pipe. Specify the applicable ASTM standard to be used.

252:656-7-2. Suction lift pumps

The pump equipment compartment shall be above grade or offset and effectively isolated from the wet well. Wet well access shall not be through the equipment compartment. Valving shall not be located in the wet well. The combined total of dynamic suction lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 22 feet.

(1) Self-priming pumps shall be capable of rapid priming and repriming at the "lead pump on" elevation. Suction piping should not exceed the size of the pump suction and shall not exceed 25 feet in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 4 feet from the maximum allowable priming lift for the specific equipment at design operating conditions.

(2) Vacuum-priming pump stations shall be equipped with dual vacuum pumps capable of automatically and completely removing air from the suction lift pump. The vacuum pumps shall be adequately protected from damage due to sewage.

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. 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.** 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 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 on-site standby generator with automatic means of activation in the event of a power failure;

(2) a portable engine-driven pump with a quick connection to the force main; four hours of emergency storage at the average 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;

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

(4) an on-site engine-driven pump with one hour of emergency storage at design flow above the alarm level and an automatic means of activation; or

(5) a portable engine-driven generator with four (4) hours of emergency storage at the design flow above the alarm level, a telemetry alarm system that communicates to the person in charge of the lift station, and a transfer switch with electrical system components that comply with the National Electrical Code requirements that is pre-wired to allow for a ready connection between the lift station and the portable generator.

(b) **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.

(D) **Telemetry.** Connect a telemetry alarm system from the engine-driven pump to the city office or cell phone during working hours and to the home or cell phone of the person(s) in responsible charge of the lift station during off-duty hours.

(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.** General construction of overflow basins shall be in accordance with 252:656-11-3.

(d) **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

Section

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. The minimum separation distance from any public water supply well is 300 feet. The minimum distance requirements from any public water supply intake structure will be determined on a case by case basis. No part of any wastewater treatment or conveyance unit 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 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.

252:656-9-2. Essential facilities

(a) **Emergency power facilities.** All plants shall provide standby equipment which will generate electric power to allow continuity of operation, including but not limited to pumping, aeration and disinfection, during power failures.

(b) **Water supply.**

(1) **General.** Provide potable water under pressure to laboratories, restrooms, offices, drinking fountains and showers. 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 a reduced pressure zone backflow prevention device will be considered in lieu of the break tank. 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) **Non-potable water outlets.** Post a permanent sign at non-potable water outlets indicating the water is not safe for drinking.

(c) **Laboratory equipment.** All treatment works shall have access to a laboratory for making analytical determinations and operation control tests.

(d) **Sewage flow measurement.** 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. Every primary flow measurement device must conform to the standard guidelines in the *Water Measurement Manual,* 3rd Edition, published by the United States Department of the Interior, Bureau of Reclamation. An equivalent set of standard guidelines may be used, if approved by the DEQ. Every primary measurement device, sharp crested weir or flume, must be equipped with an affixed staff gauge to measure the liquid level and placed at the proper head measurement location. For continuous flow measurement, the level sensor must be placed at the proper head measurement location equivalent to the location of the staff gauge so that the head measured using the staff gauge and that measured by the sensor are the same.

(1) **Influent flow.** Provide for the measurement of incoming flow at all non-industrial wastewater treatment plants. Where all incoming flow to a plant having a design flow of less than 0.5 mgd is through a single pump station, flow measurements may be satisfied by the calibration of pumps and the installation of run-time meters. Weirs must not be used to measure influent flow.

(2) **Effluent flow.** For discharging systems, provide for the measurement of wastewater effluent flow in accordance with the system's OPDES permit and OAC 252:606. For lagoon effluent, a baffle shall be provided to prevent the discharge of surface debris and algae to a depth of at least one foot (1') below the weir crest.

(3) **Land application.** For land application systems, effluent flow measurement shall be in

accordance with OAC 252:656-25-2(h).

(4) **Closed channel flow measurement.** Provide the complete design information and calculations for all closed channel flow measurement devices.

(e) **Housed facilities.** Where treatment units are in a housed facility, introduce fresh air continuously at a rate of 12 air changes per hour, or intermittently at a rate of 30 air changes per hour. 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.

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. Provide the following when designing outfall lines:

(1) Dispersion of the effluent across the stream as needed to protect aquatic life; and

(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. 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 the line into the reservoir. Anchor 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 with easy access for obtaining effluent samples during all weather conditions at a point after the final treatment process and before it reaches the receiving waters.

SUBCHAPTER 11. LAGOON STANDARDS

Section

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 groundwater 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.

252:656-11-2. Basis of design

(a) **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 BOD 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. Flow-through lagoon systems will not consistently provide ammonia removal through the nitrification process so the effluent from these facilities may be toxic to aquatic life and thus cause whole effluent toxicity test failures.

(2) **Flow Control.** Provide at least two primary cells on new systems. Design the primary cells so they may be operated in either series or in parallel, with at least 60 days retention time. 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 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 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 wastewater on an organic loading of 35 lbs BOD per surface acre per day at the average operating depth. Provide sufficient area to evaporate the annual 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, as contained in Appendix E.

(d) **Aerated lagoon systems.** The following apply to all new aerated lagoon systems. 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. Aerated lagoon systems will not consistently provide ammonia removal through the nitrification process so the effluent from these facilities may be toxic to aquatic life and thus cause whole effluent toxicity test failures.

(1) **Number of cells.** At least two aerated cells, in series, followed by one settling lagoon and provide a hydraulic retention time of at least two days.

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

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

(4) **Aeration requirements.** Oxygen requirements will depend on organic loading, required treatment, and concentration of suspended solids to be maintained in the aerated 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 O_2/lb ~~BOD_5~~ BOD applied at maximum loading.

(5) **Additional information.** For a more detailed discussion of aerated lagoon design see *Design Manual Municipal Wastewater Stabilization Ponds*, U.S. Environmental Protection Agency, EPA-625/1-83-015 (1983). Also use *Wastewater Engineering: Treatment, Disposal & Reuse*, Metcalf & Eddy, Inc., 4th Edition, (2003).

(6) **Disinfection.** Disinfection shall be required for all lagoon systems proposed to discharge to "waters of the state" where the beneficial use of the receiving water body is designated in Oklahoma's Water Quality Standards (OAC 785:45) as either "Primary Body Contact Recreational" or "Public or Private Water Supply".

252:656-11-3. Lagoon construction details

(a) **Soil borings.** Accurately represent the soil characteristics. Provide soil boring data conducted by an independent soil-testing laboratory. Borings shall extend at least 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 corresponding geological formation(s). Include a map showing the location of each boring, 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 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 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 rounded corners, with a length not more than three times the width constructed without islands, peninsulas or coves.

(6) **Erosion control.** Protect inner dikes from wave action and outer dikes from runoff and floodwaters.

(A) **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. 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.

(B) **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) **Lagoon seal.** The seepage rate through the lagoon bottom and inside dike shall not exceed 500 gal/day/acre (5.4 x 10^{-7} 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 exceed this seepage rate, then a 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 x 10^{-7} 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 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} cm/s. The soil seal shall be applied in lifts no greater than 6 inches.

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

(i) the number of samples taken;

(ii) a map of the location of the samples taken; and

(iii) a demonstration that the location and number of samples taken are representative of the seal of the lagoon, for both the bottom of the lagoon and all sides of the lagoon dike walls.

(2) **Bentonite seal.**

(A) The application rate shall 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 shall 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 3-inch lifts for a finished compacted blanket thickness of at least 6 inches.

(D) After mixing and compacting, analyze a sample of the soil/bentonite mixture for permeability. If the coefficient of permeability exceeds 10^{-7} 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 project engineer and independent soils laboratory. The written certification shall include:

(i) the number of samples taken;

(ii) a map of the location of the samples taken; and

(iii) a demonstration that the location and number of samples taken are representative of the seal of the lagoon, for both the bottom of the lagoon and all sides of the lagoon dike walls.

(3) **Synthetic liner.**

(A) The liner shall be at least 30 mil (0.030 inch) thick, unless the lagoon is subject to heavy traffic, then the liner shall be at least 60 mil (0.060 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) **Influent lines.** Influent lines shall terminate in a 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.** Raw sewage distribution lines may be placed on the surface of the lagoon bottom. Anchor 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.

(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.

(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 interlocking 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;
(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 must allow for a minimum of 250 percent of the design flow of the system.

(B) **Minimum pipe size.** All piping within the lagoon shall be at least 12 inches in diameter for facilities serving 100 PE or more and at least 8 inches for facilities serving less than 100 PE. Design influent pipe for rodding. Protect all piping between 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.

(e) **Pond level gauges.** A pond level gauge to measure the water level in a lagoon shall be installed.

SUBCHAPTER 13. PRELIMINARY TREATMENT STANDARDS

Section

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 a platform with suitable drainage and ample facilities for removal, handling, storage and disposal of screenings.

252:656-13-2. Grit chambers
(a) **Where required.** Grit chambers are required at all mechanical sewage treatment plants, ahead of pumps and other equipment that may be damaged by grit.
(b) **Outside facilities.** Protect grit removal facilities located outside from freezing.
(c) **Chamber design.**
(1) Rectangular horizontal-flow grit chambers shall be designed to regulate velocity to minimize organic matter deposition. Channels shall be designed for velocities of 0.8 to 1.3 fps, with a total detention time of 20 seconds to one minute.
(2) Aerated grit chambers shall be designed for a detention time of two (2) to five (5) minutes. Aerated grit chambers shall be sized in accordance with Appendix A.
(d) **Grit washing.** Provide 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.
(e) **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.
(f) **Grit disposal.** Provide for the removal, handling, storage and disposal of grit.
(g) **Vortex-type grit chambers.**
(1) The flow into the grit chamber shall be through a straight and smooth channel. The length of the inlet channel must be at least seven (7) times the width or fifteen (15) feet, whichever is greater.
(2) Total detention time in the chamber at design flow is thirty (30) seconds.
(3) The equipment specifications shall identify the required grit removal rates. Removal rates shall be based on the equipment manufacturer's specifications for downstream processes and meet the following minimum criteria:
(i) 95% removal rate for 50-mesh grit.
(ii) 85% removal rate for 70-mesh grit.
(iii) 65% removal rate for 100-mesh grit.
(4) Provide a propeller with a variable speed drive to operate the unit based on the plant flow.
(5) Provide air or water scour to loosen compacted grit and facilitate the grit lifting and removal from the chamber.
(6) Provide inclined screws, conveyors, chain elevators or pumps to lift the grit from the chamber and transfer the grit to the washing and separating facilities. Air or suction lift pumps shall not be used for this purpose.
(7) Automatically controlled grit lifting, washing and separating equipment with the ability to manually override.

252:656-13-3. Diurnal flow equalization

(a) **General.** Provide flow equalization basins to equalize variations in organic and hydraulic loadings where large diurnal organic or hydraulic 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 252:656-13-4.
(b) **Location.** Locate basins downstream of pretreatment facilities such as bar screens and grit chambers.
(c) **Size.** Capacity must be sufficient to reduce expected flow and load variations to less than or equal to 2:1. 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 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 shall 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) **Basin type.** For gravity inlet systems, provide flow splitting or automated flow diversion devices to divert excess flows to the flow equalization basin(s). Design shall include a method to return contents to primary basins. For pumped systems, installation of control valves or dedicated pumps to handle wet weather flow shall be 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 layout.** Basins designed for storage of 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.
(d) **Basin construction.** Basin construction must be in accordance with OAC 252:656-11-3 and OAC 252:656-11-4 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 compartments, 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 anticipated excess flow during the largest seven-day wet weather period in 10 years, with the capability to be emptied in a timely manner. Actual flow data shall be used to develop flow balance or mass diagrams for determining basin capacity. Base the frequency and duration of storms on field data and weather service records.
(f) **Aeration requirements.** Where oxygen is required to prevent the wastewater from becoming anaerobic 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 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 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]

Section

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

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

252:656-15-3. Biological nutrient removal [REVOKED]

SUBCHAPTER 16. BIOLOGICAL TREATMENT STANDARDS

Section

252:656-16-1. Suspended growth systems
(a) **General.** Suspended growth wastewater treatment systems generally consist of one or more basins where incoming wastewater is mixed with mixed liquor suspended solids and aerated for a period of time. The mixed liquor suspended 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 know 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 must be preceded by primary treatment in the form of a primary clarifer(s) in accordance with 252:656-17. 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 basins.**

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

(2) **Arrangement of aeration basins.**

(A) **Basin 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) **Basin lining.** Line earthen aeration basins 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 basin 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 basins. 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) **CBOD removal.** Where data is not available, the design oxygen requirement for the activated sludge process is 1.1 lb O_2/lb peak BOD applied to the aeration basins. For the extended aeration process, the requirement is 1.8 lb O_2/lb peak BOD.

(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 at peak diurnal flow. Assure sufficient alkalinity to maintain pH as required by 252:656-16-3 (b)(3). If the alkalinity is not sufficient, then chemical addition must be required.

(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 for aeration basin loading. For the extended aeration process the value is 2,000 ft^3/lb peak BOD 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 basin, and designed to allow spacing adjustment without major revisions to the air header piping. All plants using less than four aeration basins must be designed to incorporate removable diffusers that can be serviced and/or replaced without dewatering the basin.

(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 mixed liquor suspended 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 three (3) reactors. Design each reactor to operate in a cyclic mode with sufficient time to fill, aerate, settle and remove the clarified liquid.
(A) Organic loading shall 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 specific gravity 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 minimum 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 and grit removal facilities are required. 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 hydraulic detention time at average dry weather flow. Organic loading may range from 12 to 15 pounds BOD per 1,000 ft^3/day.
(B) Depth shall be at least 3 feet.
(C) Freeboard shall be at least one foot at maximum water depths.
(D) Aeration equipment shall 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 shall 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.
(h) **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 to
(ii) 75% maximum
(B) Carbonaceous Stage of Separate Stage Nitrification:
(i) 15% minimum to
(ii) 75% maximum
(C) Step Aeration:
(i) 15% minimum to
(ii) 75% maximum
(D) Extended Aeration:
(i) 50% minimum to
(ii) 150% maximum
(E) Nitrification Stage of Separate Stage Nitrification:
(i) 50% minimum to
(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 shall be at least 3 inches in diameter. Further, air compressors shall 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 clarifier.
(i) **Waste sludge facilities.** Waste sludge control facilities shall have a maximum capacity of not less than 25 percent of the average rate of sewage flow and function satisfactorily at rates of 0.5 percent of average sewage flow or a minimum of 10 gpm, whichever is larger.
(j) **Measuring devices.** Install a means to measure flow rates of raw sewage, primary effluent, waste sludge, return sludge, and air to each basin unit.

252:656-16-2. Attached growth systems
(a) **Rotating biological contactors (RBC).** An RBC can only be installed to replace or to add to an existing 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 clarifiers 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 be installed to pretreat high-strength waste only, or to add to or replace existing trickling filters. Provide primary clarifiers with scum and grease collecting devices before filters so the influent will be relatively free from settleable, floating, or suspended matter. Design secondary clarifiers to meet the criteria of Appendix B of this Chapter.

(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. For design criteria, 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.** Plastic media or its approved equivalent shall be used. 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 depth for standard rate filters must be 6 to 8 feet deep and, for high rate filters, from 10 to 30 feet. Depths that deviate from the above criteria must be justified by a pilot study.

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

(A) **Hydraulic capacity and ventilation.** Underdrains shall 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.

(7) **Dosing rate.** The dosing rate on a trickling filter is the depth of liquid discharged on top of the packing for each pass of the distributor. For a standard rate filter, the dosing rate shall be in the range of 0.4 inches per pass to 1.2 inches per pass. For high rate filters, the rate shall be in the re range of 0.6 inches per pass to 7.0 inches per pass.

(c) **Whole effluent toxicity failures.** Attached growth systems may not consistently provide ammonia removal through the nitrification process so the effluent from these facilities may be toxic to aquatic life and thus cause whole effluent toxicity test failures.

252:656-16-3. Biological nutrient removal

(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).** Design processes according to the requirements of 252:656 and submit all design calculations. The following factors will have a significant impact on the nitrification process: ammonia and nitrite concentrations, BOD/TKN ratio, dissolved oxygen concentration, temperature, alkalinity and pH. The following steps shall be considered in the design of the suspended growth reactor and the resulting calculations submitted to DEQ for review. If actual kinetic coefficients cannot be obtained, textbook values may be used for design.

(1) 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).

(2) 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 O_2/mg N oxidized.

(3) Evaluate the requirement for pH control. Every mg/l of ammonium-nitrogen (NH_4-N) oxidized will result in the destruction of 7.14 mg/l alkalinity.

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

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

(6) Predict the effluent nitrogen concentration.

(7) 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.

(c) **Separate-stage nitrification.** Design processes according to the requirements of 252:656 and submit all design calculations. Separate-stage suspended growth nitrification processes are similar in design to the activated sludge process. Show the process factors, considering the following:

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

(2) Nitrification rates increase as the temperature increases.

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

(4) Nitrification rates are affected by pH.

(5) Nitrification rates vary from 0.05 to 0.6 lbs. NH_4-N oxidized per pound of MLVSS.

(d) **Biological phosphorus removal.** Design proprietary processes and submit all design calculations according to the manufacturer's recommendations or *Wastewater Engineering: Treatment, Disposal & Reuse*, Metcalf & Eddy, Inc. 4th Edition (2003).

(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 shall be equipped with mechanical mixing devices. The detention period shall be at least 30 seconds.

(6) **Flocculation.** The particle size of the precipitate formed by chemical treatment may be very small. Consideration shall be given in the process design to the addition of synthetic polyelectrolytes to aid settling. The flocculation equipment shall 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 shall not exceed 1.5 feet per second in order to minimize floc destruction. Entrance works to settling basins shall also be designed to minimize floc shear.

(8) **Sludge handling.** For design of the sludge handling system, special consideration shall be given to the type and volume of sludge generated in the phosphorus removal process.

(9) **Filtration.** Effluent filtration shall be provided where effluent phosphorus concentrations of 1 mg/l or less must be achieved.

SUBCHAPTER 17. CLARIFIER STANDARDS

Section

252:656-17-1. General considerations [REVOKED]

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) **Primary clarifier design criteria.** Primary clarifiers shall be placed downstream of flow distribution devices. Surface settling rates for primary tanks shall not exceed 1,000 gal/ft^2/day at design average flows or 1,500 gal/ft^2/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. 4th Edition (2003). The primary clarifier must have a minimum side water depth of twelve feet (12'). 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) shall be determined by laboratory tests and consideration of the quantity and character of the wastes.

(c) **Secondary clarifier design criteria.** See 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. When scum ports in the inlet diffusion well baffle are provided, the elevation of the bottom edge of the ports shall be no lower than 0.10 feet below the elevation of the crest of the overflow weirs.

(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/linear 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 shall not exceed 15,000 gal/linear 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 the necessary piping and equipment to permit complete dewatering to the floor for the bypassing of individual units for maintenance and repair.

(5) **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 clarifiers 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 diameter if round, or 2 feet on any side if square. 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

Section

252:656-19-1. Design considerations

This Subchapter establishes design criteria for converting sludge from municipal wastewater treatment processes to biosolids that will meet at least one of the processes to significantly reduce pathogens ("PSRPs") (Class B) of the 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 252:521 if landfilled. Processes to further reduce pathogens ("PFRPs") (Class A) may be proposed and will be evaluated and approved using a composting procedure pursuant to the requirements of OAC 252:606. Any other process from converting municipal sludge to biosolids will be reviewed and may be approved by the DEQ on a case by case basis. A sludge management plan shall be approved by the DEQ 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.

252:656-19-1.1. Process selection

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 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). 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. 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 shall be heated, through the controlled biological decomposition of organic material, and maintained at a temperature 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.

(A) **Completely-mixed systems.** Provide sufficient mixing to prevent stratification and to assure homogeneity of digester content. Active digestion units may be loaded with volatile solids at a rate up to 80 lb/1,000 ft^3 tank volume/day.

(B) **Moderately-mixed systems.** For systems where mixing is accomplished only by circulating sludge through an external heat exchanger, the 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

(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.

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

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

(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.

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

(e) **Supernatant withdrawal.**

(1) **Piping size.** Supernatant piping shall 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, designed to return the flow back to the headworks.

(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.**

(1) The sludge shall be heated, through the controlled biological decomposition of organic material, and maintained at a temperature 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.

(2) Provide a temperature probe and recording device to continuously record digester temperature.

252:656-19-3. Aerobic sludge digestion

(a) **General.** 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 1,000 PE or more. Treatment plants, designed for less than 1,000 PE, may use a single unit if adequate provisions are made for sludge handling and redundancy.

(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 ft^3/min/1,000 ft^3 tank volume shall be maintained with the largest blower 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 ft^3 tank volume per day.

(e) **Time and temperature.** 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 1 foot vertical to 4 feet horizontal.

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

(a) **Sludge pumps.**

(1) **Duplicate units.** Provide 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 on-site sludge dewatering facility shall be provided at all plants and, at a minimum, shall provide the following:

(1) **Sludge drying beds.**

(A) **Area.** Provide all design analyses for dewatering systems. 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.**
(i) **Gravel.** 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.
(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) **Partially paved type.** Provide for the removal of dried sludge with mechanical equipment.
(D) **Walls.** Walls shall be watertight and extend 15 to 18 inches above and at least 6 inches below the sand surface. Outer walls shall extend at least 6 inches above the surrounding ground elevation.
(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 shall be on 20-foot centers.
(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) **Sludge dewatering container filters (sludge boxes).** Provide sufficient capacity for container dewatering facilities to dewater all sludge produced with the largest unit out of service. Sludge dewatering container filters shall be constructed out of non-corrosive material and designed in accordance with manufacturer's recommendations. Provide adequate storage facilities unless other standby facilities are available.
(3) **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.
(4) **Liquid return.** Provide for the return of all drainage from beds or filtrate from dewatering units to plant head works.
(5) **Sludge conditioning.** Sludge conditioning shall be required for container filters and/or mechanical dewatering facilities. Provide for coagulant feed and commercial in-line static mixers for sludge conditioning.

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 digestion 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 shall be designed to operate as either a batch or continuous flow process. The following items shall be addressed 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 shall 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 required, and shall 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 provide continuity of service during freezing weather conditions.

(5) **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

For systems that land apply biosolids, design on-site temporary sludge storage facilities to hold the sludge volume produced during a three-month period. 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. 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 headworks of the treatment system. 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

Section

252:656-21-1. Disinfection criteria

(a) **Design considerations.** The standards in this section apply to all disinfection systems. Disinfection shall be required to meet coliform limits in the Water Quality Standards. Other disinfectants may be individually approved, such as chlorine dioxide, ozone or bromine.

(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~~ Fahrenheit.

(c) **Alarms.** Provide alarms to warn of equipment failures and leaks.

(d) **Backups.** Provide standby equipment to replace the largest unit based on peak hourly flow. Provide spares for all parts that may break or wear.

(e) **Chlorine 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.

(3) **Contact tank.** Construct chlorine contact tanks to minimize short-circuiting. "Over-and-under" or "end-around" baffling shall be provided to reduce short-circuiting. Design the tanks for easy maintenance and cleaning without 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.

(f) **Gas chlorine 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. 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 shatter resistant, clear glass, gas-tight window in an exterior door or interior wall of the chlorinator room so the units can be viewed without entering the room.

(3) **Heating.** Heat disinfection equipment rooms to maintain at least 60 degrees Fahrenheit. 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. The entrance to the room exhaust duct shall be near the floor, and the point of discharge shall 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 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. 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 requirements are for the chlorination of domestic sewage. The equipment must be capable of supplying the following dosage:

(1) Trickling filter plant effluent - 10 mg/l;
(2) Activated sludge plant effluent - 8 mg/l;
(3) Tertiary filtration effluent - 6 mg/l;
(4) Nitrified effluent - 6 mg/l.

(b) **Water supply.** Provide an ample supply of water to operate the chlorinator, and protect it according to OAC 252:656-9-2(b). Back up any booster pumps, according to the power requirements of OAC 252:656-9-2(a).

(c) **Scales.** Provide corrosion-resistant scales to weigh chlorine gas cylinders. Provide at least a platform scale. Provide a recording device for the weight of the chlorine gas cylinders for installation where one-ton cylinders or larger are used.

(d) **Containers.** One-ton containers or larger are required 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, include caustic soda solution reaction tanks to absorb leaks. 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 252:656-11-4 (g).
(k) **Dechlorination.** All chlorinated effluent must be dechlorinated and discharges must be less than 0.1 mg/l total residual chlorine.

(1) **Equipment.** Do not chlorinate and dechlorinate with the same units. Handle aqueous solutions of sulphite or bisulfite with positive displacement pumps. Sulfur dioxide (SO_2) 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. 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.** Mechanical mixers are required unless the design will provide hydraulic turbulence to assure thorough and complete mixing.
(3) **Sulfonator water supply.** Provide an ample supply of water to operate the sulfonator, and protect it according to OAC 252:656-9-2(b). Back up any booster pumps, according to the power requirements of OAC 252:656-9-2(a).
(4) **Housing.** Storage and feed equipment for SO_2 shall be in a separate room from chlorine gas storage and feed equipment. The same storage requirements apply to SO_2 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. Ultraviolet radiation disinfection
(a) **Application.** The effluent to be disinfected shall 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 μWsec/cm^2 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 effluent absorbance is required. Include appropriate alarms, power meters, on/off indicators, elapsed time monitors, lamp output monitors, intensity indicators, 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 ballasts 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 [REVOKED]

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/ft^2 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/ft^2 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 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.

252:656-23-2. Disc filters

(a) **Back-up power.** Provide a back-up power source that meets the requirements of 252:656-9-2 (a).

(b) **Flocculation.**
(1) Design chemical feed equipment to meet the plant peak demand with the largest unit out of service and the ability to proportion chemical feed rates based on the plant flow.
(2) Ensure the rapid dispersion and mixing of chemicals throughout the wastewater by providing mechanical or in-line static mixers.
(3) Provide a minimum of two flocculation basins. Equip each basin with variable speed drives to control the speed of the paddles.
(4) Equip each basin with a drain line at least 6 inches in diameter capable of draining it to the head of the plant.

(c) **Filters.**
(1) Provide a minimum of two disc filter units capable of independent operation.
(2) The size of the opening in the screen material must be between 20-30 µm.
(3) Base the design on a hydraulic loading rate of 0.80 ft^3/ft^2-min.
(4) Equip the filter drum motor with a variable speed drive capable of adjusting the motor speed based on the plant flow.
(5) Provide a minimum of two backwash pumps. Base the backwash rate, pressure, backwash water storage on the disc filter manufacturer recommendations.
(6) The disc filter and backwash operation must be managed by an automated control system with the ability to manually override the automated settings.
(7) Each unit shall be equipped with a level sensor to initiate the backwash cycle. The design of each unit shall also include a high water level sensor with a telemetry system capable of alerting the person(s) in responsible charge, in case of equipment failure.
(8) Equip each filter unit with a drain line at least 6 inches in diameter capable of draining the basin to the head of the plant.
(9) The specifications shall require the equipment manufacturer to provide the following:
(A) Monitor the installation of the disc filter equipment.
(B) Equipment start-up and training of the plant personnel.

252:656-23-3. Post-aeration

(a) **Cascade aeration.** Cascade aeration may be used where site topography permits. 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.

(b) **Mechanical aeration.** Provide design calculations to meet Water Quality Standards effluent requirements.
(c) **Diffused-air aeration.** Provide design calculations to meet Water Quality Standards effluent requirements.

SUBCHAPTER 25. WASTEWATER LAND APPLICATION SYSTEMS

252:656-25-1. The slow rate land application process

Land treatment is the controlled application of wastewater to the surface of land to achieve a designed degree of treatment through natural, chemical and biological processes that occur on and in the soil. In Oklahoma, slow rate land application systems are acceptable for meeting the agronomic water needs of pasture land, hay meadows and for crop production where the crops will not be eaten raw. See Appendix D for the loading rate, field area and storage volume equations. Refer to Chapters OAC 252:619 and 252:621 for permit and operations criteria.

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 shall 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.** Disinfect the wastewater, in accordance with 252:656-21 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 shall be at least 90 days of storage in addition to the detention time required for primary treatment. The monthly available wastewater for each month shall be determined by equation (25-5) in Appendix D.
(h) **Flow measurement.** Provide for the measurement of wastewater to be land-applied. Flow measurement shall be accomplished by flow meters, or the calibration of pumps and installation of run-time meters.
(i) **Restrictions.** There shall not be any berms or other barriers on a land application site that would cause the pooling or ponding of wastewater at the land application site. Additionally, there shall not be any berms or barriers that impede the natural flow of stormwater from the site. No land application site shall exceed the maximum slope requirements at 252:621-5-2.

SUBCHAPTER 27. WASTEWATER REUSE [RESERVED]

APPENDIX A. DESIGN TABLES

OAC 252:656-13-2 (c) Aerated Grit Chambers:

Grit Chamber Measurement Units[a]		
Item	Unit	Range
Detention time at peak flowrate	Minutes	2-5
Dimension – Depth	Feet	7-16
Dimension – Length	Feet	25-65
Dimension – Width	Feet	8-23
Width to Depth Ratio	Ratio	From 1:1 to 5:1
Length to Width Ratio	Ratio	From 3:1 to 5:1
Air Supply per unit of Length	$Feet^3$ per minute per foot	3 – 8

[a]Chart from *Wastewater Engineering: Treatment, Disposal & Reuse*, Metcalf & Eddy, Inc., 4th Edition, (2003)

OAC 252:656-15-1(d)(3), Activated Sludge Aeration Basins:

AERATION TANK CAPACITIES & PERMISSIBLE LOADINGS FOR ACTIVATED SLUDGE PROCESSES			
Type of Process	Aeration Retention time[b]	Aeration Basin Loading[c]	F/M Ratio
	(Hours)	(lb BOD_5 per 1,000 ft^3/d)	(lb BOD_5/lb MLSS)
Conventional	6 – 8	30 - 40	0.25 - 0.50
Step Aeration	6 – 8	30 - 50	0.17 - 0.50
Extended Aeration/Oxidation Ditch	24	12 - 15	0.05 - 0.10

[b]Larger values for smaller plants, up to 5,000 “PE” design capacity
[c]Larger values for larger plants, over 5,000 “PE” design capacity

OAC 252:656-15-2(b), Trickling Filter Design:

DESIGN PARAMETERS FOR TRICKLING FILTERS				
	Hydraulic Loading		Organic Loading	
	gal/ft^2/day	Million gallons/acre/day	lbs BOD_5/1,000 ft^3 of media/day	lbs BOD_5/acre-ft of media/day
Standard Rate	45-90	2-4	5-12	218-523
High Rate	230-690	10-30	30-100	1300-4300

APPENDIX B. SECONDARY AND/OR FINAL CLARIFIER MINIMUM DESIGN CRITERIA

As used in Rule 252:656-17-2

Treatment Process*****	Surface Overflow Rate (gal/day/ft²)		Peak Solids Loading Rate*** (lb/day/ft²)
	Average Design Flow*	Peak Hourly Flow	
Conventional, trickling filter, step aeration, complete mix, and carbonaceous state of separate nitrification	600	1,200**	40
Extended aeration and Single stage nitrification	400	1,000	35
Two-stage nitrification	400	800	35
Activated sludge with chemical addition to mixed liquor to remove Phosphorus to less than 1.0 mg/l	400	900****	35

* Based on influent design flow only

** Plants needing to meet 20 mg/l suspended solids should reduce surface overflow rate to gal/day/ft2

*** Base the clarifier peak solids loading rate on the design maximum day flow rate plus the design maximum return sludge rate requirement and the design MLSS under aeration

**** When phosphorus removal to a concentration of less than 1.0 mg/l is required

***** All clarifiers must have a minimum side water depth of 12 feet

APPENDIX C. CASCADE AERATION

Formulas that may be used to determine the required cascade height (see rule 252:656-23-3):

(23-1)

$$r = \frac{(C_s - C_0)}{(C_s - C)}$$

(23-2)

$$h = \frac{(r - 1)}{[0.11\ ab\ (1 + 0.046\ T)]}$$

where:

r = The deficit ratio

C_s = DO saturation concentration of the wastewater at temperature T, mg/l

C_o = DO concentration of water before aeration, mg/l

C = Required DO concentration after aeration, mg/l

a = Water quality parameter equal to 0.8 for a wastewater treatment plant effluent

b = Weir geometry parameter equal to unity for a free weir, 1.1 for steps, and 1.3 for the step weirs

T = Water temperature in degrees ^oC

h = Total height in feet through which water falls.

APPENDIX D. SLOW-RATE LAND APPLICATION

Referenced in Subchapter 25 of Chapter 656

1. Hydraulic loading based on soil permeability

The general water balance equation is based on a monthly time period. With applied wastewater runoff assumed to be zero, the equation is:

(**Equation 25-1)** $L_W = ET - Pr + P_W$

where L_W = wastewater hydraulic loading rate

ET = evapotranspiration rate

Pr = precipitation rate

P_W = percolation rate

The basic steps in the procedure are:

(A) Estimate the monthly ET rate of the selected crop.

(B) Determine design precipitation for each month.

(C) Determine the maximum daily design percolation rate based on soil permeability analyses.

(i) **Evapotranspiration.** Consumptive water use by vegetation is also termed evapotranspiration (ET). Consumptive water use varies with the physical characteristics and the growth stage of the crop, the soil moisture level, and the local climate. Estimates of maximum monthly consumptive water use of many crops can be obtained from local agricultural extension offices or the NRCS (formerly SCS). Where this information is not available, it will be necessary to estimate evapotranspiration using temperature and other climatic data. Annual lake evaporation is a good estimate of evapotranspiration. The supplemental information Table of Rainfall and Evaporation Data may be used to estimate the amount of water expected to be lost through consumptive use. Water consumption by vegetation should be considered zero for months where vegetation is dormant or where there is no ground cover.

(ii) **Precipitation.** Determine design precipitation for each month based on a five year return period frequency analysis for monthly precipitation. Alternatively, use a 10 year return period for annual precipitation and distributed monthly based on the ratio of average monthly to average annual precipitation. Where local precipitation data are not available, the supplemental information Table of Rainfall and Evaporation Data may be used to estimate precipitation for the area.

(iii) **Percolation Rate.** Determine by field test the minimum clear water permeability of the soil profile. If the permeability varies over the site, determine an average minimum permeability based on areas of different soil types. The maximum daily design percolation rate is based on 4 to 10% of the minimum soil permeability. Use percentages on the lower end of the scale for variable or poorly defined soil conditions. Percolation rate of 4% of the permeability rate should be used when the permeability is less than 0.6 in/hr. Values up to 10% of the permeability may be used for soils having permeability rates greater than 2.0 in/hr. The maximum perc. rate shall not exceed 28 inches per year East of I-35, or 39 inches per year West of I-35.

(Equation 25-2) $P_{W(daily)}$ = permeability, in/h (24h/d) (4 to 10%)

(D) Calculate the monthly rate by multiplying the daily rate by the number of operating days during the month. Non-operating days may be due to:

(i) Crop management. Downtime must be allowed for planting, cultivation and harvesting.

(ii) Freezing temperatures. The design should allow for no application when the mean day temperature is less than 0º C (32º F).

(iii) Precipitation downtime is factored into the water balance computation and further adjustment is not necessary.

(iv) Where seasonal crops are grown, wastewater is not normally applied during the winter months. Design must account for all time periods when wastewater will not be applied.

2. Table 25 – Nitrogen uptake of selected crops

Forage Crop	**Nitrogen uptake**	
	Lbs/acre/year	(Kg/ha/year)
Alfalfa	200 - 601	(225 - 675)
Coastal Bermuda grass	178 - 601	(200 - 675)
Kentucky bluegrass	356 - 601	(400 - 675)
Reed canary grass	298 - 400	(335 - 450)
Tall fescue	134 - 289	(150 – 325)
Vetch	347	(390)
Field crops		
Corn	156 - 223	(175 – 250)
Barley	111 - 143	(125 – 160)
Cotton	67 - 160	(75 – 180)
Grain sorghum	120 - 223	(135 – 250)
Wheat	143 - 156	(160 – 175)

3. Hydraulic loading based on Nitrogen

The annual hydraulic loading rate based on nitrogen is determined by using equation **(25-3).** **Table 25** may be used to estimate nitrogen uptake for typical crops.

(Equation 25-3)

$$L_{W(n)} = \frac{(C_p)(Pr - ET) + (U)(4.416)}{(1 - f)(C_n) - C_p}$$

Where $L_{W(n)}$ = allowable annual hydraulic loading rate based on nitrogen limits, inches
Cp = percolate nitrogen concentration, mg/l. Maximum allowable value is 10 mg/l
Pr = design precipitation, in/yr
ET = evapotranspiration rate, in/yr
U = crop nitrogen uptake lb/ac/yr
f = fraction of applied nitrogen removed by volatilization, denitrification and storage. Unless actual data can be obtained, a value of 0.2 should be used.
Cn = applied wastewater nitrogen concentration, mg/l

Determine the hydraulic loading rate base on soil permeability and nitrogen requirements. System design approval will be based on the lower of the two rates.

4. Field area determination

The area required for wastewater application is determined using equation **(25-4)**. In areas where a significant loss of wastewater occurs from storage ponds, adjustments may be made to the field area requirement.

(Equation 25-4)

$$A = \frac{(Q)(1118)}{L_w}$$

Where A = field area, acres
Q = average daily wastewater flow, MGD
L_W = design hydraulic loading rate, ft/yr

5. Storage volume estimates

To estimate storage volume requirements:

(A) Develop a table to determ ine the storage requirement which accounts for the monthly hydraulic loading rate. (Enter the nitrogen loading rate if nitrogen is the limiting factor)

(B) Convert the volume of wastewater available each month by equation **(25-5).**

(Equation 25-5)

$$W_a = \frac{Q(D)(C)}{A_w}$$

Where W_a = monthly effluent available, inches/month
Q = daily effluent flow, MGD
D = number of days in the month
A_w = field area, acres
C = 36.8 acre-in/mg

(C) Compute the monthly net change in storage by subtracting the hydraulic loading rate from the available wastewater for each month.

(D) Compute the cumulative storage at the end of each month by adding the change in storage for each month to the accumulated quantity from the previous month. The computation should begin with the reservoir empty at the beginning of the largest storage period. (Note. If treatment lagoons are used for all or part of the storage, the lagoons liquid depth must be at least 2 feet at the beginning of the largest storage period)

(E) Compute the required storage volume using the maximum cumulative storage and the field area by

(Equation 25-6)

$$S_v = \frac{(A_w)(S_c)}{C}$$

Where S_v = required storage volume, ac-ft
A_w = field area, acres
S_c = maximum cumulative storage, from table
C = Conversion, 12 in/ft

Adjust the final sto rage design to account for net g ain or loss in volume from precipitation of evaporation.

SUPPLEMENTAL INFORMATION

Table of Rainfall and Evaporation Data by County

County	Rainfall * (in inches)	Average Pan Evaporaton (in inches)	Average Lake Evaporation (in inches)	County	Rainfall * (in inches)	Average Pan Evaporaton (in inches)	Average Lake Evaporation (in inches)
Adair	60.16	65	47	LeFlore	62.22	65	48
Alfalfa	39.50	90	62	Lincoln	45.12	80	57
Atoka	54.83	75	53	Logan	51.58	85	60
Beaver	28.31	90	62	Love	52.40	80	58
Beckham	36.66	90	64	McClain	49.04	85	60
Blaine	39.07	90	62	McCurtain	67.76	65	49
Bryan	56.75	75	54	McIntosh	55.66	70	52
Caddo	35.74	90	63	Major	29.32	90	63
Canadian	43.46	90	62	Marshall	58.62	75	55
Carter	50.54	80	58	Mayes	47.79	70	49
Cherokee	57.00	70	48	Murray	56.81	80	58
Choctaw	56.33	70	52	Muskogee	56.72	80	50
Cimarron	24.24	90	58	Noble	41.73	85	59
Cleveland	46.07	85	60	Nowata	48.74	70	51
Coal	60.94	75	55	Okfuskee	56.98	75	55
Comanche	42.29	90	64	Oklahoma	41.19	85	60
Cotton	40.86	90	64	Okmulgee	52.33	75	53
Craig	49.49	70	49	Osage	55.04	75	54
Creek	48.68	75	55	Ottawa	50.98	65	47
Custer	43.38	90	64	Pawnee	44.11	80	56
Delaware	55.88	65	47	Payne	45.52	80	52
Dewey	34.38	90	63	Pittsburg	59.27	75	58
Ellis	31.37	90	64	Pontotoc	52.13	75	56
Garfield	39.58	90	61	Pottawatomie	46.49	80	58
Garvin	46.32	80	59	Pushmataha	60.50	70	50
Grady	44.52	90	62	Roger Mills	37.90	90	64
Grant	40.07	90	60	Rogers	55.99	70	51
Greer	39.67	90	64	Seminole	54.34	75	55
Harmon	36.71	90	64	Sequoyah	61.50	65	48
Harper	25.46	90	62	Stephens	45.65	85	62
Haskell	59.46	70	49	Texas	22.07	90	62
Hughes	58.60	75	54	Tillman	40.43	90	64
Jackson	42.18	90	64	Tulsa	46.88	75	53
Jefferson	38.33	85	61	Wagoner	52.10	70	51
Johnston	94.89 49.89	75	55	Washington	44.65	70	53
Kay	40.74	80	58	Washita	36.93	90	64
Kingfisher	39.36	90	62	Woods	35.92	90	62
Kiowa	36.24	90	64	Woodward	27.26	90	62
Latimer	68.60	70	50	* Rainfall data is the 90^{th} percentile			

Source of data: OGS average rainfall data for 1988 – 1998; evaporation data from 1976 OSDH Design Guidelines

APPENDIX E. TABLE OF RAINFALL AND EVAPORATION DATA BY COUNTY

County	Rainfall * (in inches)	Average Pan Evaporaton (in inches)	Average Lake Evaporation (in inches)	County	Rainfall * (in inches)	Average Pan Evaporaton (in inches)	Average Lake Evaporation (in inches)
Adair	59.90	65	47	LeFlore	62.01	65	48
Alfalfa	38.12	90	62	Lincoln	46.13	80	57
Atoka	61.45	75	53	Logan	46.06	85	60
Beaver	28.57	90	62	Love	51.56	80	58
Beckham	32.86	90	64	McClain	48.08	85	60
Blaine	38.17	90	62	McCurtain	67.41	65	49
Bryan	55.60	75	54	McIntosh	59.39	70	52
Caddo	39.15	90	63	Major	35.22	90	63
Canadian	44.44	90	62	Marshall	55.70	75	55
Carter	50.87	80	58	Mayes	56.42	70	49
Cherokee	61.28	70	48	Murray	55.89	80	58
Choctaw	61.42	70	52	Muskogee	56.82	80	50
Cimarron	21.70	90	58	Noble	47.27	85	59
Cleveland	46.59	85	60	Nowata	50.93	70	51
Coal	64.06	75	55	Okfuskee	51.62	75	55
Comanche	42.08	90	64	Oklahoma	44.53	85	60
Cotton	44.22	90	64	Okmulgee	56.29	75	53
Craig	59.59	70	49	Osage	50.81	75	54
Creek	52.16	75	55	Ottawa	64.92	65	47
Custer	39.05	90	64	Pawnee	46.58	80	56
Delaware	62.82	65	47	Payne	44.24	80	52
Dewey	33.48	90	63	Pittsburg	54.33	75	58
Ellis	29.83	90	64	Pontotoc	49.44	75	56
Garfield	43.26	90	61	Pottawatomie	47.71	80	58
Garvin	45.02	80	59	Pushmataha	65.61	70	50
Grady	44.55	90	62	Roger Mills	35.52	90	64
Grant	44.11	90	60	Rogers	54.57	70	51
Greer	37.31	90	64	Seminole	52.15	75	55
Harmon	36.93	90	64	Sequoyah	55.66	65	48
Harper	29.66	90	62	Stephens	44.28	85	62
Haskell	61.04	70	49	Texas	24.53	90	62
Hughes	53.92	75	54	Tillman	41.14	90	64
Jackson	39.39	90	64	Tulsa	49.54	75	53
Jefferson	42.08	85	61	Wagoner	52.50	70	51
Johnston	61.46	75	55	Washington	49.79	70	53
Kay	46.96	80	58	Washita	40.55	90	64
Kingfisher	40.77	90	62	Woods	35.42	90	62
Kiowa	35.84	90	64	Woodward	31.93	90	62
Latimer	73.97	70	50	* Rainfall data is the 90th percentile			

Source of data: OGS average rainfall data for 1970 – 2004; evaporation data from 1976 OSDH Design Guidelines