CHAPTER 317: DESIGN CRITERIA PRIOR TO 2008
§§317.1 - 317.13, 317.15
Effective November 26, 2015

§317.1. General Provisions.

(a) Applicability and Purpose. This chapter applies to any wastewater collection system or wastewater treatment facility that collects, transports, treats, or disposes of wastewater, with final plans and technical specifications submitted on or before August 28, 2008, that is not subject to the requirements of Chapter 217 of this title (relating to Design Criteria for Domestic Wastewater Systems). Wastewater collection systems and wastewater treatment facilities that are subject to this chapter shall meet all requirements of these rules no later than 120 days after the effective date of this chapter. These design criteria are minimum requirements to be used for the comprehensive consideration of domestic sewage collection, treatment, or disposal systems and establish the minimum design criteria pursuant to existing state statutes pertaining to effluent quality necessary to meet state water quality standards. These criteria are intended to promote the design of facilities in accordance with good public health and water quality engineering practices. These criteria include the minimum requirements for a preliminary engineering report which provides the general engineering concepts underlying the proposed project as well as the final engineering report detailing the fully developed project along with related plans and specifications. All wastewater treatment facilities, treatment units, collection systems, and collection system units must be installed, operated, and maintained: to ensure the safety of the public and all individuals authorized to be in or around a wastewater treatment facility, treatment unit, collection system, or collection system unit; to function as described in the engineering report and the associated plans and specifications approved by the executive director; and to ensure continuous compliance with applicable statutory and regulatory requirements.

(1) Authority for requirement. The Texas Water Code (TWC) prescribes the duties of the commission relating to the control of pollution including the review and approval of plans and specifications for sewage disposal systems. This authority is found in TWC, §§5.013, 12.081 - 12.083, 15.104, 15.114, 26.023, 26.034, 49.181 - 49.182, 54.024, and 51.333.

(2) Review of plans and specifications. Plans and specifications shall meet the design criteria and the operation, maintenance, and safety requirements for the proposed project as provided by this chapter. Approval given by the executive director, or a participating municipality with review authority as provided for in paragraphs (5) and (6) of this subsection, shall not relieve the sewerage system owner or the design engineer of any liabilities or responsibilities with respect to the proper design, construction, or authorized operation of the project in accordance with applicable commission rules.

(3) Submittal requirements.

(A) "Sanitary sewer collection system projects," which will be constructed within the jurisdiction of a municipality which performs technical reviews of sanitary sewer collection system projects under TWC, §26.034, and which are not prepared by the staff of a municipality, need not be submitted to the agency for review.

(B) "Sanitary sewer collection system projects," which are prepared by the staff of a municipality, which will be constructed within the jurisdiction of a municipality which performs technical reviews of sanitary sewer collection system projects under TWC, §26.034, and where the entire project falls into one or more of the categories outlined in clauses (i) - (iii) of this subparagraph, need not be submitted to the agency for review.

(i) Any conventional gravity sewer collection system lines less than 1,500 linear feet in length which are extensions to existing systems where the existing system has been completed and in operation at least six months;

(ii) Any duplex lift stations which have a firm pumping capacity of less than 100 gallons per minute; and

(iii) Any conventional gravity sewer piping less than 12 inches in diameter.

(C) "Domestic wastewater projects" which receive a technical review and approval from a state agency other than the commission need not be submitted to the agency for review, if:

(i) the review is performed under the supervision of a professional engineer registered in the State of Texas, the review ensures that the project complies with this chapter, and the state agency has requested that the commission not perform technical reviews of a wastewater project or category of projects; or

(ii) the state agency has been granted review authority in lieu of the commission under state law.

(D) A summary transmittal letter shall be submitted, by certified mail, to the Wastewater Permits Section, and to the appropriate commission regional office, for all wastewater projects constructed in the State of Texas, which are not exempted from the commission's submittal requirements as detailed in subparagraph (A), (B), or (C) of this paragraph. If the executive director does not notify the person who submitted the summary that a review will occur, under subparagraph (E) of this paragraph, the project is deemed approved. The information in the summary shall be signed, dated, and sealed by a professional engineer registered in the State of Texas. All summaries shall include, at a minimum:

(i) the name and address of the design firm;

(ii) the name, phone number, and facsimile number of the design engineer;

(iii) the county(s) in which the project will be located with an identifying name for the project;

(iv) the name of the entity which proposes to own, operate, and maintain the project through its design life;

(v) the permit name and permit number of the relevant wastewater treatment facility;

(vi) a statement verifying that the plans and specifications are in substantial compliance with all the requirements of this chapter and which states that any deviations from the requirements are based on the best professional judgement of the registered professional engineer who prepared the project plans and specifications and final engineering design report; and

(vii) a brief description of the project scope which includes the specifics of the project, a description of deviations from the requirements of this chapter, including the use of nonconforming or innovative technology, and an explanation of the reasons for such deviations.

(E) Any project, for which a summary is submitted, is subject to review by the executive director. Factors to be used to determine whether a review will be performed include, but are not limited to, whether or not a non-conforming or innovative technology is being proposed, the stream segment in which the project is located, and the applicant's compliance record. If the executive director chooses to review a project, the design engineer will be notified in writing or by facsimile of the executive director's intent to review the project, within ten days of receipt of the summary. Upon receipt of the notification of intent to review, the design engineer shall submit to the executive director a complete set of plans and specifications and a complete final engineering design report. These submitted materials shall be sufficient to satisfy the executive director that the project is in compliance with this chapter. If the executive director reviews a project, any approval may be granted under paragraph (4) of this subsection. Construction may not commence until approval has been obtained.

(F) A complete set of plans and specifications, the final version of such plans and specifications with engineer's certification, a complete engineering design report, all change orders and test results, a copy of the written summary submitted to the executive director, and any written approvals granted by the executive director, a municipality, or another state agency, shall be maintained and kept by the permittee, or for collection system projects, person(s) responsible for management of the collection system, for at least three years from the date the engineer certifies to the executive director that the project is complete. These materials shall be submitted to the executive director, another state agency, or municipality upon request. Such materials must be readily available for inspection by the executive director's staff upon request during regular business hours.

(4) Types of approval. Regardless of the type of approval, constructed facilities when in operation are required to produce the quality of effluent specified in their discharge permit(s). The types of approvals described in subparagraphs (A) - (C) of this paragraph will be utilized by the commission or any other review authority.

(A) Standard approval. Plans and specifications found to comply with all applicable parts of these criteria and to conform to commonly accepted sanitary engineering design practices shall be approved for construction.

(B) Approvals of innovative and nonconforming technologies.

(i) Technologies considered to be nonconforming or innovative include ones not conforming to or addressed in the design criteria of this chapter.

(ii) If an approval for nonconforming or innovative technologies is requested, engineering proposals for processes, equipment, or construction materials not covered in these criteria shall be fully described in the submitted planning materials and the reasons for their selection clearly outlined. Processes considered to be nonconforming or innovative should also be supported by results of pilot or demonstration studies. Where similarly designed full scale processes exist and are known to have operated for a reasonable period of time under conditions similar to those suggested for the proposed design, performance data from these existing full scale facilities shall be required to be submitted to the executive director in addition to, or in lieu of, pilot or small scale demonstration studies. Any warranties or performance bond agreements offered by the process, equipment, or material manufacturers shall be fully described in the request.

(iii) Approvals of processes, equipment, or construction materials which are considered to be innovative or nonconforming will be granted only in cases where the commission or review authority determines, after an engineering evaluation of the supporting information provided in the submitting engineer's design report, that the technology will not result in a threat to public health or the environment.

(iv) The executive director or review authority may require the manufacturer or supplier to obtain and furnish evidence of an acceptable two-year performance bond from an approved surety which insures the performance of the innovative or nonconforming technology. The performance bond shall cover the cost of removal or abandonment of the innovative or nonconforming facility and equipment, replacement with previously agreed upon facilities or equipment, and all associated engineering fees necessary for the removal and replacement.

(v) Approval of innovative and nonconforming technologies may include a condition which states that after some predetermined period of time after the installation and startup of the innovative or nonconforming technology, requiring an engineering report to be submitted after start-up, detailing the performance of the nonconforming or innovative technology. The engineering report shall include unbiased calculations and data supporting the technology's performance; and written submittals from the design engineer and permittee which state that the nonconforming or innovative technology has satisfied its manufacturer's claims.

(C) Conditional approval. The executive director or review authority may grant approvals which contain detailed conditions, stipulations, or restrictions. Examples of such conditions and stipulations include, but are not limited to, testing requirements, reporting requirements, operational requirements, and additional installation and design requirements which may be necessary to ensure compliance with this chapter. Any conditional approval granted may be issued for a specific set of flow situations, wastewater characteristics, and/or required effluent quality. If a conditional approval is granted, both the sewage system owner and design engineer, as appropriate, shall be responsible for ensuring that the approval conditions outlined by the commission or review authority have been met.

(5) Municipalities performing technical reviews of sanitary sewer collection systems under TWC, §26.034, within 90 days of the effective date of this rule and/or within 90 days of a boundaries change, shall submit maps to the agency's Wastewater Permits Section detailing the boundaries of the review authority. If a municipality decides to perform technical reviews of sanitary sewer collection systems after the effective date of this rule, the municipality shall submit maps detailing the boundaries of the review authority, within the 30 days before starting these reviews. If at any time a municipality, which has chosen to implement this review authority, decides to cease review of sanitary sewer collection system plans and specifications, the municipality shall notify the executive director within 30 days of the date on which the

final plans and specifications review is expected to be performed. In order to meet the standards specified in TWC, §26.034, municipalities shall incorporate the items detailed in subparagraphs (A) - (E) of this paragraph into their review programs:

(A) The municipality's review and approval process shall ensure compliance with the rules of this chapter.

(B) All reviews performed by an employee of the municipality shall be conducted by a professional engineer, registered in the State of Texas, or the employee conducting the review shall be under the direct supervision of a professional engineer, registered in the State of Texas, who is ultimately responsible for the review and approval of each collection system submitted and installed in the municipality's jurisdiction.

(C) The responsible review engineer shall be either an employee of the reviewing municipality, or a consultant to the municipality, separate from the private consulting firm charged with the design work under review. For purposes of this section, the term "separate" means that the responsible review engineer is not employed by and does not receive compensation from the private consulting firm and from any of its parent companies, subsidiaries, or affiliates charged with the design. The municipality shall provide on request documentation of its agreements with private consultants sufficient to allow the agency to audit its compliance with this subsection.

(D) A participating municipality may review and approve engineering reports, plans, and specifications only for projects which transport primarily domestic waste within the boundaries of jurisdiction of that municipality. For each project approved for construction, the municipality shall issue an approval letter or other indication of the approval which clearly details the project being approved.

(E) The municipality shall maintain complete files of all review and approval activities carried out under its authority and shall make any existing project files available to the commission upon request and/or during audits performed in accordance with paragraph (6) of this subsection.

(6) The executive director may perform periodic audits of the review and approval process of municipalities which perform technical reviews of sanitary sewer collection systems in lieu of the commission, to ensure that the projects approved by the municipalities are in compliance with this chapter. If the executive director decides to perform an audit of a municipality's review and approval process, the executive director will provide the municipality with a minimum of five working days advance notice of the pending audit. The executive director may, for auditing purposes only, review specific projects which have previously been approved by the review authority. The municipality shall provide to the executive director, on request, documentation of all agreements

between the private consultants and the municipality, which relate to the wastewater collection system review program. If the executive director finds through reviews of specific projects or through audits of the municipality's review and approval process that a municipality's review and approval process does not provide for compliance with the minimum design and installation requirements detailed in this chapter, the review and approval authority shall address these findings within a time established by the executive director. If compliance cannot be achieved, the review authority shall be voided for that municipality. If such authority is voided for a municipality, the executive director shall notify the municipality in writing and shall include the justification for voiding the authority of the municipality. If the authority of a municipality is voided, all new projects proposed to be constructed within that municipality's jurisdiction shall be submitted to the executive director in accordance with paragraph (3)(D) of this subsection.

(b) Preliminary engineering report.

(1) Definition. The preliminary engineering report shall form the conceptual basis for the collection, treatment, and/or disposal system proposed. This document shall bear the signed and dated seal of the registered professional engineer responsible for the design.

(A) For projects receiving United States Environmental Protection Agency construction grants assistance, a facility plan may serve as the preliminary engineering report.

(B) For all other projects, a preliminary engineering report proposing processes, methods, or procedures may be submitted as early in the planning stage as is practical. Submission of a preliminary engineering report at this point is only necessary to resolve any potential disagreements between the design engineer and the commission regarding the essential planning information, design data, population projections, and other requirements of the commission. Agreement is desirable to eliminate delays or inconveniences and to avoid the possibility of having to revise the final plans and specifications.

(C) The preliminary engineering report may be merged directly with the final engineering report to produce a single engineering report at the discretion of the sewerage system owner.

(2) General requirements. The following is required for each project as applicable.

(A) A brief description of the project with maps showing the area to be served, general location of proposed improvements, water and wastewater treatment plant sites, existing and proposed streets, parks, drainage ditches, creeks, streams, and water mains shall be provided. The drainage area should be defined clearly, either by contour map or otherwise. Where a contour map is not available to the community, one should be obtained and the contours should be shown at intervals of not more than ten feet. The maps and plans shall be reproduced on paper not larger than 24 inches by 36 inches in size; however, where variations are necessary, all sheets shall be uniform in size.

(B) The domestic population of the area to be served (present and projected) and design population of the project shall be included.

(C) The names of industries contributing any significant wastes, types of industry (standard industry codes), volume of wastes, characteristics and strength of wastes, population equivalent, and other pertinent information shall be included. It should be emphasized that if significant amounts of wastes other than normal domestic sewage are to be treated at the wastewater treatment plant, sufficient data on such wastes must be presented to allow an evaluation of the effect on the treatment process. This would include, but not be limited to, heavy metals and toxic materials such as polychlorinated biphenyls, organic chemicals, and pesticides.

(D) The preliminary engineering report shall include the technical information described in §317.10 of this title (relating to Appendix B--Overland Flow Process) for all overland flow projects.

(3) Collection system. The following information shall be provided in the preliminary engineering report if applicable to the project:

(A) present area served and future areas to be served;

(B) terrain data in sufficient detail to establish general topographical features of present and future areas to be served;

(C) lift stations existing and/or proposed;

(D) effect of proposed system expansion on existing system capacity; and

(E) amount of infiltration/inflow existing and anticipated, and how it is to be addressed in the collection system design.

(4) Treatment plant. The following information is required in a preliminary engineering report.

(A) Quantity and quality of existing sewage influent and changes in the characteristics anticipated in the future. If adequate records are not available, analyses shall be made for the existing conditions and such information included in the report.

(B) Design and peak flow rates being considered and the design period. Design flow is defined as the wet weather maximum 30-day average flow. Therefore, when determining design flow rates, consideration must be given to flows during periods of wet weather in order to assure consistent compliance with discharge permit volume and quality limitations. Peak flow is defined as the highest two hour flow expected to be encountered under any operational conditions, including times of high rainfall (generally the two-year, 24-hour storm is assumed) and prolonged periods of wet weather. For new systems, the peak flow to average annual flow ratio is normally in the range of three-five to one, although other peaking factors may be warranted.

(C) Type of treatment plant proposed and the effluent quality expected. The information should include basis of design, flow, organic loading, infiltration allowance, and efficiency determinations sufficient to a given level of treatment.

(D) Type of units proposed and their capacities, considering the criteria contained herein. The information should include detention times, surface loadings, weir loadings, flow diagram, and other pertinent information regarding the design of the plant, including sludge processing units required for the selected ultimate sludge disposal.

(E) Treatment plant site information and the siting analysis. The location of the plant, the area included in the plant site, dedicated buffer zone, and a description of the surrounding area including a map or a sketch of the area. Particular reference should be made as to the plant's proximity to present and future housing developments, industrial sites, prevailing winds, highways and/or public thoroughfares, water plants, water supply wells, parks, schools, recreational areas, and shopping centers. If the effluent is to be discharged to the waters of the state, the immediate receiving stream, canal, major water course, etc., shall be designated. The siting analysis shall include:

(i) flood hazard analysis. Provide the 100-year flood plain elevation. Proposed treatment units which are to be located within the 100-year flood plain will not be approved for construction unless protective measures satisfactory to the commission (such as levees or elevation of the treatment units) are included in the project design;

(ii) buffer zone analysis. Demonstrate that the location of each proposed treatment unit is consistent with the buffer zone criteria specified in Chapter 309 of this title (relating to Domestic Wastewater Effluent Limitation and Plant Siting).

(5) Sludge management. The preliminary engineering report shall include a discussion of the method of sludge disposal to be utilized. The report shall assess the following factors:

(A) estimated quantity of sludge that must be handled which includes future sludge loads based on flow projections;

(B) quality and sludge treatment requirements for ultimate disposal;

(C) sludge storage requirements for each alternative considering normal operating requirements and contingencies;

(D) transportation of sludge;

(E) land use and land availability; and

(F) reliability of the various alternatives, contingencies, and mitigation plans to ensure reliable capacity and operational flexibility.

(6) Control of bypassing. Information and data shall be submitted to describe features (auxiliary power, standby and duplicate units, holding tanks, storm water clarifiers, etc.) and operational arrangements (flexibility of piping and valves to control flow through the plant, reliability of power sources, etc.) to prevent unauthorized discharges of untreated or partially treated wastewater. An outline of control measures to prevent unauthorized discharges of untreated or partially treated wastewater during construction (see subsection (e)(5) of this section) is to be included.

(c) Final engineering design report. The final engineering design report shall be submitted with the final plans and technical specifications. The report shall include calculations and any other engineering information pertaining to the plant design as may be necessary in the review of the plans and specifications by the commission. The report must include how the design of the collection system and treatment plant will handle the potential loss of graywater as defined in TWC, §26.0311. This report shall bear the signed and dated seal of the registered professional engineer responsible for the design. Information should be included to describe any changes that have been made since a preliminary engineering report was submitted, along with additional information as follows.

(1) Collection system (if applicable):

(A) minimum and maximum grades proposed for each size and type of pipe;

(B) lift stations (also refer to §317.3 of this title (relating to Lift Stations)):

(i) the operating characteristics of the stations at minimum, maximum, and design flows (both present and future);

(ii) safety considerations, such as ventilation, entrances, working areas, and prevention of explosions; and

(iii) means of preventing overflow of raw sewage;

(C) capability of existing trunk and interceptor sewers and lift stations to handle the peak flow under anticipated conditions and capability of existing treatment facilities to receive and adequately treat the anticipated peak flows;

(D) type of pipe proposed and its anticipated performance under the conditions imposed by the particular wastewater quality and loading conditions;

(E) the manhole spacing proposed;

(F) areas not served by the present proposed project, and the projected means of providing service to these areas, including special provisions incorporated in the present plans for future expansion;

(G) amount of infiltration/inflow existing and anticipated, its hydraulic effect on the proposed and existing system, and an abatement plan if applicable, including a:

(i) description of infiltration allowances and test procedures in the specifications governing design of new sanitary sewer lines; and

(ii) description of control program to reduce infiltration/inflow occurring in the existing sewer system;

(H) soil conditions, such as quicksand, that will not support collection system development, and measures to be taken to overcome the anticipated difficulties.

(2) Treatment plant:

(A) the final decisions as to the method of treatment;

(B) types of units proposed and their capacities, considering the criteria contained herein including:

(i) detention times, surface loadings, weir loadings, and flow diagram; and

(ii) other pertinent information regarding the design of the plant, including hydraulic profiles for wastewater and sludge which includes a plot of the hydraulic gradient at peak flow conditions for all gravity lines;

(C) the anticipated operation mode of the plant, the degree of treatment expected and any special characteristics of the plant; and

(D) the safety features included such as stairways, railing, lighting, insulation mats, and walkway mats.

(3) Sludge management system:

(A) the final decisions as to the method(s) of managing sludge, including final disposal;

(B) contingency alternatives; and

(C) the type and size of sludge treatment units to provide the quality of sludge for the selected sludge management method.

(d) Final plans and technical specifications.

(1) Construction drawings and technical specifications will not be considered for review unless they bear the signed and dated seal of the registered professional engineer responsible for the design on each sheet of the plans and on the title page of the technical specifications. These shall be the plans and specifications to be used by the contractor for bidding and construction.

(2) Plans and profiles for sanitary sewers, insofar as practical, shall be prepared using one of the following scales.

Figure: 30 TAC §317.1(d)(2)

Horizontal	Vertical
1" = 20 feet	1" = 2 feet
1" = 40 feet	1" = 4 feet
1" = 50 feet	1" = 5 feet

(3) The size, grade, and type of pipe material shall be shown. Alternate materials may be identified in the bid document.

(4) The location and structural features of the sewers, including manholes to be installed, shall be shown on plans and profiles. The details of the appurtenances shall be provided.

(5) The plans and technical specifications for lift stations shall fully describe all pumps, valves, pumping control mechanisms, safety and ventilation equipment, access operator points, hatches, and hoisting equipment for installing and removing equipment.

(6) The plans and technical specifications for the wastewater treatment plant shall include construction details for all units of the plant as well as equipment and material specifications and installation procedures. The location and details of inlet and outlet structures, valving, and piping arrangements that allow alternate modes of operation during periods of stress such as mechanical failure, structural repair, or any other activity which requires the removal of one or more treatment elements from service, shall be included. The plans shall include a hydraulic profile of the treatment facilities at both design and peak flows. The plans shall also show provisions for future expansion of the plant, should such be contemplated. Details of complex piping should be clarified by the inclusion of an isometric flow diagram as a part of the plans.

(e) Other requirements.

(1) Completion. Upon completion of construction, the design engineer or other engineer appointed by the owner shall notify the commission of completion and attest to the fact that the completed work is substantially in accordance with the plans, technical specifications, and change orders approved by the commission. If substantial

changes have been made to the original plans, record drawings documenting such changes shall be submitted to the commission.

(2) Inspection. During construction, the project may be visited by a representative of the commission during normal working hours to establish general compliance with the plans and technical specifications approved by the commission.

(3) Operation and maintenance manual. Prior to completion of construction of a new wastewater treatment plant or plant expansion, an operation and maintenance manual covering the recommended operating procedures and maintenance practices for the entire facility shall be furnished to the sewerage system owner by the design engineer. The design engineer shall submit a letter to the commission certifying that this action has been performed and shall furnish a copy of the operation and maintenance manual to the commission upon request.

(4) Sludge management implementation plan. The design engineer shall prepare an implementation plan for the selected sludge management method. The plan shall identify regulatory requirements of state and federal agencies. The plan shall also include requirements for selected contingency alternatives.

(5) Authorization to discharge. For treatment plant projects, the owner is required to secure proper authorization from the commission prior to initiation of construction. No discharge shall be authorized without a discharge permit. In no case shall bypassing of partially treated wastewater be authorized during construction without an order for such discharge from the commission. Also see §317.4(a)(3) of this title (relating to Wastewater Treatment Facilities).

(f) Variance. A variance from the design criteria herein may be granted by the commission if the variance would not result in an unreasonable risk to treatment plant performance, public health, or the waters in the state. Requests for variances must be submitted in writing by the design engineer and must, for each affected item, include a detailed engineering justification.

Adopted November 4, 2015 Effective November 26, 2015

§317.2. Sewage Collection System.

(a) General requirements.

(1) Design. Sewer lines shall be designed for the estimated future population to be served, plus adequate allowance for institutional and commercial flows. The collection system design shall provide a minimum structural life cycle of 50 years. The collection system design shall provide for the minimization of anaerobic conditions.

Design procedures for the minimization of anaerobic conditions outlined in the United States Environmental Protection Agency (EPA) Design Manual for Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants (EPA/625/1-85/018), American Society of Continuing Education (ASCE) Manual of Engineering Practice Number 69 (MEP-69), or other appropriate references, should be followed. The owner of the collection system shall provide inspection under the direction of a Texas registered professional engineer during construction and testing phases of the project. All collection systems to be located over the recharge zone of the Edwards Aquifer shall be designed and installed in accordance with Chapter 213 of this title (relating to Edwards Aquifer) in addition to these rules.

(2) Pipe selection. The choice of sewer pipe shall be based on the chemical characteristics of the water delivered by public and private water suppliers, the character of industrial wastes, the possibilities of septicity, the exclusion of inflow and infiltration, the external forces, internal pressures, abrasion, and corrosion resistance. For all installations, if a pipe as a whole or an integral structural component of the pipe will deteriorate when subjected to corrosive internal conditions, a corrosive resistant coating or liner acceptable to the commission shall be installed at the pipe manufacturing facility unless the final engineering design report, including calculations and data, submitted by the engineer demonstrates that the design and operational characteristics of the system will maintain the structural integrity of the system during the minimum life cycle. The sewer pipe to be used shall be identified in the plans and technical specifications with its appropriate American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), or American Water Works Association (AWWA) standard numbers for both quality control (dimensions, tolerances, etc.) and installation (bedding, backfill, etc.).

(A) Flexible pipe. The engineer shall submit an engineering report that includes the method of defining the modulus of soil reaction, (E'), for the bedding material, (E'_b), and the natural soil (E'_n), or other specific information to quantify the effect of the in-situ material on the effective modulus, (E'_e). The report shall also include design calculations for E'_e, prism load, live loads, long-term deflection, strain, bending strain, buckling, and wall crushing. The design calculations shall include all information pertinent to the determination of an adequate design including, but not limited to: pipe diameter and material with reference to appropriate standards, modulus of elasticity, tensile strength, pipe stiffness or ring stiffness constant converted to pipe stiffness as described below, Leonhardt's zeta factor or E'_e from another acceptable method, the conversion factor used to obtain vertical deflection when using the Modified Iowa Equation, trench width, depth of cover, water table elevation, etc. Pipe stiffness shall be related to Ring Stiffness Constant (RSC), when necessary, by the following equation:

Figure: 30 TAC §317.2(a)(2)(A)

$$PS = C \times RSC \times \frac{8.337}{D}$$

Where:
PS = Pipe Stiffness, per square inch (psi);
C = Conversion Factor, (0.80);
RSC = Ring Stiffness Constant; and
D = Mean Pipe Diameter, in.

In all cases the design procedure, such as outlined in this subparagraph, shall dictate the minimum pipe stiffness whether less than or greater than 46 psi; however, direct bury installations of flexible pipe material may consider a minimum stiffness requirement to ensure ease of handling, transportation, and construction. Special consideration shall be given to the pipe stiffness at the expected installation temperature. The resistance of each material to the failure modes of strain, buckling, and wall crushing shall be justified to the satisfaction of the executive director by the engineer. In all situations, the design methodology shall be consistent with currently accepted design practices and acceptable to the executive director. In the design of sanitary sewer systems using trenchless technology, other design methodology may be considered appropriate depending upon the type of pipe selected and other specific conditions.

(B) Rigid pipe. The engineer shall submit an engineering report that includes the trench width, water table, and depth of cover, etc. For rigid conduits the minimum strengths for the given class shall be noted in the appropriate standard for the pipe material. For the purpose of this section, rigid pipe is defined as concrete, vitrified clay, or ductile iron pipe.

(C) Other pipe materials may be considered on a case-by-case basis by the executive director. The design and installation of such materials shall generally follow the guidelines for flexible or rigid pipe with appropriate exceptions.

(3) Jointing material. The materials used and methods to be applied in making joints shall be included in the technical specifications. Materials used for sewer joints shall have a satisfactory record of preventing infiltration and root entrance. Rubber gaskets, polyvinyl chloride (PVC) compression joints, high compression polyurethane, welded or other types of factory made joints are required.

(4) Testing of installed pipe. An infiltration, exfiltration, or low-pressure air test shall be specified. Copies of all test results shall be made available to the executive director upon request. Tests shall conform to the following requirements.

(A) Infiltration or exfiltration tests. The total exfiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of two feet above the crown of the pipe at the upstream manhole. When pipes are installed below the groundwater level an infiltration test shall be used in lieu of the exfiltration test. The total infiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of two feet above the crown of the pipe at the upstream manhole, or at least two feet above existing groundwater level, whichever is greater. For construction within the 25-year flood plain, the infiltration or exfiltration shall not exceed ten gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head. If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, remedial action shall be undertaken in order to reduce the infiltration or exfiltration to an amount within the limits specified.

(B) Low pressure air test. The procedure for the low pressure air test shall conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417, or other appropriate procedures, except for testing times. The test times shall be as outlined in this section. For sections of pipe less than 36-inch average inside diameter, the following procedure shall apply unless the pipe is to be joint tested. The pipe shall be pressurized to 3.5 per square inch (psi) greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed from the following equation. The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined in this subparagraph or until failure. Lines with a 27-inch average inside diameter and larger may be air tested at each joint. Pipe greater than 36-inch diameter must be tested for leakage at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be ten seconds.

Figure: 30 TAC §317.2(a)(4)(B)

$$T = (0.085 \times D \times K)/Q$$

T = time for pressure to drop 1.0 pound per square inch gauge in seconds
K = $0.000419 \times D \times L$, but not less than 1.0
D = average inside pipe diameter in inches
L = length of line of same pipe size being tested, in feet

Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface shall be used

Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as follows:

Pipe Diameter (inches)	Minimum Time (seconds)	Length for Minimum Time (feet)	Time for Longer Length (seconds)
6	340	398	0.855(L)
8	454	298	1.520(L)
10	567	239	2.374(L)
12	680	199	3.419(L)
15	850	159	5.342(L)
18	1,020	133	7.693(L)
21	1,190	114	10.471(L)
24	1,360	100	13.676(L)
27	1,530	88	17.309(L)
30	1,700	80	21.369(L)
33	1,870	72	25.856(L)

(C) Deflection testing. Deflection tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27 inches and greater, a method approved by the executive director shall be used to test for vertical deflections. Other methods shall provide a precision of plus or minus two-tenths of 1.0% (0.2%) deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5.0%. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices. The design engineer should recognize that this is a maximum deflection criterion for all pipes and a deflection test less than 5.0% may be more appropriate for specific types and sizes of pipe. Upon completion of construction, the design engineer or other Texas registered professional engineer appointed by the owner shall certify to the executive director that the entire installation has passed the deflection test. This certification may be made in conjunction with the notice of completion required in §317.1(e)(1) of this title (relating to General Provisions). This certification shall be provided for the commission to consider the requirements of the approval to have been met.

(i) Mandrel sizing. The rigid mandrel shall have an outside diameter equal to 95% of the inside diameter of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for outside diameter controlled pipe and the average inside diameter for inside diameter controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

(ii) Mandrel design. The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

(iii) Method options. Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case-by-case basis. Mandrels with removable legs or runners may be accepted on a case-by-case basis.

(5) Bedding: trenching, bedding, and backfill. The width of the trench shall be minimized, but shall be ample to allow the pipe to be laid and jointed properly and to allow the backfill to be placed and compacted as needed. The trench sides shall be kept as nearly vertical as possible. As used herein, a trench shall be defined as that open cut portion of the excavation up to one foot above the pipe. The engineer shall specify the maximum trench width. The width of the trench shall be sufficient, but no greater than necessary, to ensure working room to properly and safely place and compact haunching materials. The space must be wider than the compaction equipment used in the pipe zone. A minimum clearance of four inches below and on each side of all pipes to the trench walls and floor shall be provided. Bedding Classes A, B, or C, as described in ASTM C 12 (ANSI A 106.2), Water Environment Federation (WEF) Manual of Practice (MOP) Number 9 or American Society of Civil Engineers (ASCE) MOP 37 shall be used for all rigid pipes, provided that the proper strength pipe is used with the specified bedding to support the anticipated load(s). Embedment Classes IA, IB, II, or III, as

described in ASTM D-2321 (ANSI K65.171) shall be used for all flexible pipes, provided the proper strength pipe is used with the specified bedding to support the anticipated load, except that ASTM D-2680 may be used if the pipe stiffness is 200 psi or greater. Secondary backfill shall be of suitable material removed from excavation except where other material is specified. Debris, large clods or stones greater than six inches in diameter, organic matter, or other unstable materials shall not be used for backfill. Backfill shall be placed in such a manner as not to disturb the alignment of the pipe. Where trenching encounters extensive fracture or fault zones, caves, or solutional modification to the rock strata, construction shall be halted and an engineer shall provide direction to accommodate site conditions. Water line crossings shall be governed by special backfill requirements specified in §317.13 of this title (relating to Appendix E--Separation Distances).

(6) Site inspections. The executive director shall, on a random basis, perform site inspections.

(7) Protecting public water supply. Water lines and sanitary sewers shall be installed no closer to each other than nine feet between outside diameters. Where this cannot be achieved, the sanitary sewer shall be constructed in accordance with §317.13 of this title and §290.44(e)(1) of this title (relating to Water Distribution). Separation distances between sanitary sewer systems and water wells, springs, surface water sources, and water storage facilities shall be installed in accordance with the requirements of §290.41(c)(1), (d)(1), (e)(1)(C), and (e)(3)(A), and §290.43(b)(3) of this title (relating to Water Sources; and Water Storage, respectively), as appropriate. Where rules governing separation distance are in conflict, the most strict rule shall apply. No physical connection shall be made between a drinking water supply, public or private, and a sewer or any appurtenance. An air gap of a minimum of 18 inches or two pipe diameters, whichever is greater, shall be maintained between all potable water outlets and the maximum water surface elevation of sewer appurtenances. All appurtenances shall be designed and constructed so as to prevent any possibility of sewage entering the potable water system.

(8) Excluding surface water. Proposals for the construction of combined sewers will not be approved. Roof, street, or other types of drains which will permit entrance of surface water into the sanitary sewer system shall not be acceptable.

(9) Active geologic faults. For systems to be located in areas of known active geologic faults, the design engineer shall locate any faults within the area of the collection system and the system shall be laid out to minimize the number of sewers crossing faults. Where crossings are unavoidable, the engineering report shall specify design features to protect the integrity of the sewer. Consideration should be given to joints providing maximum deflection and to providing manholes on each side of the

fault so that a portable pump may be used in the event of sewer failures. Service connections within 50 feet of an active fault should be avoided.

(10) Erosion control. Erosion or sedimentation control that minimizes the effects of runoff shall be provided during the construction phase of a project. This requirement will be reviewed on a case-by-case basis.

(b) Capacities.

(1) Sources. The peak flow of domestic sewage, peak flow of waste from industrial plants, and maximum infiltration rates shall be considered in determining the hydraulic capacity of sanitary sewers.

(2) Existing systems. The design of extensions to sanitary sewers should be based on the data from the existing system. If this is not possible, the design shall be based on data from similar systems or paragraph (3) of this subsection, new systems.

(3) New systems. New sewers shall be sized using an appropriate engineering analysis of existing and future flow data. The executive director shall have the authority to determine the reliability and appropriateness of the data utilized for sizing the system. In the absence of local reliable flow data and engineering analysis, new sewer systems shall be designed on the basis of an estimated daily sewage flow contribution as shown in the table in §317.4(a) of this title (relating to Wastewater Treatment Facilities). Minor sewers shall be designed such that when flowing full they will transport wastewater at a rate approximately four times the system design daily average flow. Main trunk, interceptor, and outfall sewers shall be designed to convey the contributed minor sewer flows.

(c) Design details.

(1) Minimum size. No sewer other than service laterals and force mains shall be less than six inches in diameter.

(2) Slope. All sewers shall be designed and constructed with slopes sufficient to give a velocity when flowing full of not less than 2.0 feet per second. The grades shown in the following table are based on Manning's formula with an assumed "n factor" of 0.013 and constitute minimum acceptable slopes. The minimum acceptable "n" for design and construction shall be 0.013. The "n" used takes into consideration the slime, grit, and grease layers that will affect hydraulics or hinder flow as the pipe matures.

Figure: 30 TAC §317.2(c)(2)

Size of Pipe In Inches I.D.	**Minimum Slope In Percent**	**Maximum Slope In Percent**
6	0.50	12.35
8	0.33	8.40
10	0.25	6.23
12	0.20	4.88
15	0.15	3.62
18	0.11	2.83
21	0.09	2.30
24	0.08	1.93
27	0.06	1.65
30	0.055	1.43
33	0.05	1.26
36	0.045	1.12
39	0.04	1.01
>39	*	*

** For lines larger than 39 inches in diameter, the slope may be determined by Manning's formula (as shown below) to maintain a minimum velocity greater than 2.0 feet per second when flowing full and a maximum velocity less than 10 feet per second when flowing full.

$$V=\frac{1.49}{n}\times R_h^{0.67}\times\sqrt{S}$$

V = velocity (ft/sec)
n = Manning's roughness coefficient (0.013)
R_h = hydraulic radius (ft)
S = slope (ft/ft)

(3) High velocity protection. Where velocities greater than ten feet per second will occur when the pipe is flowing full, at slopes greater than those listed in paragraph (2) of this subsection, special provisions shall be made to protect against pipe displacement by erosion of the bedding and/or shock.

(4) Alignment. Sewers shall be laid in straight alignment with uniform grade between manholes unless slight deviations from straight alignment and uniform grade are justified to the satisfaction of the executive director.

(5) Manhole use. Manholes shall be placed at all points of change in alignment, grade, or size of sewer, at the intersection of all sewers and the end of all sewer lines that will be extended at a future date. Any proposal which deviates from this requirement shall be justified to the satisfaction of the executive director. Clean-outs with watertight plugs may be installed in lieu of manholes at the end of sewers which are not anticipated to be extended. Such installations must pass a leakage test and a deflection test for all flexible lines.

(A) Type. Manholes shall be monolithic, cast-in-place concrete, fiberglass, precast concrete, high-density polyethylene (HDPE), or of equivalent construction. Brick manholes shall not be used, nor shall brick be used to adjust manhole covers to grade.

(B) Spacing. The maximum required manhole spacing for sewers with straight alignment and uniform grades are in the following table. Reduced manhole spacing may be necessary depending on the utility's ability to maintain its sewer lines. Areas subject to flooding require special consideration to minimize inflow.

Figure: 30 TAC §317.2(c)(5)(B)

Pipe Diameter (inches)	**Maximum Manhole Spacing (feet)**
6-15	500
18-30	800
36-48	1,000
54 or larger	2,000

(C) Inflow and infiltration control. Watertight, size-on-size resilient connectors allowing for differential settlement shall be used to connect pipe to manholes. Pipe to manhole connectors shall conform to ASTM C-923. Other types of connectors may be used when approved by the commission. Manholes should not allow surface water to drain into them. If manholes are located within the 100-year flood plain, the manhole covers shall have gaskets and be bolted or have another means of preventing inflow. Where gasketed manhole covers are required for more than three manholes in sequence, an alternate means of venting shall be provided at less than 1,500 foot intervals. Vents should be designed to minimize inflow. Impervious material should be utilized for manhole construction in these areas in order to minimize infiltration.

(D) Manhole diameter. Manholes shall be of sufficient inside diameters to allow personnel to work within them and to allow proper joining of the sewer pipes in the manhole wall. The inside diameter of manholes shall be not less than 48 inches.

(E) Manhole inverts. The bottom of the manhole shall be provided with a "U" shaped channel that is as much as possible a smooth continuation of the inlet and outlet pipes. For manholes connected to pipes less than 15 inches in diameter the channel depth shall be at least half the largest pipe diameter. For manholes connected to pipes 15 to 24 inches in diameter the channel depth shall be at least three-fourths the largest pipe diameter. For manholes connected to pipes greater than 24 inches in diameter the channel depth shall be at least equal to the largest pipe diameter. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be sloped at a minimum of 0.5 inch per foot.

Where sewer lines enter the manhole higher than 24 inches above the manhole invert, the invert shall be filleted to prevent solids deposition. A drop pipe should be provided for a sewer entering a manhole more than 30 inches above the invert.

(F) Manhole covers. Manhole covers of nominal 24-inch or larger diameter are to be used for all sewer manholes.

(G) Manhole access. Design of features for entering manholes shall be guided by the following criteria.

(i) It is suggested that entrance into manholes in excess of four feet deep be accomplished by means of a portable ladder. Other designs for ingress and egress should be given careful evaluation considering the safety hazards associated with the use of manhole steps under certain conditions.

(ii) Where steps are used, they shall be made of a noncorrosive material and be in accordance with applicable OSHA specifications as published by the United States Department of Labor.

(H) Testing. Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, vacuum testing, or other methods acceptable to the commission. If a manhole fails a leakage test, the manhole must be made watertight and retested. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete.

(6) Sag pipes (inverted siphons). Sag pipes shall have two or more barrels, a minimum pipe diameter of six inches and shall be provided with necessary appurtenances for convenient flushing and maintenance. The manholes shall have adequate clearances for rodding, and in general, sufficient head shall be provided and pipe sizes selected to assure velocities of at least three feet per second at design flows. The inlet and outlet details shall be arranged so that the normal flow is diverted to one barrel. Provisions shall be made such that either barrel may be taken out of service for cleaning.

(d) Alternative wastewater collection systems. Use of alternative wastewater collection systems may be considered when justified by unusual terrain or geological formations, low population density, difficult construction, or other circumstances where an alternative wastewater collection system would offer an advantage over a conventional gravity system. An alternative wastewater collection system will be considered for approval only when conditions make a conventional gravity collection system impractical. Alternative wastewater collection system types include pressure sewers (septic tank effluent pumping or grinder pump systems), small diameter gravity sewers (minimum grade effluent sewers or variable grade effluent sewers), vacuum sewers, and combinations thereof. Alternative wastewater collection systems are comprised of both on-site (interceptor tanks, pumps, pump tanks, valves, service laterals) and off-site components (collector mains, force mains, vacuum stations, clean-outs, manholes, vents, and lift stations). Pressure sewer systems, small diameter gravity sewers, and vacuum sewers will be approved on a case-by-case basis. The engineering report must justify the design of alternative wastewater collection systems to the satisfaction of the executive director. The EPA's Manual of Alternative Wastewater Collection Systems (EPA/625/1-91/024), the WEF's Alternative Sewer Systems (MOP FD-12), or other appropriate engineering literature should be used as the basis for design.

(1) Management. A responsible management structure under the regulatory jurisdiction of the Texas Commission on Environmental Quality shall be established, to the satisfaction of the executive director, to be in charge of the operation and maintenance of an alternative wastewater collection system. A legally binding service agreement shall be required to insure the alternative wastewater collection system is properly constructed and maintained. The required elements of the service agreement are as follows.

(A) The document must be legally binding.

(B) Existing septic and pump tanks that are to be used as interceptor tanks for primary treatment, wastewater storage, or pump tanks prior to the discharge into an alternative sewer system must be cleaned, inspected, repaired, modified, or replaced if necessary, to minimize inflow and infiltration into the collection system prior to connection.

(C) The utility shall have approval authority for the design of the system including all materials and equipment prior to the installation of an interceptor tank, pressure sewer pump tank, or vacuum system appurtenances. The materials shall comply with standard specifications submitted to and approved by the executive director.

(D) The utility must be able to approve the installation of the interceptor tank, pressure sewer pump tank, or vacuum system appurtenances after construction to ensure the installation was as specified.

(E) The utility must be responsible for the operation and maintenance of the system including any interceptor tank, pressure sewer pump tank, or vacuum system appurtenances incorporated.

(F) The utility must be able to stop any discharges from any collection system appurtenances in order to prevent contamination of state waters.

(G) The utility shall submit a maintenance schedule to the executive director which outlines routine service inspections and maintenance for all types of pressure sewers, small diameter gravity sewers, and vacuum sewer system components.

(H) Pumping units, grinder pumps, vacuum sewer appurtenances, interceptor tanks shall be regarded as integral components of the system and not as a part of the home plumbing.

(I) Provision to ensure collection system integrity during a power outage (two-year event) shall be incorporated into the design. Power outage duration will be determined as described in §317.3(e)(1) of this title (relating to Lift Stations).

(2) Pressure sewer system design considerations. The following shall be submitted to and approved by the executive director:

(A) hydraulic calculations for sizing the pressure sewer pumping system shall be based on providing the firm capacity to pump the expected peak flow. These calculations shall include system and pump curves as described in §317.3(c)(4) of this title, wet well capacity calculations based on minimum cycle times as described in §317.3(b)(4)(B) of this title, and emergency and flow equalization storage as necessary. The number of units pumping at any one time may be estimated based on appropriate engineering literature;

(B) flow velocities in the range of three to five feet per second;

(C) the installation of air relief valves;

(D) the provision of means to flush all lines in the system;

(E) the installation of clean-outs; and

(F) development of procedures whereby portions of the pressure system may be rerouted with temporary lines in the event of leaks, construction, or repair.

(3) Pipe selection. Appropriate ASTM, ANSI, or AWWA standards shall be specified for alternative wastewater collection system pipe and joints. Pipe which will be used in pressure sewer systems shall have a minimum sustained working pressure rating of 150 pounds per square inch gauge as per appropriate standard. Pipe selection shall also conform to subsection (a)(1) - (3) and (5) of this section.

(4) Leakage testing. All alternative wastewater collection systems components shall be tested for leakage. Testing procedures for on-site system components, small diameter gravity sewer systems, and vacuum sewer systems will be approved on a case-by-case basis. Pressure sewer installation shall be tested for leakage with a hydrostatic test. Copies of all test results shall be made available to the executive director upon request. Leakage in the pressure sewer hydrostatic test shall be defined as the quantity of water that must be supplied into the pipe or any valved section thereof to maintain pressure within five pounds per square inch of the specified test pressure after the air in the pipeline has been expelled. The test pressure shall be either a minimum of 25 pounds per square inch gauge or 1.5 times the maximum force main design pressure, whichever is larger. The maximum allowable leakage shall be calculated using the formula in this paragraph. If the quantity of leakage exceeds the maximum amount calculated, remedial action shall be taken to reduce the leakage to an amount within the allowable limit as follows.

Figure: 30 TAC §317.2(d)(4)

$$\mathrm{L} = \frac{S \times D \times \sqrt{P}}{133{,}200}$$

Where:
L = leakage in gal/hr
S = length of pipe in ft
D = inside diameter of pipe in inches
P = pressure in pounds per square inch

(5) Pumps. Pumping units and grinder pumps used in pressure sewer systems should be reliable, easily maintained, and should have compatible characteristics.

(A) Pumps and grinder pump units shall be provided with two backflow prevention devices (one check valve at tank, to protect against back drainage into tank, second check valve at connection of service line to pressure collection line to protect against leaking sewage in case service line is damaged) and shall be easily accessible for maintenance.

(B) Sufficient holding capacity shall be provided in the pumping compartment to allow for wastewater storage during power outages and equipment failures. Storage volume should be based on power supply outage records and replacement equipment availability.

(C) Pumping units shall not be installed in the settling chamber of an interceptor tank if the interceptor tank is to be used for solids reduction.

(D) Alarms, warning lights, or other suitable indicators of unit malfunction shall be installed at each pumping station.

(E) Whenever any pumping station handles waste from two or more residential housing units or from any public establishment, dual pump units shall be provided to assure continued service in the event of equipment malfunction.

Adopted November 4, 2015 Effective November 26, 2015

§317.3. Lift Stations.

(a) Site selection. In the selection of a site for a lift station, consideration shall be given to accessibility and potential nuisance aspects. The station shall be protected from the 100-year flood and shall be accessible during a 25-year flood. All lift stations shall be intruder-resistant with a controlled access. Lift stations should be located as remotely as possible from populated areas.

(b) Design.

(1) Small lift stations. Lift stations designed for a discharge capacity of less than 100 gallons per minute will be reviewed on a case-by-case basis by the commission and shall be used only for institutional use or other locations where it is necessary to pump the sewage from a single building, school, or other measurable source establishment into the sanitary sewer lines. If the location of the discharge does not provide a positive head due to elevation, then a positive pressure control valve shall be provided. Ejectors may be used for this type of lift station. Whenever a lift station handles waste from two or more residential housing units, or from any public establishment, standby pumps shall be provided. In the case of ejectors or eductors, two air compressors shall be provided. Grinder pumps should be used for all small installations.

(2) Dry well sump pump. The following design considerations shall be addressed in providing dry well sump pumps.

(A) Two separate sump pumps should be provided for removal of leakage or water from the dry well floor.

(B) The discharge pipe level from the sump pumps shall be above the maximum liquid level of the wet well. A check valve should be installed on the discharge side of each sump pump.

(C) All floor and walkway surfaces shall have an adequate slope to a point of drainage with sufficient measures taken to maximize traction and safety.

(D) Motors to drive sump pumps shall be located above the height of the maximum liquid level in the wet well. As an alternate, sump pumps may be of the submersible type.

(3) Pump controls. All lift stations shall have automatically operated pump control mechanisms. Pump control mechanisms shall be located so that they will not be affected by flow currents in the wet well. Provisions shall be made to prevent grease and other floating materials and rags in the wet well from interfering with the operation of the controls. When a float tube is located in the dry well, its height shall be such as to prevent overflow of the sewage into the dry well. Pump control mechanisms which depend on a bubbler in the wet well shall be equipped with a backup air supply system. All connections to level controls in the wet well shall be accessible at all times. The circuit breakers, indicator lights, pump control switches, and other electrical equipment should be located on a control panel at least three feet above ground surface elevation. If controls are located in a dry well, the dry well shall be protected from flooding.

(4) Wet wells.

(A) Wet wells and dry wells, including their superstructure, shall be separated by at least a watertight and gastight wall with separate lockable entrances provided to each. Equipment requiring regular or routine inspection and maintenance shall not be located in the wet well, unless the maintenance can be accomplished without entering the wet well.

(B) Based on design flow, wet well capacity should provide a pump cycle time of not less than six minutes for those lift stations using submersible pumps and not less than 10 minutes for other nonsubmersible pump lift stations.

(C) All influent gravity lines into a wet well shall be located where the invert is above the "off" setting liquid level of the pumps, and preferably should be located above the lead pump "on" setting.

(5) Stairways. Stairways with non-slip steps shall be provided in all underground dry wells. Removable ladders may be provided in small stations where it is impractical to install stairways.

(6) Ventilation. Ventilation shall be provided for lift stations, including both wet and dry wells.

(A) Passive ventilation such as gooseneck type or turbine ventilators designed to prevent possible entry of insects or birds shall be provided in all wet wells if mechanical ventilation is not provided. All mechanical and electrical equipment in wet wells should be explosion-proof and spark-proof construction if mechanical ventilation is not provided.

(B) Mechanical ventilation shall be provided for all dry wells below the ground surface. The ventilation equipment shall have a minimum capacity of six air changes per hour under continuous operations. At least a capacity of 30 air changes per hour shall be required where the operation is intermittent. All intermittently operated venting equipment shall be interconnected with the stations lighting system.

(7) Wet well slopes. The bottom of wet wells shall have a minimum slope of 10% to the pump intakes and shall have a smooth finish. There shall be no projections in the wet well which will allow deposition of solids under ordinary operating conditions. Antivortex baffling should be considered for the pump suctions in all large sewage pumping stations (greater than five million gallons per day (mgd) firm pumping capacity).

(8) Hoisting equipment. Hoisting equipment or access by hoisting equipment for the removal of pumps, motors, valves, etc., shall be incorporated in the station design.

(9) Dry wells and valve vault drains. Drains from dry wells or valve vaults to the wet well shall be equipped with suitable devices to prevent entry of potentially hazardous gases.

(c) Pumps.

(1) General. All raw sewage pumps shall be of a non-clog design, capable of passing 2 1/2 inch diameter spheres, and shall have no less than three-inch diameter suction and discharge openings. Inspection and cleanout plates, located both on the suction and discharge sides of each pumping unit, are suggested for all nonsubmersible pumps so as to facilitate locating and removing blockage-causing materials. Where such openings are not provided on the pumps, a hand hole in the first fitting connected to the suction of each pump shall be provided. All pumps shall be securely supported so as to

prevent movement during operation. For submersible pumps, rail-type pump support systems incorporating manufacturer-approved mechanisms designed to allow the operator to remove and replace any single pump without first entering or dewatering the wet well should be provided.

(2) Lift station pumping capacity. The firm pumping capacity of all lift stations shall be such that the expected peak flow can be pumped to its desired destination. Firm pumping capacity is defined as total station maximum pumping capacity with the largest pumping unit out of service.

(3) Variable capacity pumps. Lift stations or transfer pumping facilities at a wastewater treatment plant or those discharging directly to the treatment plant where the plant's permitted daily average flow is equal to or greater than 100,000 gallons per day shall be provided with three or more pumps or with duplex automatically controlled variable capacity pumps or other automatic flow control devices. The pumps or other devices shall be adjusted for actual flow conditions and controlled to operate so as to minimize surges in the treatment units. No single pumping unit shall have a capacity greater than the design peak flow of the wastewater treatment plant unless flow splitting/equalization is provided.

(4) Pump head calculations. The engineering design report accompanying the plans shall include system curves, pump curves, and head calculations. Calculations and pump curves at both minimum (all pumps off) and maximum (last normal operating pump on) static heads and for a C value of both 100 and 140 must be provided for each pump and for the combination of pumps (modified pump curves). Where a suction lift is required, the report shall include a calculation of the available net positive suction head (NPSH) and a comparison of that value to the required NPSH for the pump as furnished by the pump manufacturer.

(5) Self-priming pumps. Only self-priming pumps or pumps with acceptable priming systems, as demonstrated by a reliable record of satisfactory operation, shall be used where the suction head is negative. All self-priming pumps shall include a means for venting the air back to the wet well when the pump is priming.

(6) Pump positioning. All raw sewage pumps, other than submersible pumps without "suction" piping and self-priming units capable of satisfactory operation under any negative suction heads anticipated for the lift station under consideration, shall be positioned such that the pumps always experience, during their normal on-off cycling, a positive static suction head.

(7) Grinder pumps. See §317.2(d) of this title (relating to Sewage Collection System).

(d) Piping.

(1) Pump suctions. Each pump shall have a separate suction pipe. Cavitation may be avoided by using eccentric reducers in lieu of typical reducers in order to prevent air pockets from forming in the suction line.

(2) Valves. Full closing valves shall be installed on the discharge piping of each pump and on the suction of all dry pit pumps. A check valve shall be installed on the discharge side of each pump, preceding the full closing valve. Check valves should be of a swing check type with external levers. Rubberball check valves may be used for grinder pump installations in lieu of the swing check type. Butterfly valves, tilting disc check valves, or other valves with a pivoted disc in the flow line are not allowed. The design shall consider surge effects and provide protection where necessary. Surge relief shall be contained in the system.

(3) Valve position indicators. Gate valves should be rising-stem valves. If other than rising-stem gate valves and check valves with external levers are used, the valves shall include a position indicator to show their open and closed positions.

(4) Lift station piping. Flanged pipe and fitting or welded pipe shall be used for exposed piping inside of lift stations. A flexible or flanged connection shall be installed in the piping to each pump so that the pump may be removed easily for repairs. Provisions shall be made in the design to permit flexure where pipes pass through walls of the station. Piping should normally be sized so that the maximum suction velocity does not exceed five feet per second and the maximum discharge velocity does not exceed eight feet per second.

(5) Force main pipe selection. Force mains shall be a minimum of four inches in diameter, unless justified, as with the use of grinder pumps. In no case shall the velocity be less than two feet per second with only the smallest pump operating, unless special facilities are provided for cleaning the line at specified intervals or it can be shown that a flushing velocity of five feet per second or greater will occur one or more times per day. Pipe specified for force mains shall be of a type having an expected life at least as long as that of the lift station and shall be suitable for the material being pumped and the operating pressures to which it will be subjected. All pipe shall be identified in the technical specifications with appropriate American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), or American Water Works Association (AWWA) specifications numbers for both quality control (dimensions, tolerances, etc.) and installation (bedding, backfill, etc.). All pipe and fittings shall have a minimum working pressure rating of 150 pounds per square inch.

(6) Force main tests. Final plans and specifications shall describe and require pressure testing for all installed force mains. Minimum test pressure shall be 1.5 times the maximum design pressure.

(7) Air release valves. Air release valves or combination air release/vacuum valves suitable for sewage service shall be provided at all peaks in elevation. The final engineering drawings must depict all proposed force mains in both plan and profile.

(e) Emergency provisions. Lift stations shall be designed such that there is not a substantial hazard of stream pollution from overflow or surcharge onto public or private property with sewage from the lift station. Options for a reliable power source may include the following.

(1) Power supply. The commission will determine the reliability of the existing commercial power service. Such determinations shall be based on power outage records obtained from the appropriate power company and presented to the commission. When requesting outage records for submittal to the commission, it is important to note that the records be in writing, bear the signature of an authorized utility employee, identify the location of the wastewater facilities being served, list the total number of outages that have occurred during the past 24 months, and indicate the duration of each recorded outage. The facility will be deemed reliable if the demonstrated wastewater retention capacity, in the station's wet well, spill retention facility, and incoming gravity sewer lines, is sufficient to insure that no discharge of untreated wastewater will occur for a length of time equal to the longest electrical outage recorded in the past 24 months. If records for the service area cannot be obtained, a 120 minute worst case outage duration will be assumed. Provisions for a minimum wastewater retention period of 20 minutes should be considered even in those cases where power company records indicate no actual outages of more than 20 minutes occurred during the past 24 months.

(2) Alternative power supply. If the existing power supply is found to be unreliable, an emergency power supply or detention facility shall be provided. Options include:

(A) electrical service from two separate commercial power companies, provided automatic switchover capabilities are in effect;

(B) electrical service from two independent feeder lines or substations of the same electric utility, provided automatic switchover capabilities are in effect;

(C) on-site automatic starting electrical generators;

(D) reliance on portable generators or pumps. Proposals for the utilization of portable units shall be accompanied by a detailed report showing conclusively the ability of such a system to function satisfactorily. Portable units will be approved only in those cases where the station is equipped with an auto-dialer, telemetry device, or other acceptable operator notification device, operators knowledgeable in acquisition and startup of the portable units are on 24-hour call, the station is accessible in all weather conditions, reasonable assurances exist as to the timely availability and accessibility of the proper portable equipment, and the station is equipped with properly designed and tested quick connection facilities. This option is usually acceptable only for smaller lift stations.

(3) Restoration of lift station. Provisions should be made to restore the lift station to service within four hours of outage.

(4) Spill containment structures. A spill containment structure should be considered together with in-system retention in determining a total wastewater retention time. Because separate spill retention facilities are not suitable for all locations, engineers should check with the commission prior to designing such structures. The design shall provide:

(A) a minimum storage volume of average design flow from the contributing area and the longest power outage during the most recent consecutive 24-month period or, if power records are not available, an assumed 24-hour outage;

(B) an impermeable liner (such as concrete or synthetic fabric (20 mil thickness)) and should have an energy dissipator at the point of overflow from the lift station to prevent scour;

(C) a fence with a controlled access; and

(D) a plan for routine cleaning and inspection.

(5) Alarm system. An audiovisual alarm system (red flashing light and horn) shall be provided for all lift stations. These alarm systems should be telemetered to a facility where 24-hour attendance is available. The alarm system shall be activated in case of power outage, pump failure, or a specified high water level.

Adopted November 4, 2015 Effective November 26, 2015

§317.4. Wastewater Treatment Facilities.

(a) General requirements. Whenever possible, existing data of flows and raw waste strength from the same plant or nearby plants with similar service areas should be used in design of treatment facilities. When using such data for design purposes, the variability of data should be considered and the design based on the highest flows and strengths encountered during normal operating periods taking into consideration possible infiltration/inflow. In the absence of existing data, the following are generally acceptable parameters to which must be added appropriate allowances for inflow and infiltration into the collection system to obtain plant influent characteristics.

Figure: 30 TAC §317.4(a)

		Daily Wastewater Flow - Gallons	**Wastewater Strength**
Source	**Remarks**	**Per Person**	**mg/L BOD_5**
Municipality	Residential	100	200
Subdivision	Residential	100	200
Trailer Park (Transient)	2 ½ persons per trailer	50	300
Mobile Home Park	3 persons per trailer	75	300
School with Cafeteria	With Showers	20	300
	Without Showers	15	300
Recreational Parks	Overnight user	30	200
	Day user	5	100
Office Building or Factory		20	300
Motel		50	300
Restaurant	Per Meal	5	1000
Hospital	Per Bed	200	300
Nursing Home	Per Bed	100	300

(1) Effluent quality. Wastewater treatment plants shall be designed to consistently meet the effluent concentration and loading requirements of the applicable waste disposal permit.

(2) Effluent quantity. The design flow of a treatment plant is defined as the wet weather, maximum 30-day average flow. The design basis shall include industrial wastewaters which will enter the sewerage system. The engineering report shall state the flow and strength of wastewaters from industries which individually contribute 5.0% or more of plant flow or loading and discuss the aspect of hazardous or toxic wastes. It is the intent of these design criteria that the permit conditions not be violated. The engineering report shall list the design influent flow and concentration of five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), or other parameters for the following:

(A) dry weather 30-day average (Q_D W);

(B) wet weather maximum 30-day average (Q_D W); and

(C) two-hour peak flow (Q_P W).

(3) Piping. The piping within all plants shall be arranged so that when one unit is out of service for repairs, plant operation will continue and emergency treatment can be accomplished. Valves and piping shall be provided and sized to allow dewatering of any unit, in order that repairs of the unit can be completed in as short a period of time as possible. Portable pumping units may be used for dewatering small treatment plants (design flow of less than 100,000 gallons per day) or interim facilities. Removed wastes must be stored for retreatment or delivered to another treatment facility for processing. Consideration shall be given in design for means to clean piping, especially piping carrying raw wastewater, sludges, scum, and grit.

(4) Peak flow. For treatment unit design purposes, peak flow is defined as the highest two-hour average flow rate expected to be delivered to the treatment units under any operational condition, including periods of high rainfall (generally the two-year, 24-hour storm is assumed) and prolonged periods of wet weather. With pumped inflow, clarifiers shall have the capacity of all pumps operating at maximum wet well level unless a control system is provided that will limit the pumping rate to the firm capacity. This flow rate may also include skimmer flow, thickener overflow, filter backwash, etc. All treatment plants must be designed to hydraulically accommodate peak flows without adversely affecting the treatment processes. The engineer shall determine, by methods acceptable to the commission, the appropriate peak flow rate, including the possibility of utilizing standby pumps. The proposed two-hour peak flow rate, together with a discussion of rationale, calculations, and all supporting flow rate data shall be, unless presented in the preliminary engineering report, included in the

final engineering design report. Special storm flow holding basins or flow equalization facilities can be specified to partially satisfy the requirements of this section where all treatment units within a plant are not sized for peak flow. See §317.9 of this title (relating to Appendix A) for referencing a two-year 24-hour rainfall event.

(5) Auxiliary power. The need for auxiliary power facilities shall be evaluated for each plant and discussed in the preliminary and final engineering reports. Auxiliary power facilities are required for all plants, unless dual power supply arrangements can be made or unless it can be demonstrated that the plant is located in an area where electric power reliability is such that power failure for a period to cause deterioration of effluent quality is unlikely. Acceptable alternatives to auxiliary power include the ability to store influent flow or partially treated wastewater during power outage. Auxiliary power may be required by the commission for plants discharging near drinking water reservoirs, shellfish waters, or areas used for contact recreation, and for plants discharging into waters that could be unacceptably damaged by untreated or partially treated effluent. For more information on power reliability determination and emergency power alternatives, refer to §317.3(e) of this title (relating to Lift Stations).

(6) Component reliability. Multiple units may be required based upon the uses of the receiving waters and the significance of the treatment units to the treatment processes.

(7) Stairways, walkways, and guard rails. Basins having vertical walls terminating four or more feet above or below ground level shall provide a stairway to the walkway. Guard rails on walkways shall have adequate clearance space for maintenance operations (see §317.7 of this title (relating to Safety)).

(8) Public drinking water supply connections. There shall be no water connection from any public drinking water supply system to a wastewater treatment plant facility unless made through an air gap or a backflow prevention device, in accordance with American Water Works Association (AWWA) Standard C506 (latest revision) and AWWA Manual M14. All backflow prevention devices shall be tested annually with their test and maintenance report forms retained for a minimum of three years. All washdown hoses using potable water must be equipped with atmospheric vacuum breakers located above the overflow level of the washdown area.

(9) Ground movement protection. The structural design of treatment plants shall be sufficient to accommodate anticipated ground movement including any active geologic faults and allow for independent dewatering of all treatment units. Plants should not be located within 50 feet of geologic faults.

(10) Odor control facilities. The need for odor control facilities shall be evaluated for each plant. Factors to be considered are the dissolved oxygen level of the incoming sewage and the type of treatment process proposed.

(b) Preliminary treatment units. Bar screens, screens, or shredders through which all wastewater will pass should be provided at all plants with the exception of plants in which septic tanks, Imhoff tanks, facultative, aerated, or partially mixed lagoons represent the initial treatment unit. In the event bar screens, screens, or shredders are located four or more feet below ground level, appropriate equipment shall be provided to lift the screenings to ground elevation. Where mechanically cleaned bar screens or shredders are utilized, a backup unit or manually cleaned bar screen shall be provided. A means of diverting flow to the backup screen shall be included in the design.

(1) Bar screens. Manually cleaned bar screens shall be constructed having a 30-degree to 60-degree slope to a horizontal platform which will provide for drainage of the screenings. Bar screen openings shall not be less than 3/4 inch for manually cleaned bar screens and 1/2 inch for mechanically cleaned bar screens. The channel in which the screen is placed shall allow a velocity of two feet per second or more at design flow. Velocity through the screen opening should be less than three feet per second at design flow.

(2) Grit removal. Grit removal facilities should be considered for all wastewater treatment plants. Grit washing facilities shall be provided unless a burial area for the grit is provided within the plant grounds, or the grit is handled otherwise in such a manner as to prevent odors or fly breeding. Grit removal units shall have mechanical means of grit removal or other acceptable methods for grit removal. Plants which have a single grit collecting chamber shall have a bypass around the chamber. All grit collecting chambers shall be designed with the capability to be dewatered. The method of velocity control used to accomplish grit removal in gravity settling chambers shall be detailed in the final engineering report.

(3) Fine screens. Fine screens, if used, shall be preceded by a bar screen. Fine screens shall not be substituted for primary sedimentation or grit removal; however, they may be used in lieu of primary treatment if fully justified by the design engineer. A minimum of two fine screens shall be provided, each capable of independent operation at peak flow. A steam cleaner or high pressure water hose shall be provided for daily maintenance of fine screens.

(4) Screenings and grit disposal. All screenings and grit shall be disposed of in an approved manner. Suitable containers with lids shall be provided for holding screenings. Runoff control must be provided around the containers where applicable. Fine screen tailings are considered as infectious waste; therefore, containers must provide vector control if wastes are not disposed of daily at a Type 1 landfill.

(5) Preaeration. Because preaeration may be proposed when a particular problem is anticipated, evaluation of these units will be on a case-by-case basis. Diffuser equipment shall be arranged for greatest efficiency, with consideration given to maintenance and inspection.

(6) Flow equalization. Equalization should be considered to minimize random or cyclic peaking of organic or hydraulic loadings. Equalization units should be provided after screening and grit removal.

(A) Aeration. Aeration may be required for odor control. When required, air supply must be sufficient to maintain 1.0 milligrams per liter (mg/liter) of dissolved oxygen in the wastewater.

(B) Volume. A diurnal flow graph with supporting calculations used for sizing the equalization facility must be provided in the engineering report. Generally, an equalization facility requires a volume equivalent to 10% to 20% of the anticipated dry weather 30-day average flow. Tankage should be divided into separate compartments to allow for operational flexibility, repair, and cleaning.

(c) Flow measuring devices and sampling points. A means for measuring effluent flow shall be provided at all plants. Consideration should be given to providing a means to monitor influent flow. Where average influent and effluent flows are significantly different, e.g., plants with large water surfaces located in areas of high rainfall or evaporation or plants using a portion of effluent for irrigation, both influent and effluent must be measured. Consideration should be given to internal flow monitoring devices to measure returned activated sludge and/or to facilitate splitting flows between units with special attention being given when units are of unequal size. All plants shall be provided with a readily accessible area for sampling effluent.

(d) Clarifiers.

(1) Inlets. Clarifier inlets shall be designed to provide uniform flow and stilling. Vertical flow velocity through the inlet stilling well shall not exceed 0.15 feet per second at peak flow. Inlet distribution channels shall not have deadened corners and shall be designed to prevent the settling of solids in the channels. Inlet structures should be designed to allow floating material to enter the clarifier.

(2) Scum removal. Scum baffles and a means for the collection and disposal of scum shall be provided for primary and final clarifiers. Scum collected from final clarifiers in plants utilizing the activated sludge process, or any modification thereof, and aerated lagoons may be discharged to aeration basin(s) and/or digester or disposed of by other approved methods. Scum from all other final clarifiers and from

primary clarifiers shall be discharged to the sludge digester or other approved method of disposal. Discharge of scum to any open drying area is not acceptable. Mechanical skimmers shall be used in units with a design flow greater than 25,000 gallons per day. Smaller systems may use hydraulic differential skimming provided that the scum pickup is capable of removing scum from the entire operating surface of the clarifier. Scum pumps shall be specifically designed for this purpose.

(3) Effluent weirs. Effluent weirs shall be designed to prevent turbulence or localized high vertical flow velocity in the clarifiers. Weirs shall be located to prevent short circuiting flow through the clarifier and shall be adjustable for leveling. Weir loadings shall not exceed 20,000 gallons per day peak design flow per linear foot of weir length for plants with a design flow of 1.0 mgd or less. Special consideration will be given to weir loadings for plants with a design flow in excess of 1.0 million gallons per day (mgd), but such loadings shall not exceed 30,000 gallons per day peak flow per linear foot of weir.

(4) Sludge lines. Means for transfer of sludge from primary, intermediate, or final clarifiers for subsequent processing shall be provided so that treatment efficiency will not be adversely affected. Gravity sludge transfer lines shall not be less than eight inches in diameter.

(5) Basin sizing. Overflow rates are based on the surface area of clarifiers. The surface areas required shall be computed using the following criteria. The actual clarifier size shall be based on whichever is the larger size from the two surface area calculations (peak flow and design flow surface loading rates). The final clarifier solids loading for all activated sludge treatment processes shall not exceed 50 pounds of solids per day per square foot of surface area at peak flow rate. The following design criteria for clarifiers are based upon a side water depth of ten feet and shall be considered acceptable.

Figure: 30 TAC §317.4(d)(5)

Effective [c] Detention Design	**Maximum Surface[a] Loading at Peak Flow**	**Minimum Effective[c] Detention Time at Peak Flow**	**Maximum Surface[a] Loading at Design Flow**	**Minimum Time at Flow**
Clarifier	**(gal/day/sq ft)**	**(hrs)**	**(gal/day/sq ft)**	**(hrs)**

Primary and Intermediate	1,800		1000	
Final:				
Fixed Film Secondary	1,600	1.1	800	2.2
Fixed Film Enhanced	1,400	1.3	700	3.0
Secondary[b]				
Activated Sludge (except extended air) Secondary	1,400	1.3	700	2.6
Enhanced Secondary[b]	1,200	1.5	600	3.0
Extended Air Secondary	1,000	1.8	500	3.6
Extended Air Enhanced Secondary[b]	800	2.2	400	4.5
Second Stage Nitrification	1,200	1.5	600	3.0

a. Does not include recirculation
b. Enhanced Secondary Treatment refers to enhanced solids removal achieved through reducing the hydraulic and solids loading to the clarifier
c. Overflow rate and sidewater depth (SWD) may be adjusted, keeping the detention time unchanged, over a range of 8 feet to 16 feet of SWD. The detention time is based on the effective volume and the overflow rate of the circular or rectangular clarifier. (The effective volume includes all liquid above the sludge blanket). For cone bottom tanks, the top of the sludge blanket is considered to be at the top of the cone. For flat bottom tanks, a sludge blanket of 3 feet should be allowed for development of maximum return sludge concentration.

(6) Sidewater depth (SWD). The minimum SWD for conventional primary and intermediate clarifiers is seven feet. All final clarifiers shall have a minimum SWD of eight feet. Final clarifiers having a surface area equal to or greater than 1,250 square

feet (diameter equal to or greater than 40 feet) must be provided with a minimum SWD of 10 feet.

(7) Hopper bottom clarifiers. Hopper bottom clarifiers without mechanical sludge collecting equipment will only be approved for those facilities with a permitted design flow of less than 25,000 gallons per day. The required SWD for hopper bottom clarifiers may be computed using the following equation: SWD = 160 QD + 4, where SWD equals required SWD in feet and QD equals design flow in million gallons per day. Furthermore, SWD as computed previously for any flow may be reduced by crediting the upper one-third of the hopper as effective SWD if the following conditions are met:

(A) clarifier surface loading rate is reduced by at least 15% from maximum loading rate as per paragraph (5) of this subsection;

(B) influent stilling baffle and effluent weir are designed to prevent short circuiting;

(C) detention time at peak flow is at least 1.8 hours for secondary treatment and 2.4 hours for advanced treatment; and

(D) an appropriate form of flow equalization is used.

(8) Sludge collection equipment. All conventional clarifier units that treat flow from a treatment plant facility with a design flow of 25,000 gallons per day or greater shall be provided with mechanical sludge collecting equipment. Hopper bottom clarifiers must have a smooth wall finish and a hopper slope of not less than 60 degrees.

(9) BOD_5 removal. It shall be assumed that the BOD_5 removal in a primary clarifier is 35%, unless satisfactory evidence is presented to indicate that the efficiency will be otherwise. In plant efficiency calculations, it shall be assumed that the BOD_5 removal in intermediate and final clarifiers is included in the calculation for the efficiency of the treatment unit preceding the intermediate or final clarifier.

(e) Trickling filters.

(1) General. Trickling filters are secondary aerobic biological processes which are used for treatment of sewage.

(2) Basic design parameters. Trickling filters are classified according to applied hydraulic loading in million gallons per day per acre (mgd/acre) of filter media surface area, and organic loadings in pounds of biochemical oxygen demand (BOD) per day per 1,000 cubic feet of filter media (lb BOD/day-1,000 cu ft). The following factors should be considered in the selection of the design hydraulic and organic loadings:

strength of the influent sewage, effectiveness of pretreatment, type of filter media, and treatment efficiency required. Typical ranges of applied hydraulic and organic loadings for the different classes of trickling filters are presented in the following table for illustrative purposes. The design engineer shall submit sufficient operating data from existing trickling filters of similar construction and operation to justify his efficiency calculations for the filters, and a filter efficiency formula from a reliable source acceptable to the commission. The formula of the National Research Council may be used when rock media is used in the trickling filter(s).

Figure: 30 TAC §317.4(e)(2)

Typical Design Loadings

Operating Characteristics	**Standard Rate**	**Intermediate Rate**	**High Rate**	**High Rate**	**Roughing**
Media	**Rock**	**Rock**	**Rock**	**Manufactured**	**Rock**
Hydraulic Loading					
mgd/acre	1-4	4-10	10-40	15-90*	60-180*
gpd/ft^2	25-90	90-230	230-900	350-1,000*	1,400-4,200*
Organic Loading					
lb BOD/acre-ft/day	200-1,000	700-1,400	1000-1300	up to 300	100+
lb BOD/day/1000 ft^3	5-25	15-30	25-300	65-85	40-65
BOD Removal (%)	80-85	50-70	65-85		

*Does not include recirculation

(3) Pretreatment. The trickling filter treatment facility shall be preceded by primary clarifiers equipped with scum and grease removal devices. Design engineers may submit operating data as justification of other alternative pretreatment devices

which provide for effective removal of grit, debris, suspended solids, and excess oil and grease. Preaeration shall be provided where influent wastewater contains harmful levels of hydrogen sulfide concentrations.

(4) Filter media.

(A) Material specifications for rock media. The following are minimum requirements.

(i) Crushed rock, slag, or similar media should not contain more than 5.0% by weight of pieces whose longest dimension is greater than three times its least dimension. The rock media should be free from thin, elongated, and flat pieces and should be free from dust, clay, sand, or fine material. Rock media should conform to the following size distribution and grading when mechanically graded over a vibrating screen with square openings:

(I) passing five-inch sieve--100% by weight;

(II) retained on three-inch sieve--95% to100% by weight;

(III) passing two-inch sieve--0.2% by weight;

(IV) passing one-inch sieve--0.1% by weight;

(V) the loss of weight by a 20-cycle sodium sulphate test, as described in the American Society of Civil Engineers Manual of Engineering and Engineering Practice Number 13, shall be less than 10%.

(ii) Rock media shall not be less than four feet in depth (at the shallowest point) nor deeper than eight feet (at the deepest point of the filter).

(B) Synthetic (manufactured or prefabricated) media.

(i) Application of synthetic media shall be evaluated on a case-by-case basis. Suitability should be evaluated on the basis of experience with installations treating similar strength wastewater under similar hydraulic and organic loading conditions. The manufacturer's recommendations shall be included, as well as case histories involving the use of the media.

(ii) Media shall be relatively insoluble in sewage and resistant to flaking or spalling, ultraviolet degradation, disintegration, erosion, aging, all common acids and alkalies, organic compounds, biological attack, and shall support the weight of a person when the media is in operation.

(iii) Media depths should be consistent with the recommendations of the manufacturer.

(C) Placing of media.

(i) The dumping of media directly on the filter is unacceptable. Instructions for placing media shall be included in the specifications.

(ii) Crushed rock, slag, and similar media shall be washed and screened or forked to remove clays, organic material, and fines.

(iii) Such materials should be placed by hand to a depth of 12 inches above the underdrains and all material should be carefully placed in a manner which will not damage the underdrains. The remainder of the material may be placed by means of belt conveyors or equally effective methods approved by the engineers. Trucks, tractors, or other heavy equipment should not be driven over the filter media during or after construction.

(iv) Prefabricated filter media shall be placed in accordance with recommendations provided by the manufacturer.

(5) Filter hydraulics.

(A) Dosing. Wastewater may be applied to the filters by siphons, pumps, or by gravity discharge from preceding treatment units when suitable flow characteristics have been developed.

(B) Distribution equipment. Settled wastewater may be distributed over the filter media by rotary, horizontal, or travelling distributors, provided the equipment proposed is capable of producing the required continuity and uniformity of distribution over the entire surface of the filter. Deviation from a calculated uniformly distributed volume per unit surface area shall not exceed 10% at any portion of the filter. Filter distributors shall be designed to operate properly at all flow rates. Excessive head in the center column of rotary distributors shall be avoided, and all center columns shall have adequately sized overflow ports to prevent the head from building up sufficiently for the water to reach the bearings in the center column. Distributors shall include cleanout gates on the ends of the arms and shall also include an end nozzle to spray water on the wall of the filter to keep the edge of the media continuously wet. The filter walls shall extend at least 12 inches above the top of the ends of the distributor arms.

(C) Seals. The use of mercury seals is prohibited in the distributors of newly constructed trickling filters. If an existing treatment facility is to be modified, any mercury seals in the trickling filters shall be replaced with oil or mechanical seals.

(D) Distributor clearance. A minimum clearance of six inches shall be provided between the top of the filter media and the distributing nozzles.

(E) Recirculation. In order to insure that the biological growth on the filter media remains active at all times, provisions shall be included in all designs for minimum recirculation during periods of low flow. This minimum recirculation shall not be considered in the evaluation of the efficiency of the filter unless it is part of the proposed specified continuous recirculation rate. Minimum flow to the filters shall not be less than 1.0 mgd/acre of filter surface. In addition, the minimum flow rate must be great enough to keep rotary distributors turning and the distribution nozzles operating properly. For facilities with a design capacity greater than or equal to 0.5 mgd and in which recirculation is included in design computations for BOD_5 removal, recirculation shall be provided by variable speed pumps and a method of conveniently measuring the recycle flow rate shall be provided.

(F) Surface loading. The engineering report shall include calculations of the maximum, design, and minimum surface loadings on the filter(s) in terms of mgd/acre of filter area per day (for the initial year and design year). Hydraulic loadings of filters with crushed rock, slag, or similar media shall not exceed 40 mgd/acre based on design flow. The minimum surface loading shall not be less than 1.0 mgd/acre. Loadings on synthetic (manufactured or prefabricated) filter media shall be within the ranges specified by the manufacturer.

(6) Underdrain system.

(A) Underdrains. Underdrains with semicircular inverts or equivalent shall be provided and the underdrainage system shall cover the entire floor of the trickling filter. Inlet openings into the underdrains shall provide an unsubmerged gross combined area of at least 15% of the surface area of the filter.

(B) Hydraulics. Underdrains and the filter effluent channel floor shall have a minimum slope of 1.0%. Effluent channels shall be designed to produce a minimum velocity of two feet per second at average daily flow rate of application to the trickling filter.

(C) Drain tile. Underdrains for rock media trickling filters shall be either vitrified clay or precast reinforced concrete. The use of half tile for underdrain systems is unacceptable.

(D) Corrosion. Underdrain systems for synthetic media trickling filters shall be resistant to corrosion.

(E) Ventilation. The underdrain system, effluent channels, and effluent pipe shall be designed to permit free passage of air. Drains, channels, and effluent pipes shall have a cross-sectional area such that not more than 50% of the cross-sectional area will be submerged at peak flow plus recirculation. Provision shall be made in the design of the effluent channels to allow the possibility of increased hydraulic loading. The underdrain system shall provide at least one square foot of ventilating area (vent stacks, ventilating holes, ventilating ports) for every 250 square feet of rock media filter plan area. Ventilating area for synthetic media underdrains will be provided as recommended by the manufacturer, but shall be at least one square foot for every 175 square feet of synthetic media trickling filter plan area.

(F) Maintenance. All flow distribution devices, underdrains, channels, and pipes shall be designed so they may be maintained, flushed, and properly drained. The units shall be designed to facilitate cleaning of the distributor arms. A gate shall be provided in the wall to facilitate rodding of the distributor arms.

(G) Flooding. Provisions shall be made to enable flooding of the trickling filter for filter fly control; however, consideration will be given by the commission to alternate methods of filter fly control provided that the effectiveness of the alternate method is verified at a full scale installation. This information shall be submitted with the plans and specifications.

(H) Flow measurements. Means shall be provided to measure flow to the filter and recirculation flows.

(f) Rotating biological contactors (RBC).

(1) General.

(A) RBC units shall be covered and ample ventilation provided. Working clearance of approximately 30 inches should be provided within the cover unless the covers are removable, utilizing equipment normally available on site. Enclosures shall be constructed of a suitable corrosion-resistant material.

(B) The design of the RBC media shall provide for self-cleaning action due to the flow of water and air through the media. Careful selection of media that will not entrap solids should be made.

(C) The RBC tank should be designed to minimize zones in which solids will settle out.

(D) RBC media should be selected which is compatible with the wastewater. Selection of media can be critical where the wastewater has an industrial waste portion which either significantly increases the wastewater temperature or contains a chemical constituent which may decrease the life of the RBC media.

(2) Design.

(A) Pretreatment. RBC units shall be preceded by pretreatment to remove any grit, debris, and excess oil and grease which may hinder the treatment process or damage the RBC units. The design engineer should consider primary clarifiers with scum and grease collecting devices, fine screens, and oil separators. For wastes with high hydrogen sulfide concentrations, preaeration shall be provided.

(B) Organic loading. The organic loading for the design of RBC units shall be based on total BOD5 in the waste going to the RBC, including any side streams. The design engineer should consider a maximum loading rate of five pounds BOD5 per day per 1,000 square feet of media in any stage, depending on the character of the influent wastewater. The maximum loading rate shall not exceed eight pounds BOD5 per day per 1,000 square feet of media in any stage. The design engineer should also consider the ratio of soluble BOD5 to total BOD5 and its possible effect on required RBC media area. Allowable organic loading for the entire RBC system shall not exceed the following criteria.

Figure: 30 TAC §317.4(f)(2)(B)

Degree of Treatment	**Maximum Organic Loading (lb. BOD_5/day/1,000 ft^2 of media area)**
Secondary	3.0
Advanced Secondary	2.0

(C) Stages of treatment. The number of RBC units in series (stages) for BOD removal only shall be a minimum of three stages. For BOD removal and nitrification, there shall be a minimum of four stages. If the plant is designed with less stages than noted in the previous sentences of this subparagraph, the engineer must provide justification based on either full-scale operating facilities or pilot unit operational data. Any pilot unit data used in the justification must take into consideration an appropriate scale-up factor.

(D) Drive system. The drive system for each RBC unit shall be selected for the maximum anticipated media load. A variable speed system should be considered to provide additional operator flexibility. The RBC units may be mechanically driven or air driven.

(i) Mechanical drives.

(I) Each RBC unit shall have a positively connected mechanical drive with motor and speed reduction unit to maintain the required rpm.

(II) A fully assembled spare mechanical drive unit for each size shall be provided on-site.

(III) Supplemental diffused air should be considered for mechanical drive systems to help remove excess biomass from the media and to help maintain the minimum dissolved oxygen concentration.

(ii) Air drives.

(I) Each RBC unit shall have air diffusers mounted below the media and off-center from the vertical axis of the RBC unit. Air cups mounted on the outside of the media shall collect the air to provide the driving force and maintain the required rpm.

(II) Blowers shall provide enough air flow for each RBC unit plus additional capacity to double the air flow rate to any one unit while the others are running normally.

(III) The blowers shall be capable of providing the required air flow with the largest unit out of service.

(IV) The air diffuser line to each unit shall be mounted such that it can be removed without draining the tank or removing the RBC media.

(V) An air control valve shall be installed on the air diffuser line to each RBC unit.

(E) Dissolved oxygen. The RBC plant shall be designed to maintain a minimum dissolved oxygen concentration of one milligram per liter at all stages during the peak organic flow rate. Supplemental aeration may be required.

(F) Nitrification. The design of an RBC plant to achieve nitrification is dependent upon a number of factors, including the concentration of ammonia in the influent, effluent ammonia concentration required, BOD_5 removal required, minimum operational temperatures, and ratio of peak to design hydraulic flow. Each of these factors will impact the number of stages of treatment required and the allowable ammonia nitrogen loading (lb NH_3/day/1,000 ft^2 media) required to achieve the desired levels of nitrification for a given facility. The engineer shall submit appropriate data supporting the design.

(G) Design flexibility. The designer of an RBC plant should consider provisions to provide additional operational flexibility such as controlled flow to multiple first stages, alternate flow and staging arrangements, removable baffles between stages, and provision for step feed and supplemental aeration.

(g) Activated sludge facilities.

(1) Organic loading rates. Aeration tank volumes should be based upon full scale experience, pilot scale studies, or rational calculations based upon commonly accepted design parameters such as food to microorganism ratio, mixed liquor suspended solids, and the solids retention time. Other factors to be considered include size of the treatment plant, diurnal load variations, return flows and soluble organic loads from digesters, or sludge dewatering operations and degree of treatment required. Temperature, pH, and dissolved oxygen concentration are particularly important to consider when designing for nitrification. As a general rate, minimum aeration tank volumes shall be as set forth in the following table. Calculations must be submitted to fully justify the basis of design for any aeration basins not conforming to these minimum recommendations.

Figure: 30 TAC §317.4(g)(1)

DESIGN ORGANIC LOADINGS

Process	**Aeration Tank Organic Loading lb BOD_5/day/1,000 cubic feet**

Conventional[A]	45
Complete Mix	45
Contact Stabilization[B]	50
Extended Aeration	15
Oxidation Ditch[C]	15
Single Stage Nitrification	35

(A) The conventional activated sludge process is characterized by having a plug flow hydraulic regime wherein particles are discharged in the same sequence in which they enter the aeration basin. Plug flow may be approximated in long tanks with a high length-to-width ratio.

(B) The contact stabilization process divides the aeration tank volume between the reaeration zone and the contact zone. The ratio of reaeration volume to contact volume ranges from 1:1 to 2:1. The hydraulic detention time in the contact zone shall be sufficient to provide removals of soluble substrates to the required levels. For domestic flows normally two hours is sufficient in the contact zone. Contact zone volume shall be based upon acceptable removal kinetics for soluble BOD_5 and ammonia nitrogen.

(C) Oxidation ditches (which are organically loaded consistent with this paragraph) shall have a minimum hydraulic retention time of 20 hours based on design flow. These oxidation ditch systems shall provide final clarification and return sludge capability equal to that required for the extended aeration process. There shall be a minimum of two rotors per ditch, each capable of supplying the required oxygenation capacity and maintaining a minimum channel velocity of 1.0 foot per second with one rotor out of service. The ditch shall be lined with reinforced concrete or other acceptable erosion-resistant liner material. Provision shall be made to easily vary the liquid level in the ditch to control the immersion depth of the rotor for flexibility of operation. A motor of sufficient size to maintain the proper rotor speed for continuous operation shall be provided. Rotor bearings should have grease fittings that are readily accessible to maintenance personnel. Gear housing and outboard bearings should be shielded from rotor splash.

(2) Aeration basin general design considerations. Aeration tank geometry shall be arranged to provide optimum oxygen transfer and mixing for the type aeration

device proposed. Aeration tanks must be constructed of reinforced concrete, steel with corrosion-resistant linings or coatings, or lined earthen basins. Liquid depths shall not be less than 8.0 feet when diffused air is used. All aeration tanks shall have a freeboard of not less than 18 inches at peak flow. Access walkways with properly designed safety handrails shall be provided to all areas that require routine maintenance. Where operators would be required to climb heights greater than four feet, properly designed stairways with safety handrails should be provided. The shape of the tank and the installation of aeration equipment should provide a means to control short circuiting through the tank. For plants designed for design flows greater than 2.0 mgd the total aeration basin volume shall be divided among two or more basins. Each treatment facility shall be designed to hydraulically pass the design two-hour peak flow with one basin out of service.

(3) Sludge pumps, piping, and return sludge flow measurement. The pumps and piping for return activated sludge shall be designed to provide variable underflow rates of 200 to 400 gallons per day per square foot for each clarifier. If mechanical pumps are used, sufficient pumping units shall be provided to maintain design pumping rates with the largest single unit out of service. Sludge piping and/or channels shall be so arranged that flushing can be accomplished. A minimum pipe line velocity of three feet per second should be provided at an underflow rate of 200 gallons per day per square foot. Some method shall be provided to measure the return sludge flow from each clarifier.

(4) Aeration system design.

(A) General design consideration. Aeration systems shall be designed to maintain a minimum dissolved oxygen concentration of 2.0 mg/liter throughout the basin at the maximum diurnal organic loading rate and to provide thorough mixing of the mixed liquor. The design oxygen requirements for activated sludge facilities are presented in the following table. The minimum air volume requirements may be reduced with appropriate supporting performance evaluations from the manufacturer.

Figure: 30 TAC §317.4(g)(4)(A)

Process	**Minimum O_2 Required lb O_2/lb BOD_5**	**Minimum[i] Air Required SCFM/lb BOD_5**

Conventional	1.2	1800
Complete Mix	1.2	1800
Contact Stabilization	1.2	1800
Extended Aeration	2.2	2850
Oxidation Ditch	1.6 (2.2)[ii]	
Nitrification	2.2	3200

(i) Minimum air volume requirements are based upon a transfer efficiency of 4.0% in wastewater for all activated sludge processes except extended aeration, for which a wastewater transfer efficiency of 4.5% is assumed.

(ii) Value in parentheses represents the minimum oxygen requirement for ditch type systems which will achieve nitrification.

(B) Diffused air systems.

(i) Volumetric aeration requirements. Volumetric aeration requirements shall be as determined from the preceding table unless certified diffuser performance data is presented which demonstrates transfer efficiencies greater than those used in the preparation of the table. Wastewater transfer efficiencies may be estimated for:

(I) coarse bubble diffusers by multiplying the clean water transfer efficiency by 0.65%;

(II) fine bubble diffusers by multiplying the clean water transfer efficiency by 0.45%. The maximum allowable wastewater transfer efficiency shall be 12%. Plants treating greater than 10% industrial wastes shall provide data to justify actual wastewater transfer efficiencies. Wastewater oxygen transfer efficiencies greater than 12% are considered innovative technology. See §317.1(a)(2)(C) of this title (relating to General Provisions) for performance bond requirements. Clean water transfer efficiencies obtained at 20 degrees Celsius shall be adjusted to reflect field conditions (i.e., wastewater transfer efficiencies) by use of the following equation.

Figure: 30 TAC §317.4(g)(4)(B)(i)(II)

$$\text{Air Flowrate} = \frac{(\text{lbs.BOD5/day})\ (\text{lbs.}O_2\ \text{Req'd/lb.BOD5})}{\text{Required (scfm) Wastewater T.E.x } 0.23 \times 0.075 \times 1440}$$

Where:

Wastewater T.E. = Wastewater Transfer Efficiency, %
0.23 = lb O_2/lb air at 20 degrees Celsius
1440 = minutes/day
0.075 = lb of air/(cubic foot)

(ii) Mixing requirement. Air requirements for mixing should be considered along with those required for the design organic loading. The designer is referred to Table 14-V, aerator mixing requirements in Wastewater Treatment Plant Design, a joint publication of the American Society of Civil Engineers and the Water Pollution Control Federation.

(iii) Blowers and compressors. Blowers and compressors shall be of such capacity to provide the required aeration rate as well as the requirements of all supplemental units such as airlift pumps. Multiple compressor units shall be provided and shall be arranged so the capacity of the total air supply may be adjusted to meet the variable organic load to be placed on the treatment facility. The compressors shall be designed so that the maximum design air requirements can be met with the largest single unit out of service. The blower/compressor units shall automatically restart after a period of power outage or the operator or owner shall be notified by some method such as telemetry or an auto-dialer. The specified capacity of the blowers or air compressors, particularly centrifugal blowers, should take into account that the air intake temperature may reach 104 degrees Fahrenheit (40 degrees Celsius) or higher and the pressure may be less than standard (14.7 pounds per square inch absolute). The capacity of the motor drive should also take into account that the intake air may be 10 degrees Fahrenheit (-12 degrees Celsius) or less and may require oversizing of the motor or a means of reducing the rate of air delivery to prevent overheating or damage to the motor.

(iv) Diffusers and piping. Each diffuser header shall include a control valve. These valves are basically for open/close operation but should be of the throttling type. The depth of each diffuser shall be adjustable. The air diffuser system, including piping, shall be capable of delivering 150% of design air requirements. The aeration system piping should be designed to minimize headlosses. Typical air velocities in air delivery piping systems are presented in the following table.

Figure: 30 TAC §317.4(g)(4)(B)(iv)

Pipe Diameter (Inches)	**Velocity (Feet/min. -Std.Air)**
1 - 3	1,200 -

	1,800
4 - 10	1,800 - 3,000
12 - 24	2,700 - 4,000
30 - 60	3,800 - 6,500

(5) Mechanical aeration systems. Mechanical aeration devices shall be of such capacity to provide oxygen transfer to and mixing of the tank contents equivalent to that provided by compressed air. A minimum of two mechanical aeration devices shall be provided. Two speed or variable speed drive units should be considered. The oxygen transfer capability of mechanical surface aerators shall be calculated by the use of a generally accepted formula and the calculations presented in the engineering report. Proposed clean water transfer rates in excess of 2.0 pounds per horsepower-hour shall be justified by performance data. In addition to providing sufficient oxygen transfer capability for oxygen transfer, the mechanical aeration devices shall also be required to provide sufficient mixing to prevent deposition of mixed liquor suspended solids under any flow condition. A minimum of 100 horsepower per million gallons of aeration basin volume shall be furnished.

(h) Nutrient removal.

(1) Nitrogen removal. Biological systems designed for nitrification and denitrification may be utilized for the conversion/removal of nitrogen. Various physical/chemical processes may be considered on a case-by-case basis.

(2) Phosphorus removal.

(A) Chemical treatment. Addition of lime or the salts of aluminum, or iron may be used for the chemical removal of soluble phosphorus. The phosphorus reacts with the calcium, aluminum, or iron ions to form insoluble compounds. These insoluble compounds may be flocculated with or without the addition of a coagulant aid such as a polyelectrolyte to facilitate separation by sedimentation. When adding salts of aluminum or iron, the designer should evaluate the wastewater to ensure sufficient alkalinity is available to prevent excessive depression of the wastewater or effluent pH. This is of particular importance when the system will also be required to achieve nitrification. The designer is referred to Nutrient Control, Manual of Practice FD-7 Facilities Design, published by the Water Pollution Control Federation and the Process Design Manual for Phosphorus Removal, published by the Environmental Protection Agency, for additional information.

(B) Biological phosphorus removal. Biological phosphorus removal systems will be considered on a case-by-case basis for systems which can produce operating data which demonstrate the capability to remove phosphorus to the required levels. All biological systems which are required to meet a 1.0 mg/liter effluent phosphorus concentration shall make provision for standby chemical treatment to ensure the 1.0 mg/liter is achieved.

(i) Aerated lagoon.

(1) Horsepower. Mechanical aeration units in aerated lagoons shall have sufficient power to provide a minimum of 1.6 pounds of oxygen per pound of BOD_5 applied with the largest unit out of service. If oxygen requirements control the amount of horsepower needed, proposed oxygen transfer rates in excess of two pounds per horsepower-hour must be justified by actual performance data. The amount of oxygen supplied or the pounds of BOD_5 per hour that may be applied per horsepower-hour may be calculated by the use of any acceptable formula. The combined horsepower rating of the aeration units shall not be less than 30 horsepower per million gallons of aerated lagoon volume.

(2) Construction. Earthen ponds shall have large sections of concrete slabs or equivalent protection under each aeration unit to prevent scouring of the earth. Concrete scour pads shall be used in all areas where the velocity exceeds one foot per second. Earthen ponds shall have protection on the slopes of the embankment at the water line to prevent erosion of the slopes from the turbulence in the lagoon. Where the horsepower level is more than 200 horsepower per million gallons of lagoon volume, the pond embankment at the water line shall be protected from erosion with riprap which may be concrete, gunite, a six-inch thick layer of asphalt-saturated or cement-stabilized earth rolled and compacted into place, or suitable rock riprap. The crest and dry slopes of embankments shall be protected from erosion by planting of grass.

(3) Subsequent treatment, discharge systems. Aerated lagoon effluent will normally be routed to additional ponds for secondary treatment and to provide sufficient detention time for disinfection. The secondary ponds system shall consist of two or more ponds. Secondary pond sizing shall not exceed 35 pounds of BOD_5 per acre per day. Hydraulic detention time in a combined aerated lagoon and secondary pond system shall be a minimum of 21 days (based on design flow) in order to provide adequate disinfection. In designing the secondary ponds, BOD_5 removal efficiency in the aerated lagoon(s) may be calculated using the following formula.

Figure: 30 TAC §317.4(i)(3)

$$E = \frac{1}{1+K\left(\frac{V}{Q}\right)}$$

Where:
E = efficiency of a complete mix of reactor without recycle
K = removal rate constant, day^{-1} (generally 0.5 day -1 for domestic sewage)
V = aeration basin volume, million gallons
Q = wastewater flow rate, in million gallons per day

(j) Wastewater stabilization ponds (secondary treatment ponds).

(1) Pretreatment. Wastewater stabilization ponds shall be preceded by facilities for primary sedimentation of the raw sewage. Aerated lagoons or facultative lagoons may be utilized in place of conventional primary treatment facilities.

(2) Imperviousness. All earthen structures proposed for use in domestic wastewater treatment or storage shall be constructed to protect groundwater resources. Where linings are necessary, the following methods are acceptable:

(A) in-situ or placed clay soils having the following qualities may be utilized for pond lining:

(i) more than 30% passing a 200-mesh sieve;

(ii) liquid limit greater than 30%;

(iii) plasticity index greater than 15; and

(iv) a minimum thickness of two feet;

(B) membrane lining with a minimum thickness of 20 mils, and an underdrain leak detection system;

(C) other methods with commission approval.

(3) Distribution of flow. Stabilization ponds shall be of such shape and size to insure even distribution of the wastewater flow throughout the entire pond. While the shapes of ponds may be dictated to some extent by the topography of the location, long narrow ponds are preferable and they should be oriented in the direction of the prevailing wind such that debris is blown toward the inlet. Ponds with narrow inlets or sloughs should be avoided.

(4) Access area. Storm water drainage shall be excluded from all ponds. All vegetation shall be removed from within the pond area during construction. Access areas shall be cleared and maintained for a distance of at least 20 feet from the outside toes of the pond embankment walls.

(5) Multiple ponds. The use of multiple ponds in pond systems is required. The operation of the ponds shall be flexible, enabling one or more ponds to be taken out of service without affecting the operation of the remaining ponds. The ponds shall be operated in series during routine operation periods.

(6) Organic loading. The organic loading on the stabilization ponds, based on the total surface area of the ponds, shall not exceed 35 pounds of BOD_5 per acre per day. The loading on the initial stabilization pond shall not exceed 75 pounds of BOD_5 per acre per day.

(7) Depth. The stabilization ponds or cells shall have a normal water depth of three to five feet.

(8) Inlets and outlets. Multiple inlets and multiple outlets are required. The inlets and outlets shall be arranged to prevent short circuiting within the pond so that the flow of wastewater is distributed evenly throughout the pond. Multiple inlets and outlets shall be spaced evenly. All outlets shall be baffled with removable baffles to prevent floating material from being discharged, and shall be constructed so that the level of the pond surface may be varied under normal operating conditions. Submerged outlets shall be used to prevent the discharge of algae.

(9) Embankment walls. The embankment walls should be compacted thoroughly and compaction details shall be covered in the specifications. Soil used in the embankment shall be free of foreign material such as paper, brush, and fallen trees. The embankment walls shall have a top width of at least 10 feet. Interior and exterior slope of the embankment wall should be one foot vertical to three feet horizontal. There shall be a freeboard of not less than two feet nor more than three feet based on the normal operating depth. All embankment walls shall be protected by planting grass or riprapping. Where embankment walls are subject to wave action, riprapping should be installed. Erosion stops and water seals shall be installed on all piping penetrating the embankments. Provisions should be made to change the operating level of the pond so the pond surface can be raised or lowered at least six inches.

(10) Partially mixed aerated lagoons.

(A) Horsepower. With partially mixed aerated lagoons, no attempt is made to keep all pond solids in suspension. Mechanical or diffused aeration equipment should be sized to provide a minimum of 1.6 pounds of oxygen per pound of BOD_5 applied with the largest unit out of service. Where multiple ponds are used in series, the power input may be reduced as the influent BOD_5 to each pond decreases. proposed oxygen transfer rates in excess of two pounds per horsepower-hour must be justified by actual performance data.

(B) Pond sizing. Partially mixed aerated lagoons should be sized in accordance with the formula in subsection (i)(3) of this section using K-0.28. Pond length to width ratios should be three to one or four to one.

(C) Imperviousness. Requirements for imperviousness, multiple cells, embankment walls, and inlets and outlets shall be the same as for other secondary treatment ponds.

(k) Facultative lagoon (raw wastewater stabilization pond).

(1) Configuration. The length to width ratio of the lagoon should be three to one, with flow along the length from inlets near one end to outlets at the opposite end (other configurations may be approved if adequate means of prevention of short circuiting are provided). The length should be oriented in the direction of the prevailing winds with the inlet side located such that debris will be blown toward the inlet (generally, the north-northwest side). Inlet baffles shall be provided to collect flotable material. The outlets shall be constructed so that the water level of the lagoon may be varied under normal operating conditions. Storm water drainage shall be prevented from entering the lagoon. The design engineer may wish to locate the facultative lagoon in a central location with regard to the surrounding secondary ponds to facilitate compliance with the buffer zone requirement specified in Chapter 309 of this title (relating to Domestic Wastewater Effluent Limitations and Plant Siting).

(2) Imperviousness. Requirements for imperviousness shall be the same as those for secondary treatment ponds.

(3) Depth. The portion of the lagoon near the inlets shall have a 10 to 12 foot depth to provide sludge storage and anaerobic treatment. This deeper portion should be approximately 25% of the area of the lagoon bottom. The remainder of the pond should have a depth of five to eight feet.

(4) Organic loading. The organic loading, based on the surface area of the facultative lagoon, shall not exceed 150 pounds of BOD_5 per acre per day.

(5) Odor control. The facultative lagoon shall have multiple inlets and the inlets should be submerged approximately 24 inches below the water surface to minimize odor but not disturb the anaerobic zone. Capabilities for recirculation at 50% to 100% of the design flow should be provided. Care should be taken to avoid situations where siphoning of lagoon contents through submerged inlets can occur.

(6) Embankment walls. Refer to subsection (j)(9) of this section.

(7) Subsequent treatment. The facultative lagoon effluent will normally be routed to a wastewater stabilization pond system for secondary treatment. In designing the stabilization pond system, it may be assumed that BOD removal in the facultative lagoon is 50%. The stabilization pond system shall contain two or more ponds.

(l) Filtration. Filtration must be employed as a unit operation to supplement suspended solids removal for those treatment facilities with tertiary effluent limitations (suspended solids effluent quality equal to or less than 10 mg/liter). Filtration may be employed as a unit operation for those treatment facilities with secondary or advanced secondary effluent limitations. The utilization of filtration in the design of the treatment facility normally provides effective removal of suspended biological floc and neutral density trash material which may remain in secondary clarifier effluent. Intermittent filter operation is acceptable where on line controls monitor plant performance or filters are not necessary to meet a specific discharge limitation.

(1) General requirements.

(A) Filter units shall be preceded by final clarifiers designed in accordance with subsection (d) of this section for secondary treatment criteria.

(B) Filtered effluent, and not potable water, shall be utilized as the source of backwash water.

(2) Deep bed, intermittently backwashed granular media filters.

(A) Single media (sand filters), dual media (anthracite-sand filters), or mixed media filter types (nonstratified anthracite, sand, garnet, or other media) are acceptable for application; however, single media filters shall be designed for maximum filtration runs of six hours between backwash periods.

(B) Design filtration rates shall not exceed three gpm/square foot for single media filters, four gpm/square foot for dual media filters, and five gpm/square foot for mixed media filters. The filter area required shall be calculated utilizing the previously listed specified rates at the design flow of the facility. A minimum of two filter units shall be provided with the required filter area calculated with one unit out of service.

(C) Facilities to provide periodic treatment utilizing chlorine or other suitable agents, introduced to the influent stream of the filter units, shall be provided as an operational technique to control slime growth on the filter surface and the backwash storage basin.

(D) A graded gravel layer of a minimum of 15 inches or variable thickness of other filter media support material shall be provided over the filter underdrain system. Filter media support material other than gravel will be reviewed on a case-by-case basis. Normal media depths for the various filter types are as specified below. Media depths significantly different than these must be justified to the commission. The justification must include an analysis of the backwash rates. The uniformity coefficient shall be 1.7 or less. The particle size distribution for dual and mixed media filters shall result in a hydraulic grading of material during backwash which will result in a filter bed with a pore space graded progressively coarse to fine from the top of the media to the supporting layer.

Figure: 30 TAC §317.4(l)(2)(D)

Filter Type	**Type of Media**	**Minimum Depth (Inches)**	**Effective Particle Size (mm)**
Single Media	Sand	24	1.0-4.0
Automatic Backwash	Sand	11	1.0-4.0
Dual Media	Anthracite & Sand	16	
	Anthracite	10	1.0-2.0
	Sand	6	0.5-1.0
Mixed Media	Anthracite, Sand and Other	16	
	Anthracite	10	1.0-2.0
	Sand	4	0.6-0.8
	Garnet or Similar Material	2	0.3-0.6

(E) The unit piping for the filter units shall be designed to return backwash waste to upstream treatment units. In order to minimize a hydraulic surge, a backwash tank must be included into the design for those plants that do not have some means of flow equalization or surge control. A backwash tank shall be designed to provide storage for filter backwash based upon the number of design daily backwash cycles and the volume required for each backwash. Calculations must be provided to the commission demonstrating that the performance of the plant will not diminish with the discharging of the backwash water into the treatment process. Enclosed backwash tanks shall be vented to maintain atmospheric pressure. Surge control shall be provided to the backwash system to limit flow rate variations to no more than 15% of the design flow of the treatment units that will receive the backwash water. For these calculations, an influent lift station is not considered as a treatment unit and, therefore, is not bound by the 15% design flow requirement.

(F) Pumps for backwashing filter units shall be designed to deliver the required rate with the largest pump out of service. The backup pump unit may be uninstalled provided that the commission is satisfied that the spare unit can be quickly installed and placed into operation. Valve arrangement for isolating a filter unit for backwashing shall provide ready access for the operator. Provision for manual override shall be provided for any backwash system employing automatic control.

(G) Head loss indicators shall be provided for all filter units.

(H) Backwash for dual or mixed media filters shall provide a minimum bed expansion of 20%. A surface scour shall be provided prior to or during the backwash cycle. Backwash flow rates at 15 to 20 gpm/square foot and at a cycle time of 10 to 15 minutes should be provided. The backwash cycle shall provide media fluidization at the end of the cycle to restratify the media. Backwash for single media filters should be provided by a surface air scour or combination air-water scour and washwater at recommended rates as follows.

Figure: 30 TAC §317.4(l)(2)(H)

Air Scour	3 - 5 scfm/ft^2
Water Scour	0.5 - 2 gpm/ft^2
Backwash Water	6 - 8 gpm/ft^2

(I) The filter underdrain system shall be of a design adaptable to wastewater treatment, providing a uniform distribution of filter backwash and freedom from excessive orifice plugging. Wash water collection trough bottoms shall be located a minimum of six inches above the maximum elevations of the expanded media. A minimum freeboard of three inches shall be provided in addition to the design upstream depth of the wash water media. A minimum freeboard of three inches shall be provided in addition to the design upstream depth of the wash water trough to prevent submerged trough conditions during filter backwashing.

(3) Multi-compartmented low head filters with continuous operation (automatic backwash). This paragraph contains the design criteria for multi-compartmented low head filters where the applicable criteria are different than those contained in paragraphs (1) and (2) of this subsection. All other criteria included in paragraphs (1) and (2) of this subsection will apply to multi-compartmented low head filters with continuous operation.

(A) Filtration rates. Filtration rates shall not exceed three gpm/square foot for single media filters and four gpm/square foot for dual media filters based on the design flow rate applied to the filters. The total filter area should be provided in two or more units and the filtration rate shall be calculated on the total available filter area with one cell of each unit out of service. Manufacturer's recommended rates should be utilized if substantiated by test data.

(B) Backwash. The backwash rate shall be adequate to fluidize and expand each media layer a minimum of 20%. Provision should be made for an approximate rate of 10 gpm/square foot over a 30 to 60 second interval. Manufacturer's recommended rates should be utilized if substantiated by test data. Pumps for backwashing filter units shall be adequate to provide the required rate with the largest pump out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed unit can be easily removed and replaced. Waste filter backwash water shall be returned to upstream units, preferably the final clarifiers, for treatment.

(C) Backwash surge control. The rate of return of waste filter backwash water to treatment units shall be controlled such that the rate does not exceed 15% of the design flow of the treatment units. The hydraulic and organic load from waste backwash water shall be considered in the overall design of the treatment plant. Where waste backwash water is returned for treatment by pumping, adequate pumping capacity shall be provided with the largest unit out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed unit can be easily removed and replaced.

(4) Alternative design for effluent polishing. Where filters are proposed to remove remaining visible particles, other criteria will be considered on a case-by-case basis.

§317.5. Sludge Processing.

(a) General requirements.

(1) Disposal requirements, agreement with. Sludge processing and treatment shall be in agreement with the requirements of the ultimate form of disposal.

(2) Control of sludge and supernatant volumes. Provisions shall be made to insure that waste sludge will be discharged to the sludge digester in such a manner so as to minimize the volume of digester supernatant liquor. Provisions shall be made for the return of supernatant from sludge thickeners and digesters to the head of the treatment works or to the aeration system accounting for the impact on the treatment units.

(3) Piping. All piping from clarifiers to thickeners, digesters, or other sludge processing facilities shall be arranged for ease of maintenance and with sufficient hydraulic gradient to insure the flow of sludge. Piping under stationary structures shall be arranged so that stoppages can be readily eliminated by rodding or with sewer cleaning devices. The sludge piping within the digester, including the sludge drain line, shall be a minimum of four inches in diameter. Appropriate facilities for transfer of supernatant liquor shall be provided. Piping shall include means to observe the quality of the supernatant from each of the withdrawal outlets provided. All units shall be capable of being drained independently of one another.

(4) Sludge pumps. Selection of sludge transfer pumps shall be based on both the quantity and character of the anticipated solids load to be handled by them. Where mechanical pumps are used, a sufficient number of pumps shall be provided so that the design pumping capacity is available with the largest sludge pump out of service. Air lift pumps are an acceptable mechanism for sludge transfer. Duplicate design pumping capacity is not required when air lift pumps are used. Pumps used for pumping sludge shall be specifically designed for that purpose. Centrifugal sludge pumps shall have a positive suction head unless they are self-priming or equipped with some other priming device acceptable to the commission.

(5) Sludge stabilization. Sludge stabilization is required for all biological treatment processes with the exception of extended aeration processes (with a solids retention time (SRT) of 20 days or more) in which case the sludge may be drawn directly to a sludge dewatering facility.

(6) Sizing. Sizing requirements must be determined using the five-day biochemical oxygen demand (BOD5) and design flow of the raw sewage influent to the plant.

(b) Aerobic digesters.

(1) Sludge thickening. Aerobic digesters should be provided with sludge thickening capability.

(2) Aeration. Air supplied from air compressors or blowers through diffusers shall be not less than 30 standard cubic feet per meter (scfm) per 1,000 cubic feet of aerobic digester volume. If a separate system of air compressors or blowers will supply air to the digester, then the compressor or blower system shall be designed so that the air requirements can be met with the largest single unit out of service. If mechanical aerators are used, a minimum of 1.5 horsepower per 1,000 cubic feet must be provided.

(3) Mixing. Adequate mixing of the sludge shall be provided to keep the solids in suspension and to bring the deoxygenated liquid continuously to the aeration device. The amount of mixing shall be based upon the sludge characteristics, the tank geometry, and type of aeration mixing devices.

(4) Volume. A digester shall provide a minimum sludge retention time of 15 days. The design volume of the aerobic digesters may be calculated using 20 cubic feet per pound BOD_5 per day. This volume should be provided in two cells capable of operating as a single or two-step unit.

(5) Sludge withdrawal. Provisions shall be made to include an effective means of removing solids from the digester.

(c) Anaerobic digesters.

(1) Volume. The following minimum design criteria shall be used in computing the capacity of digesters with and without facilities for heating the sludge undergoing digestion and without sludge thickening ahead of the digester. Variances to the table referenced as follows for minimum digester volume may be granted provided that it can be demonstrated to the satisfaction of the commission that a minimum SRT of 30 days will be provided for unheated digesters and a minimum SRT of 15 days will be provided for heated digesters. Heating of the digester means that adequate facilities shall be provided for heating and mixing the sludge and maintaining a year-round temperature of at least 95 degrees Fahrenheit. Heating coils inside the digester are not acceptable. All heated digesters shall include a thermometer with not less than a four-inch dial to indicate the temperature of digester contents. The use of flat-bottomed digestion chambers is not acceptable. In sewage treatment plants employing sludge thickeners, the volume of the digester may be reduced, with sufficient justification, as a result of the thickeners reducing the volume of sludge going to the digester. The

calculations for the required sludge digestion volume shall be based on the minimum percent solids in the sludge expected to be encountered.

Figure: 30 TAC §317.5(c)(1)

Type of Sludge	Cubic Feet Per Pound BOD_5 per day Unheated Digester	Cubic Feet Per Pound BOD_5 per day Heated Digester
Sludge from primary clarifiers	20.5	14.5
Sludge from primary clarifiers, including Imhoff tanks, plus sludge from clarifiers following trickling filters; sludge from chemical precipitation units, either alone or with sludge from biological treatment unit	26.5	19.0
Sludge from primary clarifiers with waste activated sludge or contact stabilization sludge; sludge from secondary clarifiers	44.0	29.5

(2) Mixing. Adequate mixing of digester contents is required for all first-stage and all single-stage digesters. Mixing may be performed by mechanical equipment, including external pumps, or by gas recirculation. The rate of mixing shall be such that the flow created in the digester is sufficient to completely mix the incoming sludge with the digester contents and prevent the formation of a scum layer.

(3) Digester covers. Uncovered anaerobic digesters are not acceptable. The sludge and supernatant withdrawal piping for all single-stage and first-stage digesters with fixed covers shall be arranged in such a manner so as to minimize the possibility of air being drawn into the gas chamber above the liquid in the digester. All digester covers shall include a gas chamber adequate for the gas production anticipated. Digester covers shall be gas tight and the specifications shall require a test of every digester cover for gas leakage.

(4) Gas piping and safety equipment. The gas piping shall be adequate for the volume of gas to be handled and shall be pressure tested for leakage (at 1.5 times the design pressure) before the digester is placed into operation. All gas piping shall slope at least 1/8 inch per foot to provide drainage of condensation in the gas piping. The main gas line from the digester shall have a sediment trap equipped with a drip trap. Drip

traps shall be provided at all other low points in gas piping. The gas piping to every gas outlet including the pilot line to the waste gas burner shall be equipped with flame checks or flame traps. A natural or bottled gas source shall be utilized for the burner pilot. Flame traps with fusible shutoffs shall be included in all main gas lines. The gas line to the waste gas burner shall include a suitable pressure, vacuum and relief valve. Digester covers shall be equipped with an air vent which includes a flame trap, a vacuum breaker, and pressure relief valve. The main gas line shall be provided with a manometer or other acceptable device which measures the gas pressure in inches of water. Manometers may be used to measure the gas pressure in other gas lines. All manometers shall be vented to the atmosphere outside digester buildings. A gas meter to measure the rate of gas production is desirable and is mandatory on all anaerobic digester systems designed for 1.0 mgd facilities or larger. All rooms in digester buildings with floor level below grade shall be ventilated. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least six complete air changes per hour; if intermittent, at least 30 complete air changes per hour.

(5) Other requirements. The discharge end of sludge inlet piping shall be separated from the overflow of the supernatant liquor withdrawal point by a minimum distance equal to the radius of the digester tank. Every digester shall be provided with an overflow. A means shall be provided by which the level can be varied from which supernatant liquor is withdrawn either automatically or by the operator. If this means is by withdrawal pipes at different levels in the digester, at least three different levels of supernatant liquor withdrawal shall be provided. All supernatant liquor withdrawal systems shall be provided with sampling cocks or other means of inspecting and testing the supernatant liquor from each level. Piping for hot water heating systems may be of any size adequate for the flow. The fresh water supply to hot water heating systems shall be from a tank with an air gap between the top of the tank and the fresh water supply pipe to prevent a cross connection between the digester hot water system and the fresh water supply system.

(6) Treatment of digester supernatant liquor. Supernatant liquor from anaerobic digesters may be treated by chemical means or other acceptable methods before being returned to the plant. If the commonly used method of dosing with lime is employed, the following criteria shall apply: lime shall be applied to obtain a pH of 11.5. The lime feeder shall be capable of feeding 2,000 mg/liter of hydrated lime or its equivalent. The lime shall be mixed with the supernatant liquor by a rapid mixer or by agitation with air in a mixing chamber. After adequate mixing, the solids shall be allowed to settle. The supernatant liquor treatment system may be a batch or continuous process. If a batch process is used, the mixing and settling may be in the same tank. The sedimentation tank shall have a capacity to hold 36 hours of supernatant liquor but not less than 1.5 gallons per capita. If a continuous process is used, the sedimentation tank shall have a detention time of not less than eight hours. Solids settled from the supernatant liquor treatment are to be returned to the digester or conveyed to sludge

handling facilities. The clarified supernatant liquor shall be returned to the head of the treatment works or to the aeration system.

(d) Other stabilization processes.

(1) Incineration and heat treatment. The equipment shall be housed in a fireproof building. Adequate facilities shall be provided for storage of sludge during the longest period that drying and or incineration units might normally be out of service for repairs or maintenance. Plans for control of odors, insects, fly ash, and for adequate facilities for the disposal of dried sludge or ash shall be provided to the commission. Prior to construction of an incineration or heat treatment facility, consultation should be made to the Texas Air Control Board for applicable emission standards and the possible requirement for a separate Texas Air Control Board permit.

(2) Composting, wet oxidation, and other processes. Design information given to the commission shall include the demonstrated level of stabilization achieved by the process to be employed. Test results to verify the degree of stabilization may be required. In addition, design information shall address design and/or operational methods to minimize odor, insects, and other nuisance conditions. Sludge storage requirements for each process shall be provided to the commission. Also, the ultimate disposal method for the processed sludge shall be reflected in the waste disposal application.

(e) Sludge dewatering facilities. Sludge shall be dewatered sufficiently to meet the requirements of the ultimate form of disposal.

(1) Sludge drying beds.

(A) Required area. The area of sludge drying beds to be provided will vary in accordance with the average rainfall, average humidity, and type of treatment process used. The required area for aerobic sludge dewatering shall be determined from §317.12 of this title (relating to Appendix D) (for anaerobic sludge dewatering, the value obtained from §317.12 of this title) may be reduced 35% to determine the required area) using a waste load based on sewage strength and the daily average flow of the raw sewage. The bed area sizing requirements shown in §317.12 of this title are for sludge drying beds utilizing a continuous underdrain media as specified in this subsection. Concrete (or similar impervious material) sludge drying beds which do not use an underdrain media may require additional area and will be evaluated on a case-by-case basis; however, in those counties of the state which experience both high rainfall and high relative humidity (Brazoria, Chambers, Fort Bend, Galveston, Hardin, Harris, Jasper, Jefferson, Liberty, Newton, and Orange), other methods of sludge dewatering should be utilized in lieu of sludge drying beds. Where sludge drying beds are used in those counties of high rainfall and humidity, provisions shall be made in the design of these beds for covering the beds, for means of accelerated dewatering, or for extra storage capacity and alternate dewatering methods to effectively dewater the sludge during inclement weather.

(B) General design features. At least two sludge drying beds shall be provided and they shall be constructed at elevations above groundwater level. Construction shall be such as to exclude surface water runoff from the beds and seepage from the beds into the ground. Channels shall be of sufficient grade and size to facilitate the flow of the sludge to the various beds. Runners should be provided to facilitate sludge handling.

(C) Filtrate. The filtrate (or drainage) from the sludge drying beds shall be returned to the head of the treatment works or to the aeration system.

(D) Sludge removal. A splash block or slab shall be provided at the point where digested sludge is discharged onto each of the beds. Appropriate means shall be provided to facilitate the removal of the dried sludge from the beds for disposal without bed damage resulting. Every sludge drying bed should include a removal gate or stop planks in one end to provide access for machinery and trucks to remove and haul away the dried sludge.

(E) Media. A minimum depth of 12 inches of filtering material, of which four to six inches is coarse sand, is required. To exclude surface water and eroded earth, the bed shall be protected by a permanent wall which shall extend at least 12 inches but not more than 24 inches above the finished surface of the beds.

(2) Vacuum filters, belt filters, belt filter presses, and other mechanical dewatering filters.

(A) Multiple units. Where dewatering of sludge is proposed, the design engineer shall provide data to document sufficient capacity, alternate disposal means, or storage facilities capable of maintaining normal daily operations during breakdowns, upsets, etc.

(B) Filtrate. The filtrate from the filters shall be returned to the head of the treatment works or to the aeration system. Consideration shall be given to the impact of the returned filtrate on the treatment units and to providing odor and insect control facilities.

(3) Portable dewatering units. If sludge is to be treated using portable mechanical dewatering units, provisions shall be made in the facility plan or preliminary engineering report for the location and connection of the portable dewatering unit(s) during facility operation.

Adopted November 4, 2015 Effective November 26, 2015

§317.6. Disinfection.

(a) General policy. Facilities for disinfection shall be provided to protect the public health and as an aid to plant operation.

(b) Chlorination facilities.

(1) Chlorination equipment. Chlorination equipment shall be selected and installed which is capable of applying desired amounts of chlorine continuously to the effluent. Chlorination equipment may also be installed to control odors and generally assist treatment. To accomplish these objectives, points of chlorine application may be established at the head of the plant for prechlorination, in the effluent chlorine contact chamber, or other suitable locations.

(A) Capacity. Chlorination equipment shall have a capacity greater than the highest expected dosage to be applied. Chlorination systems shall be capable of operating under all design hydraulic conditions. Duplicate equipment with automatic switchover should be considered for standby service, so that continuous chlorination can be provided.

(B) Controls. Means for automatic proportioning of the chlorine amount to be applied in accordance with the rate of effluent being treated is encouraged for all plants and may be required if a maximum chlorine residual is required in the applicable discharge permit. Manual control will be permitted where the rate of effluent flow is relatively constant and for prechlorination applications. Consideration shall also be given to controlling chlorine feed by use of demand.

(C) Measurements. A scale for determining the amount of chlorine used daily, as well as the amount of chlorine remaining in the container, shall be provided.

(D) Safety equipment. Self-contained breathing apparatus shall be available for use by plant personnel. The equipment should be located at a safe distance from the chlorine facilities to insure accessibility. Self-contained breathing apparatus shall be located outside the entrance to the chlorine facility.

(E) Housing. Housing of chlorination equipment and cylinders of chlorine shall be in separate rooms above ground level, with the door opening to the outside, as a measure of safety. Doors should be equipped with panic hardware. The chlorination room should be separated from other rooms by gas-tight partitions and should be equipped with a clear glass, gas-tight window which permits the chlorinator to be viewed without entering the room. Forced mechanical ventilation shall be included in chlorination rooms which will provide a complete air change a minimum of every three minutes. The exhaust equipment should be automatically activated by external light switches and gas detectors that are provided with contact closures or relays. No other equipment shall be installed or stored in the chlorinator room. Vents from chlorinators, vaporizers, and pressure reducing values should be piped to the outdoors at a point not frequented by personnel, nor near a fresh air intake. Detectors and alarms should be located in each area containing chlorine gas under pressure. If gas withdrawal chlorine storage cylinders are subjected to direct sun, pressure reducing devices must be provided at the cylinders. Fire protection devices and fireproof construction is required for all chlorine storage areas. Electrical controls in chlorine facilities must be replaceable or protected against corrosion. Separate, trapless floor drains or a drain to an ample dilution point shall be provided from the chlorine storage room and from liquid feed chlorinator rooms.

(F) Emergency chlorination. Emergency power should be provided for chlorination facilities.

(G) Other. Chlorine rooms shall maintain a minimum temperature of 65 degrees Fahrenheit. Chlorinate solution should be prepared using treated effluent. If potable water is used, the potable water supply system must be protected by an adequate backflow prevention device. When a booster pump is required, duplicate equipment should be provided.

(2) Pellets. The use of pellet systems will be considered for approval on a case-by-case basis.

(3) Chlorine contact chamber design criteria.

(A) Initial mixing. Rapid initial mixing of the chlorine solution and wastewater is essential for effective disinfection. Effective initial mixing can be accomplished by applying the chlorine solution in a highly turbulent flow regime created by in-line diffusers, submerged hydraulic structures, mechanical mixers, or jet mixers. The mean velocity gradient in the area of turbulent flow, or G value, shall exceed 500 sec.-1 with residence times of three to 15 seconds. Calculations supporting the design G value shall be presented in the engineering report. Mixing devices for which the mean velocity gradient is difficult to verify shall be justified by pilot or full-scale performance data.

(B) Contact time. Contact chambers shall be designed to provide a minimum average hydraulic residence time (chamber volume divided by flow) of 20 minutes at the design peak hydraulic flow.

(C) Contact chamber configuration. Pipe contact chambers shall be sized so that a scour velocity of at least one foot per second will be obtained at the existing maximum daily dry weather flow rate. If adequate initial mixing is not provided, contact chambers shall have a flow pathway length-to-width ratio of at least 40 and a maximum depth-to-width ratio of no greater than 1.0. This length-to-width ratio may be accomplished by baffling.

(D) Sludge and scum removal. Contact chambers shall either be provided with a means to remove sludge and scum, such as a small hydraulic dredge and skimmers, without taking the contact tank out of service, or shall be configured so that one-half of the contact chamber can be drained for cleaning without interrupting flow through the other half.

(c) Other means of disinfection.

(1) Chemical disinfection is not normally required when the total residence time in the wastewater treatment system (based on design flow) is at least 21 days.

(2) Ultraviolet light (UV) disinfection.

(A) General. Ultraviolet disinfection systems are considered applicable to treated wastewaters with daily average five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) concentrations consistently less than 20 milligrams per liter (mg/liter).

(B) Definitions.

(i) Ultraviolet module--A grouping of UV germicidal lamps of a specified arc length in a quartz or teflon sleeve, sealed and supported in a single stainless steel or some other noncorrosive frame.

(ii) Ultraviolet bank--A grouping of UV modules which span the entire width and depth (of flow) of the reactor.

(C) Sizing, configuration, and required dosage. Ultraviolet disinfection units will be designed in accordance with methodologies presented in the United States Environmental Protection Agency Design Manual, Municipal Disinfection, EPA/625/1-86/021. Turbulent flow is necessary due to non-uniform intensity fields in an ultraviolet reactor. The proposed design shall have a Reynolds' number of greater than 6,000 at average design flows. Disinfection systems shall consist of a minimum of two ultraviolet banks in series and shall be capable of providing disinfection to permitted fecal coliform levels at the design daily average flow with the largest bank out of service.

(D) System details. The ultraviolet unit shall be configured so that there is adequate space for the removal and maintenance of lamps. One person should be able to replace lamps without the aid of mechanical lifting devices, special tools, or equipment. Drains shall be provided to completely drain the ultraviolet reactor unless the equipment can be easily removed from the effluent channel, but lamps shall be replaceable without draining the unit. The materials used to construct the reactor shall be resistant to ultraviolet light. Ballasts and other electrical components shall be consistent with the ultraviolet lamp manufacturer's recommendations. Temporary screens shall be installed to protect the lamps and other fragile components from construction debris.

(E) Controls. Each individual ultraviolet lamp shall be provided with a remote operation indicator. Lamp failure alarms shall also be provided for a predetermined number of lamp failures. Techniques that result in nonirradiated flow pathways are prohibited. Each ultraviolet bank shall be equipped with at least one ultraviolet intensity meter or some means to monitor changes in ultraviolet dosage; however, intensity meters shall not be relied upon to automatically control system operation. A flow control device, such as an automatic level control, shall be provided to ensure that the lamps are submerged in the effluent at all times regardless of flow rate. The automatic level control shall be arranged so that it will allow suspended solids, which may settle, to be washed out of the area of UV disinfection. Proper heating and ventilation are critical to ultraviolet system operation. Cabinets containing ballasts and or transformers shall be provided with positive filtered air ventilation and automatic shutdown alarms at high temperatures. Provisions shall also be made to maintain the ultraviolet lamps at or near their optimum operating temperature and to filter ventilating air so as to limit ultraviolet light absorbance by dust accumulations. Elapsed operation time meters shall be provided for each bank of ultraviolet lamps.

(F) Cleaning. Provisions for routine cleaning such as mechanical wipers, high pressure sprayers, ultrasonic transducers, or chemical cleaning agents are required. Quartz sleeve ultraviolet systems shall have a chemical cleaning capability in addition to any ultrasonic and/or mechanical wiper systems. Cleaning solution mix and storage tanks shall have a volume of at least 125% of the reactor volume to be cleaned. A spent cleaning solution disposal plan shall be included in the engineering report.

(G) Safety. Operators shall be protected from exposure to ultraviolet light during normal operations.

(H) Replacement parts. Replacement part provisions shall be based on:

(i) the following table which summarizes minimum requirements as a percentage of the total provided in the ultraviolet system; or

(ii) a minimum of one uninstalled spare module.

Figure: 30 TAC §317.6(c)(2)(H)(ii)

Part Description	**Minimum Percent of Total**
Lamps	10
Ballast	5
Enclosure Tubes	5
Modules*	2

* (excluding lamps and enclosure tubes)

(3) Disinfection techniques not in widespread use, such as ozonation, bromine chloride, and chlorine dioxide, will be considered for approval on a case-by-case basis. Full details of application, operation, and maintenance, and results of pilot and developmental studies, shall be furnished to the commission by the design engineer for each proposal.

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§317.7. Safety.

(a) General policy. Design of facilities should follow guidelines established under 29 Code of Federal Regulations §1901.1 (Occupational Safety and Health Administration) and other regulatory authorities.

(b) Railings and stairways. Railings should conform with guidelines contained in 29 Code of Federal Regulations §1910.23. Openings in railings must have removable chains. Open valve boxes and pits must be guarded by railings. Refer to §317.4(a)(7) of this title (relating to Wastewater Treatment Facilities) for additional requirements. Steep and vertical ladders are acceptable for infrequent access to equipment. Walkways and steps must have a nonslip finish. Ladders must have flat safety tread rungs and extensions at least one foot out of a vault. Seven feet of clearance shall be provided for overhead piping, unless piping is padded to prevent head injury and warning signs are provided.

(c) Electrical code. Electrical design shall conform to local electrical codes. Where there are no local electrical codes, the design shall conform to the National Electrical Code. Where a flammable gas may exist, all electrical equipment shall conform to the requirements of the National Electrical Code, Chapter 5, Articles 500-510, "Hazardous Locations." The equipment shall bear the seal of the Underwriter Laboratories, Inc. or comply with the National Electrical Code. Adequate lighting must be provided, especially in areas to be serviced by personnel on duty during hours of darkness.

(d) Unsafe water. When nonpotable water is made available to any part of the plant, all yard hydrants and outlets shall be properly marked "Unsafe Water," and all underground and exposed piping shall be identified as specified in subsection (g) of this section.

(e) Plant protection. The plant area shall be completely fenced and have lockable gates at all access points. Plants containing open clarifiers, aeration basins, and other open tanks shall be surrounded by an eight-foot fence with a minimum single apron barbed wire outrigger. Livestock fence may be provided in lieu of an eight-foot fence for stabilization ponds, lagoons, overland flow plots, and similar facilities. Hazard signs stating "Danger--Open Tanks--No Trespassing" must be secured to the fence, within visible sighting of each other, as well as on all gates and levees. Plants shall have at least one all-weather access road with the driving surface situated above the 100-year flood plain or be provided by an alternate method of access approved by the commission.

(f) Other safety equipment. The plant as a whole, and hazardous areas in particular, shall be posted in accordance with the Hazardous Communication Act.

(g) Color coding of piping. All piping both exposed and to be buried or located out of view, containing gas, chlorine, or other hazardous materials, shall be color coded. Other piping should be color coded. All nonmetallic underground plant piping should be installed with tracer type. The nonpotable waterline should also be identified with a proper color coding. This line shall be painted white and be stenciled "NON-POTABLE WATER" or "UNSAFE WATER." The following coding is recommended by the Water Pollution Control Federation.

Figure: 30 TAC §317.7(g)

Sludge Line	Brown
Gas Line	Red
Potable Water Line	Blue
Chlorine Line	Yellow
Sewage Line	Grey
Compressed Air Line	Green

Heating Water Lines	Blue with 6" red bands spaced 30" apart
Power Conduit	Orange

(h) Portable ventilators and gas detection equipment. Portable gasoline operated ventilators must be provided for ventilating manholes. Personal gas detectors are required for wear by all personnel whose jobs require entering enclosed spaces capable of having accumulations of hydrogen sulfide or other harmful gases. An approved personnel retrieval system should be provided for continued space entry.

(i) Potable water. Potable water should be provided to the plant site. Double-check backflow preventers must be provided at the main plant service. Atmospheric vacuum breakers are required at all potable water washdown hoses.

(j) Freeze protection. All surfaces subject to freezing shall be adequately sloped to prevent standing water.

(k) Noise levels. Noise levels in all working areas shall be kept below standards established by the Occupational Safety and Health Act. Removable noise attenuators should not be utilized.

(l) Safety training. Regular safety training shall be provided to all employees.

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§317.8. Design and Operation Features.

(a) Laboratory control.

(1) Facilities. Laboratory capability for operational control and testing shall be provided. The laboratory should be located on ground level and easily accessible to the treatment plant and sampling points. The laboratory should be located away from vibrating machinery or equipment which could have an adverse effect on the performance of the operation of laboratory instruments. The extent of the equipment to be provided and the specific tests to be performed will vary according to capacity and type of plant. As a minimum, provisions should be made at all plants so that chemicals and equipment are available for performing such on-site tests as settleable solids (Imhoff cone), 30-minute settleability, dissolved oxygen, pH, and chlorine residual. For plants with a design flow of 1.0 mgd to 5.0 mgd, equipment shall also be provided to determine suspended solids concentration. All plants with design flows in excess of 5.0 mgd shall have access to facilities to provide all permit required compliance monitoring, plus volatile suspended solids, nitrogen series, and alkalinity determinations (if anaerobic sludge digestion is used). Alternately, such tests may be performed under

contract with other laboratories. Special consideration, for treatment plants located in remote or vandal prone areas, may be given by the commission to methods for storing chemicals and analytical equipment at an off-site location. Provisions shall be made in all cases to provide for the requirements of the commission self-reporting system procedures and for proper monitoring of significant industrial connections. These requirements are minimum requirements only; additional provisions may be needed to insure optimum plant operations. Raw waste characterization should be provided for all facilities with a design flow in excess of 5.0 mgd and for all facilities anticipating a plant expansion.

(2) Air conditioning. All laboratories shall be air conditioned and heated to maintain a constant temperature.

(b) Office and toilet facilities. Hand washing facilities should be provided for the protection of operating personnel. Office, showers, toilets, heating, proper lighting, and ventilation shall be provided where operators are to be stationed at the plant for operating shifts. The needs of male and female employees, the handicapped, and visitors to the plant should be considered in the design of sanitary facilities.

(c) Tool shed and workshop. Appropriate facilities should be provided for the storage of tools and spare parts, and a workshop should be provided to allow repairs and maintenance.

(d) Landscaping and beautification. Upon completion of the treatment plant, the grounds should be properly graded for surface drainage. Asphalt, concrete, gravel, or shell walkways should be provided for access to all treatment units and to the final sampling point. Where possible, steep slopes should be avoided to prevent erosion. Surface water shall not be allowed to drain into any unit. Particular care shall be taken to protect trickling filter beds, sludge drying beds, and intermittent sand filters from storm water runoff. Provision should be made for landscaping and plant site beautification, particularly when a plant is visible to the public.

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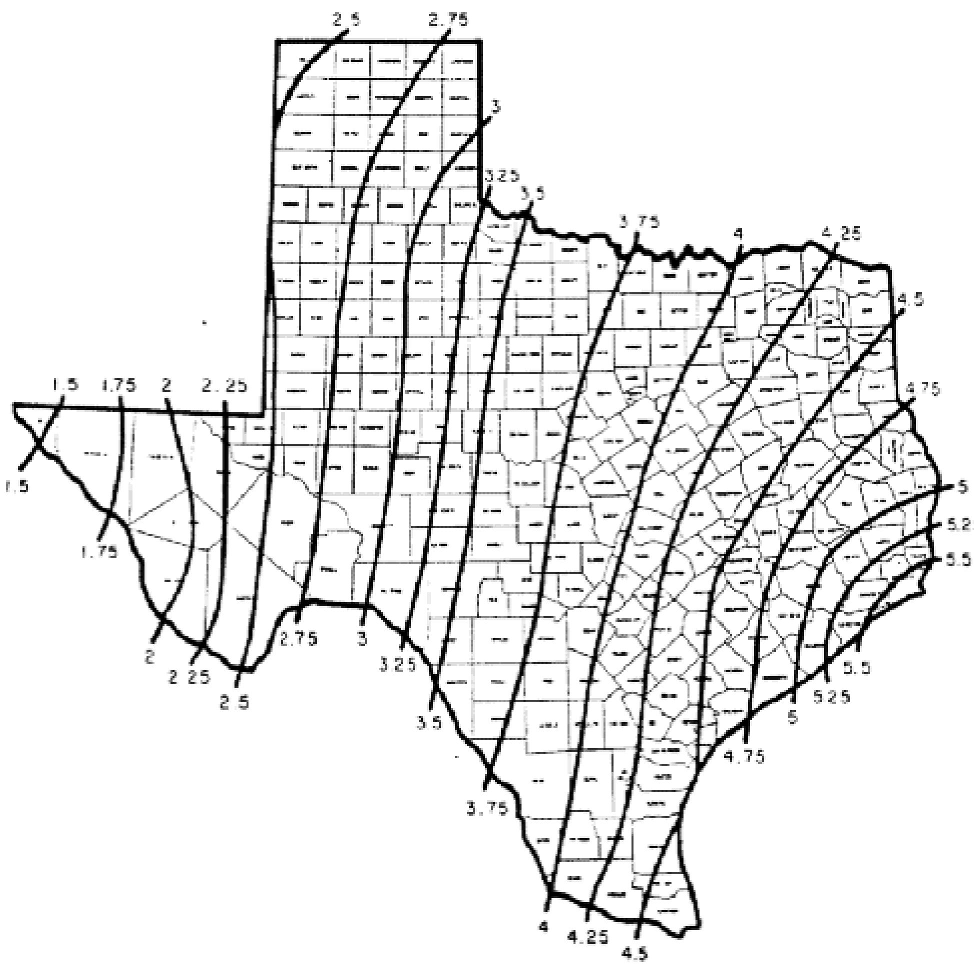
§317.9. Appendix A.

The following map establishes the maximum 24-hour rainfall at a two-year frequency.

Figure: 30 TAC §317.9

Rainfall
Maximum 24-Hour Rainfall,
Two-Year Frequency



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§317.10. Appendix B--Overland Flow Process.

The overland flow process is the application of wastewater along the upper portion of uniformly sloped and grass-covered land and allowing it to flow in a thin sheet over the vegetated surface to runoff collection ditches. The primary objective of this process is treatment of wastewater. Utilization of this process does result in a discharge and therefore a waste discharge permit from the Texas Water Commission is required. This process is best utilized on soils with low permeability. The performance of the overland flow process is dependent on the detention time of the wastewater on the vegetated sloped area. Therefore, in order to meet a specified effluent criteria, the hydraulic loading rate, the application rate, and the effectiveness of the distribution system are essential design considerations. For detailed process design guidance, the latest edition of the Environmental Protection Agency Technology Transfer Process Design Manual for Land Treatment of Municipal Wastewater may be used.

(1) Hydraulic loading rate. The hydraulic loading rate and application rate can vary depending on levels of pretreatment, quality of effluent, temperature, and other climatic conditions. A hydraulic loading rate of 1.5 to 2.0 inches per day and an application rate of six to eight gallons per hour per foot of slope width are suggested as general guides. The design rates selected and their justification shall be submitted in the design report.

(2) Wastewater storage. Storage capacity for inclement weather conditions shall be provided. To minimize the impact of algae on the treatment performance, this storage shall be designed as an off-line basin, used only as needed and emptied as soon as possible by blending with other pretreated wastewater prior to application. To control odors, provisions for aeration in the storage basin should be considered.

(3) Soil testing. For the overland flow process, the soil profile evaluation should extend to a depth of at least three feet. The soil sampling and testing specified in subsection (b) of this section shall be representative of the soil to this depth.

(4) Other design considerations.

(A) The overland flow process treatment area shall be subject to the same buffer zone requirement as a treatment plant.

(B) The minimum slope length for the applied wastewater shall be 100 feet.

(C) The sloped areas to receive wastewater shall be uniformly graded to eliminate wastewater ponding and short circuiting for the length of the flow. Site grading procedures and tolerances shall be included in the specifications. Minimum slopes shall equal or exceed 2.0%; maximum slope shall not exceed 8.0%. The application site shall be protected from flooding.

(D) The application cycle should provide a maximum of 10 hours for dosing followed by a minimum period of 14 hours of resting.

(E) The method of application shall provide uniform coverage of the area.

(F) A vegetative cover shall be provided on the application site. The plant types selected shall be suitable for overland flow conditions and shall provide uniform coverage of soil to prevent short circuiting and channelization of the area.

(G) Wastewater quality and disinfection requirements for overland flow process discharges will be established by the discharge permit.

(H) An effluent sampling station shall be provided prior to discharge to surface waters. The sampling and reporting requirements will be established by the discharge permit.

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§317.11. Appendix C--Hyacinth Basins.

(a) Introduction.

(1) Purpose. Hyacinths may be used for the removal of suspended solids from secondary effluent. Other proposed treatment applications, however, are not excluded by these criteria, and such proposals will be reviewed on a case-by-case basis.

(2) Other permits. The authority to use hyacinths is contingent upon obtaining a possession permit from the Texas Parks and Wildlife Department.

(3) Location. Uncovered hyacinth basins will be approved only in Cameron, Hidalgo, Kenedy, and Willacy Counties. Hyacinth basins elsewhere shall be covered with a greenhouse structure. A variance will be considered for systems which are designed for seasonal operation. Greenhouse design shall provide for adequate dike top width for equipment maneuverability, doors for personnel and equipment access, and openings for ventilation.

(b) Design.

(1) Multiple basins. Multiple basins shall be provided. Capacity to treat the design flow with one basin out of service shall be provided. A variance may be considered for systems which are designed for seasonal operation. Average water depth of basin shall not exceed 36 inches.

(2) Basin sizing and configuration. Multiple surface inlets and outlets shall distribute flow uniformly through the basin. This may be accomplished by a weir,

openings in a baffle, by a perforated pipe, or other methods. Basins of one acre or less in size are required. The bottom of the hyacinth basin shall be sloped to facilitate draining. A surge basin or some other method of flow equalization to achieve a more constant rate of inflow to the basin is desirable.

(3) Barrier. A fixed barrier creating a clear zone shall be installed at the outlet to prevent the discharge of hyacinths or hyacinth seed. While screening may be used as a barrier material, a permeable rock barrier is preferred. Water depth within the outlet area shall not be more than 24 inches with the bottom covered by a layer of broken rock or washed gravel.

(4) Loading. Organic loading of hyacinth basins shall not exceed 100 pounds per acre per day of five-day biochemical oxygen demand (BOD_5) unless supplemental aeration is provided to consistently maintain an aerobic surface water layer. The maximum hydraulic loading shall not exceed 0.20 million gallons per day per acre.

(5) Natural aerators and mosquito control. Exclosures shall be placed at intervals along basin edges to provide clear zones for aeration and to enhance fish production for mosquito control. Total area of exclosures should be approximately 20% of total basin area. Exclosures shall have a uniform depth of not more than 24 inches, with bottoms lined with broken rock or washed gravel. Plastic sheeting covered with a layer of broken rock or washed gravel, extending above and below operating water level, shall be placed all along inner basin berms to prevent weed growth and eliminate a mosquito breeding habitat.

(c) Operation.

(1) Harvesting. Adequate provisions for access, removal, and disposal of the hyacinth plants shall be provided. Removal shall be done mechanically.

(2) Cleaning. Each basin shall be cleaned once each year by dewatering and removing plants and sludge.

(3) Coverage. Plant coverage shall be limited to 90% of the basin area.

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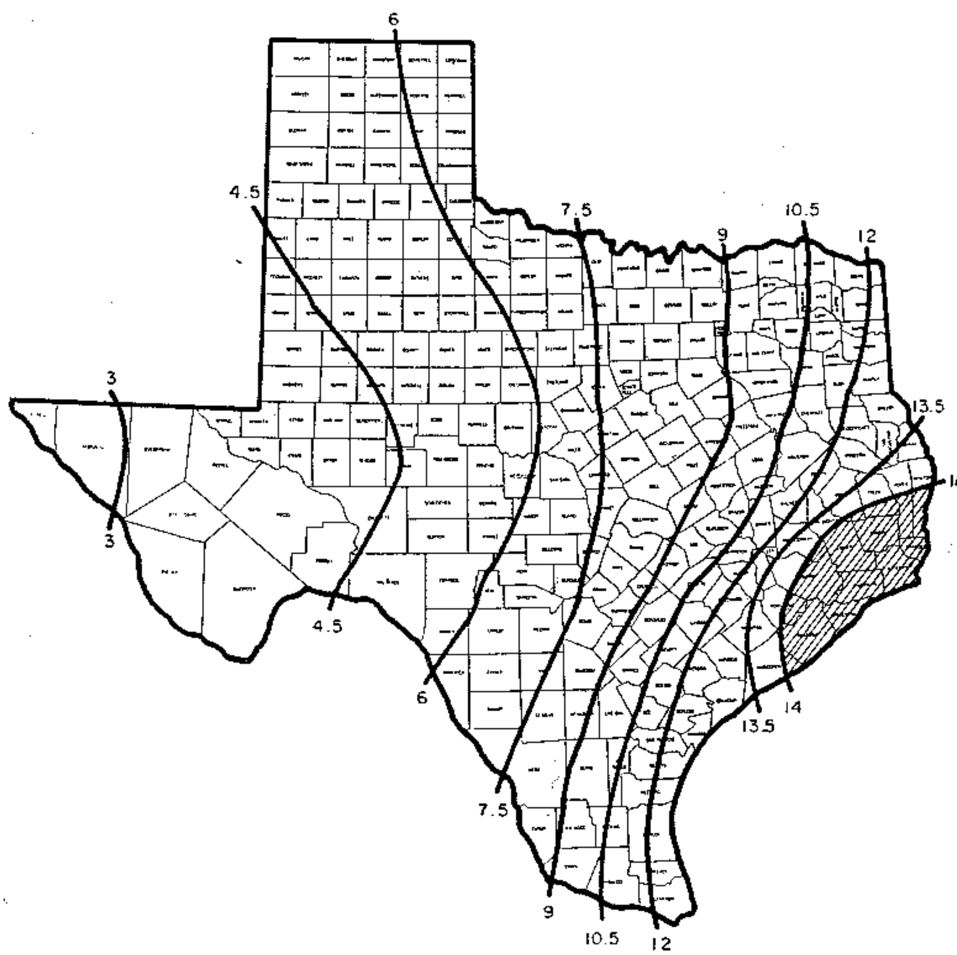
§317.12. Appendix D.

The following map establishes the required area for sludge drying beds with aerobic sludges. For aerobic sludges, the value obtained from the map may be reduced by 35%.

Figure: 30 TAC §317.12

APPENDIX D

Required Area (ft^2/lb. BOD) for Sludge Drying Beds with Aerobic Sludges (Reduce by 35% for Anaerobic Sludges)



Shaded area should have coverage of drying beds or other means of accelerated dewatering.

§317.13. Appendix E--Separation Distances.

The following rules apply to separation distances between potable water and wastewater treatment plants, and waterlines and sanitary sewers.

(1) Waterline/new sewer line separation. When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel waterlines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following guidelines will apply.

(A) Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or polyvinyl chloride (PVC) meeting American Society of Testing and Materials specifications with a pressure rating for both the pipe and joints of 150 per square inch (psi). The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.

(B) Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron, or PVC with a minimum pressure rating of 150 psi, an absolute minimum distance of six inches between outside diameters shall be maintained. In addition, the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.

(C) Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe, or concrete pipe with gasketed joints, a minimum two-foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.

(D) Where a sewer crosses over a waterline, all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five feet intervals with spacers or be filled to the spring line with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

(2) Waterline manhole separation. Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine-foot separation distance cannot be achieved, a carrier pipe as described in paragraph (1)(D) of this section may be used where appropriate.

Adopted November 4, 2015 Effective November 26, 2015

§317.15. Appendix G--General Guidelines for the Design of Constructed Wetlands Units for Use in Municipal Wastewater Treatment.

(a) Definitions. The following words and terms, when used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise.

(1) Constructed wetlands--Designed and man-made complexes of saturated substrates, emergent and submergent vegetation, animal life, and water that simulates natural wetlands. Constructed wetlands as described in these rules are meant to function exclusively as wastewater treatment units. They consist of two varieties: submerged flow systems and free water surface systems. Combinations of these varieties may also be acceptable methods of treatment. Constructed wetlands are constructed treatment systems that are inundated or saturated by wastewater flows at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of flora and fauna typically adapted for life in saturated or inundated soil conditions, i.e., a wetland. Terms that are considered synonymous with constructed wetlands treatment systems are man-made wetlands, engineered wetlands, artificial wetlands, rock reed filters, vertical bio-reactor, submerged flow systems, free water surface systems, artificial marsh, marsh reed filter, botanical reactor, rooted emergent wetland filters, and microbial rock plant filters.

(2) Submerged flow--A submerged flow system consists of a lined basin or channel filled with a granular rock media. The media supports the growth of both emergent vegetation on the surface and fixed bio-film on the subsurface. The wastewater flows horizontally, vertically, and transverses the subsurface of the rock media through interstices of the media and vegetation root structure. Wastewater levels are nominally maintained at least six inches below the rock media surface. Total rock media depth shall not exceed 24 inches.

(3) Free water surface--The free water surface system consists of a lined basin or channel partially filled with soil or other media suitable for supporting rooted emergent and/or submergent vegetation. Wastewater flows over the top of the media and through the stalks of the emergent and/or submergent vegetation at an average depth no greater than 18 inches.

(b) General considerations. These guidelines are intended for an exemplary basis. The criteria for design, construction, and operation should be based on data collected from operational data of similar facilities, pilot-plant and bench-scale studies, and/or proper engineering and scientific investigations which should be submitted at the time of review.

(1) Algal mat removal. Provisions shall be made for algal mat removal from primary treated effluent prior to entering into the wetland units. These provisions may include bar screens, adjustable inlets, baffles, and other methods as approved by the commission.

(2) Natural wetlands. The commission will prohibit the use of any land defined as a wetland by the United States Army Corps of Engineers in 40 Code of Federal Regulations §122.2 and subject to regulations found in the federal Clean Water Act, §404, for use in wastewater treatment. Any subsequent construction activity located in a natural wetland may require a permit from the United States Army Corps of Engineers.

(3) Typical wetlands vegetation. Suggested flora for constructed wetlands in the State of Texas, include the following.

(A) Emergent aquatic vegetation such as Typha spp. (cattails), Scirpus spp. (bulrush), Sagittaria spp. (arrowhead), Phragmites spp. (reeds), Juncus spp. (rushes), Eleocharis spp. (spikerush), caladium spp. (elephant ear), or other acceptable species may be used.

(B) Floating aquatic vegetation such as Lemna spp. (duckweed), Hydrocotyle umbellata (water pennywort), Limnobium spongia (frogbit), Nymphaea spp. (water lily), Wolffia spp. (water meal), or other acceptable species may be used.

(C) The use of indigenous plants is strongly recommended provided that these species have been proven suitable for use in wastewater treatment. Procurement of these seed plants from natural wetlands should ensure the natural wetlands are not significantly impacted.

(D) The use of all harmful or potentially harmful wetlands plants and organisms, as described in 31 TAC §§57.111 - 57.118 (concerning Potentially Harmful Fish, Shellfish, or Aquatic Plants) and 31 TAC §§57.251 - 57.258 (concerning Introduction of Fish, Shellfish, and Aquatic Plants), must first be approved by the Texas Parks and Wildlife Department.

(4) Allowed uses. Constructed wetlands can be used as a:

(A) secondary treatment unit; or

(B) advanced secondary treatment unit.

(5) Primary treatment. All systems shall be preceded by primary treatment. Systems may be preceded by secondary treatment. Primary treatment can

include septic tanks, Imhoff tanks, facultative lagoons, aerated lagoons, stabilization ponds, and any other treatment process which removes the settleable solids and floating material. The design of these pretreatment units shall conform with applicable state design criteria.

(6) Liners. When required in the facility's permit or by the commission, basins shall be lined with an impermeable liner, either soil or synthetic, as described in subparagraphs (A) and (B) of this paragraph.

(A) Soil.

(i) All placed clay or in-situ soils used for basin liners shall be certified by adequate geotechnical test results. For all in-situ soils, the design engineer shall present adequate soil borings information which ensures the homogeneousness of the selected soil. Placed clay or in-situ soils shall have a measured permeability of less than 10^{-7} cm/sec. and/or the following characteristics:

(I) more than 30% passing a #200 mesh sieve;

(II) liquid limit greater than 30%;

(III) plasticity index greater than 15;

(IV) no clods larger than two inches;

(V) minimum compacted thickness of two feet for placed clay liners and four feet for in-situ soils.

(ii) All placed clay liners shall be installed according to the following criteria. However, when using in-situ soils for the required liner, only the upper six inches should be reworked as follows:

(I) maximum loose lift of eight inches, six inches compacted;

(II) minimum compaction effort of 95% Standard Proctor (ASTM D-698);

(III) liners shall be keyed into the existing in-situ soils.

(B) Synthetic. All synthetic liners shall have a minimum thickness of 30 mils and contain underdrain leak detection which shall consist of leachate collection and detection systems. Proper installation of the materials mentioned in subparagraph (A) of this paragraph shall be described in the project's specifications. The liner material shall be resistant to or protected from ultraviolet (UV) light degradation.

(7) Flood hazard analysis. The 100-year flood plain elevation shall be provided. Proposed treatment units which are to be located within the 100-year flood plain will not be approved for construction unless protective measures satisfactory to the commission (such as levees or elevated treatment units) are included in the project design. If construction inside the 100-year flood plain is necessary, authorization from the proper coordinating authority must be obtained. All units must either be three feet above the 100-year flood plain or have a berm with at least three feet of freeboard above the 100-year flood plain.

(8) Berms. Berms shall have side slopes of no steeper than 3:1. Berms shall be lined or constructed of impermeable clay as described in the preceding section pertaining to soil liners. All clay berms shall be keyed into the clay liner.

(9) Configuration. Facilities with permitted average daily flows over 100,000 gallons per day shall conform with the following configuration standards.

(A) Multiple units. The treatment system shall be divided into multiple units that can be operated separately. Each unit shall have the ability to be completely drained.

(B) Parallel trains. Design considerations may include parallel treatment streams or trains which can be operated independently of each other.

(C) Length to width ratio. The units shall be designed to operate as plug flow channels. A proper length to width ratio to achieve this condition should be considered in the design of each system.

(D) Switching capability. The design shall allow for each unit to be taken out of service at any time and its flows routed to another unit. The treatment system must be capable of treating the daily average flow with the largest unit out of service.

(E) Wind protection. All free water surface (FWS) systems shall be situated so as to minimize the adverse effects of the prevailing winds.

(F) Minimum slope. All systems should maintain a minimum slope along the bottom of at least 0.075% to facilitate draining.

(10) Flow distribution.

(A) Inlets. All treatment units shall have multiple inlets (a minimum of three) and provide a method to mitigate erosion of the media.

(B) Outlets. All treatment units shall have multiple outlets (a minimum of three). FWS outlets shall be submerged and be able to exclude floating detrital material and scum.

(C) Water levels. The design should allow inlets and outlets to be raised and lowered, so that water levels within the basin can similarly be varied and provide the ability to flood the beds when necessary.

(D) Basin hydraulic design.

(i) Submerged flow systems (SFS). SFS systems should be designed to prevent surface ponding of wastewater. The hydraulic loading of these systems should be limited to the effective hydraulic capacity of the media in place. This effective hydraulic capacity will be a function of the clean media's hydraulic capacity reduced by root intrusion, slime layer, detritus, algae, and other blockages.

(ii) Free water surface systems. FWS systems should be designed to prevent scour, erosion, and plant damage during peak flow periods. The hydraulic loading of these systems should be limited to the open channel carrying capacity of the unit at full growth.

(11) Flow equalization. Flow to the units shall provide for a uniform environment and growth conducive to wetlands.

(12) Initial vegetation spacing. Plants should be placed no greater than 66 inches apart (center to center). All plants to be used should be healthy, insect free, and undamaged. A broad diversity of plant species within any unit is recommended.

(13) Total suspended solids (TSS) removal. The TSS removal efficiency of the wetland system is dependent on the quiescence of the system. However, if the facility is unable to meet its permitted parameters, alternate means of solids removal must be pursued.

(14) Nitrification. Current wetland technology has not proven the ability to consistently nitrify typical domestic strength sewage to meet average permit limitations below 5.0 mg/liter. The design of any wetland proposed for use in this type situation will incorporate a separate nitrification process.

(15) Harvesting. Harvesting of dead wetland vegetation and detritus plant matter is recommended.

(c) Submerged flow system design.

(1) Basic design parameters. SFS wetlands are sized according to primary and/or secondary treatment efficiency preceding the units, i.e., fraction of remaining five-day biochemical oxygen demand (BOD_5), and the permitted 30-day average effluent discharge concentration of BOD_5. The following factors shall be considered in the selection of the design hydraulic and organic loadings: strength of the influent sewage, effectiveness of primary and/or secondary treatment, type of media, ambient wastewater temperature for winter conditions, and treatment efficiency required.

(A) Rock/media design. The following are minimum requirements for material specifications of the rock media.

(i) Crushed rock, slag, or similar media should not contain more than 5.0% by weight of pieces whose longest dimension is three times its least dimension. The rock media should be free from thin, elongated, and flat pieces and should be free from clay, sand, organic material, or dirt. The media should have a Morhs hardness of at least 5.0.

(ii) Rock media, except for the top planting layer, should conform to the following size distribution and gradation when mechanically graded over a vibrating screen with square openings:

(I) passing six-inch sieve--100% by weight;

(II) retained on two-inch sieve--90% to100% by weight;

(III) passing one-inch sieve--less than 0.1% by weight.

(B) Installation of the rock media.

(i) Rock media shall be rinsed or washed to remove sediment. This washing should be sufficient to remove any significant amounts of dirt or accumulated debris.

(ii) The proper placement and installation of media is vital to the success of the system. Undue compaction exerted on the media's surface, as it is installed and after its installation, can fracture and consolidate the media. The introduction of foreign fine particles and fracturing can adversely affect the system's hydraulic conductivity. Therefore, the following guidelines are recommended.

(I) A layer of smaller rock (0.5 - 1.0 inches) may be used on the top of the unit to ease planting of the vegetation and aid in vector control.

(II) Media should be gently put in place, avoiding excessive dropping, jostling, and abusive handling.

(III) Heavy machinery should not be allowed on the surface of the media after final placement. If machinery is allowed on the surface, all tire ruts should be smoothed over to prevent ponding in ruts.

(IV) Provisions should be made prior to planting to provide water and nutrients to the plants if the system start-up will be delayed.

(2) Organic loadings. The following tables present typical ranges for detention time within the system in days. Each detention time represents combinations of different classes of secondary and advanced secondary treatment and different effluent parameters. Design engineers may submit sufficient operating data for similar installations, and/or actual field conditions to justify their efficiency calculations. These times represent the theoretical detention time of wastewater within the basin. Therefore, the amount of detention volume available is equal to the basin's volume multiplied by the average porosity of the media. Evapotranspiration and precipitation should also be considered when calculating detention time. The tables are based upon an average effective porosity media of 32%, and an average wastewater treatment plant influent BOD5 of 200 mg/liter.

(A) Secondary and advanced secondary treatment. The detention times in Table Number 1 are based on the fractional BOD_5 remaining in the wetland system's influent and the permitted effluent limits. For permitted effluent BOD_5 concentration and removal efficiencies that fall between the listed quantities, linear interpolation is permissible. Table Number 1 is based on the following assumptions:

(i) ambient winter conditions wastewater temperature of 7.5 degrees Centigrade (45.5 degrees Fahrenheit); and

(ii) an average wastewater treatment plant influent BOD_5 of 200 mg/liter. If the wastewater winter temperature is lower than that indicated above, detention times must be modified.

Figure: 30 TAC §317.15(c)(2)(A)(ii)

Table No. 1
Detention Time (days)
Submerged Flow System
Fractional BOD_5 Remaining After Initial Treatment

Permitted BOD_5 mg/L	**0.70**	**0.60**	**0.50**	**0.40**	**0.30**	**0.20**	**0.10**
30	3.0	2.6	2.3	1.8	1.3	1	n/a
20	3.7	3.4	3.0	2.6	2.1	1.3	n/a
10	5	4.7	4.4	4.0	3.4	2.6	1

(B) Advanced secondary treatment following pond systems only. The detention time is based on the assumption that the treatment facility is composed of a facultative lagoon followed by two stabilization ponds, each sized according to the current state design criteria found in this chapter. For applications where pond effluent is to be polished to meet an effluent BOD_5 concentration of 30 mg/liter, a minimum of one-day detention time through the wetland system will be required.

(3) Oxygen loadings. Since SFS should function in an aerobic environment, the wastewater dissolved oxygen level is critical. Surface area needed to maintain sufficient oxygen transfer through developed plant roots shall be designed based on approved and acceptable engineering methods.

(d) Free water surface system design.

(1) Basic design parameters. FWS wetlands are sized according to primary and/or secondary treatment efficiency, i.e., fraction of remaining BOD_5, and the permitted 30-day average effluent discharge concentration of BOD_5. The following factors are considered in the selection of the design hydraulic and organic loadings: strength of the influent sewage, effectiveness of primary and/or secondary treatment, type of media, ambient wastewater temperature for winter conditions, and treatment efficiency required.

(2) Organic loading. The following tables present typical ranges for detention time within the wetland system in days. Each detention time represents combinations of different classes of primary and secondary treatment and the different effluent parameters. Design engineers may submit sufficient operating data for similar installations, and/or actual field conditions to justify their efficiency calculations for the wetland system. The tables are based on the following assumptions: specific surface area of the media (stems, roots, detritus, etc. 15.7 m2/m3; ambient winter conditions

wastewater temperature of 7.5 degrees Centigrade (45.5 degrees Fahrenheit); and an average wastewater treatment plant influent BOD_5 of 200 mg/liter.

(A) Secondary treatment. These detention times are based on the type and efficiency of the primary treatment unit which precedes the FWS wetlands.

(i) Septic tank or facultative pond as primary treatment method.

Figure: 30 TAC §317.15(d)(2)(A)(i)

Table No. 2

Effluent BOD_5 Concentration (mg/l)	**Required Detention Time (days)**
30	8
20	11
10	15

(ii) Imhoff tank or clarification as primary treatment method.

Figure: 30 TAC §317.15(d)(2)(A)(ii)

Table No. 3

Effluent BOD_5 Concentration (mg/l)	**Required Detention Time (days)**
30	12
20	15
10	21

(B) Advanced secondary treatment. The detention times given in Table Number 4 are based on the fraction of BOD_5 remaining after secondary treatment. Table Number 4 assumes a wastewater treatment plant influent BOD_5 of 200 mg/liter. For percentages that fall between the listed quantities, linear interpolation is permissible.

Figure: 30 TAC §317.15(d)(2)(B)

Table No. 4

Detention Time (days)

Advanced Secondary Treatment Free Water Surface System

Fractional BOD_5 Remaining After Secondary Treatment

Permitted BOD_5 mg/L	**0.50**	**0.45**	**0.40**	**0.35**	**0.30**	**0.25**	**0.20**	**0.15**	**0.10**
30	8	7	6	6	5	4	2	n/a	n/a
20	11	10	9	8	7	6	5	3	n/a
10	15	14	13	12	11	10	9	7	5

(C) Vector control. The presence of mosquitos and other vectors has been associated with open water. Since the FWS systems will have open water surfaces, vector control must be a priority. Vector control mechanisms using natural controlling agents such as introduction of Gambusia spp. (mosquito fish) have been proven effective. However, if the predatory fish are used to control vectors, provisions must be made within the basin for designated open water areas so the fish can surface for oxygen. At least 20% of the basin's surface should be open to the atmosphere. Other methods of vector control may be considered. However, the introduction of chemicals (such as pesticides) should be carefully evaluated so that there are no adverse effects on vegetation or on effluent water quality.