SUBCHAPTER A : ADMINISTRATIVE PROVISIONS
§§217.1-217.19

STATUTORY AUTHORITY

The rules in Subchapter A, Administrative Provisions, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §12.081, which provides the commission's continuing right of supervision over certain districts and authorities; §12.082, which provides the commission's duty to investigate fresh water supply district projects; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health; §49.181, which provides the commission's authority over projects related to the issuance of certain district bonds; §49.182, which provides the commission's supervision over projects and improvements related to the issuance of certain district bonds; and §54.024, which provides the commission's continuing supervision of municipal utility districts.

§217.1. Applicability.

Chapter 217 applies to any person who proposes to construct facilities which will collect, transport, treat, or dispose of domestic wastewater. This subchapter details the administrative processes which will govern the implementation of this chapter. This chapter is not applicable to facilities constructed for the purposes of complying with a commission-issued non-domestic wastewater discharge permit.

§217.2. Authority.

§217.3. Definitions.

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

(1) **Alternative wastewater collection system -** a system that includes the categories or combinations of pressure sewers, small diameter gravity sewers, and vacuum sewers, that are not conventional gravity collection systems. Alternative wastewater collection systems are comprised of both on-site and off-site components.

(2) **Annual average flow -** the arithmetic average of all daily flow determinations taken within a period of 12 consecutive months.

(3) **Buffer tank -** an on-site component that is used to house vacuum valves in situations where flow quantity requires flow attenuation and/or as transition structures between non-vacuum and vacuum systems. A buffer tank may also be used as an appurtenance with an off-site component.

(4) **Building lateral -** line work that exclusively conveys raw wastewater and connects the plumbing of a structure to an on-site component. The building lateral is not a part of an alternative wastewater collection system.

(5) **By-Pass-** the divergence of flow from the design flow path.

(6) **Design flow** - the flow rate permitted by the commission.

(7) **Diurnal Flow -** the daily or weekly flow cycle of influent to a wastewater treatment system.

(8) **Effective size -** if a sample of filter media is examined, and the grain size plotted as a semi-log grain size curve with the ordinates representing the percent P, by weight, of grains is smaller than the size denoted by the abscissa, then the effective size of the sample is the diameter D10 which corresponds to P = 10%. In other words, 10% of the sample particles are finer and 90% are larger than the effective size.

(9) **Engineer** - a design engineer licensed by the Texas Board of Professional Engineers.

(10) **Equivalent dwelling unit (EDU) -** a single residence or a commercial establishment which produces wastewater of a composition and quantity comparable to that discharged by a single, private residence.

(11) **Facility** – a wastewater treatment system; including all components.

(12) **Facility owner -** the person or entity that is named as the permittee on the permit to dispose of wastes.

(13) **Filter media -** the material placed in the filter containment structure to perform the filtering action.

(14) **Firm Pumping Capacity -** the maximum flowrate under design conditions with the largest pumping unit out of service.

(15) **Force main -** a pressure-rated conduit that conveys wastewater from a pump station to a discharge point.

(16) **Grinder pump unit -** an on-site component that receives raw wastewater by a building lateral, grinds the solids present in the raw wastewater into a slurry, and provides the motive force for transporting the raw wastewater to the terminus of the collection system.

(17) **Innovative technology -** a process not addressed in this chapter, or a process specifically identified as innovative by this chapter.

(18) **Interceptor tank -** an on-site component that receives raw wastewater from a building lateral, removes floatable and settleable solids, stores the removed solids, and provides flow attenuation.

(19) **Intermittent filter -** a filter through which the water being filtered passes one time.

(20) **Lateral sewer -** a sewer running laterally down a street, alley, or easement which receives only the flow from the abutting properties.

(21) **Licensed professional geoscientist -** A geoscientist who maintains a current license through the Texas Board of Professional Geoscientists in accordance with its requirements for professional practice.

(22) **Lift Station -** a structure that houses pumps for the facility.

(23) **Manager/Operator of the alternative wastewater collection system -** a political subdivision of the State, water supply or sewer service corporation, or other legal entity under the regulatory jurisdiction of the commission that is authorized to own, operate, and/or maintain a wastewater system as a public utility.

(24) **Multiple equivalent dwelling unit (MEDU) -** a group of single, private residences served by a common on-site component, or a commercial, industrial, institutional, or other non-residential establishment that produces wastewater in excess of 1500 gallons per day and/or wastewater of a composition not comparable to that discharged by a single private residence.

(25) **Nonconforming technology -** technology or a process that does not conform to the design criteria of this chapter, or a technology or process specifically identified as nonconforming by this chapter.

(26) **Off-site components -** a facility component that includes collection system lines, force mains, pump stations, lift stations, vacuum stations and related appurtenances.

(27) **On-site component -** interceptor tanks, effluent pump and grinder pump units, vacuum valve pits and buffer tanks, and their service lines.

(28) **Overflows -** the planned flow over of brim from a treatment unit or flows that inundate a unit and cause an unauthorized discharge of wastewater.

(29) **Owner -** The owner and designated agent of the owner.

(30) **Peak flow -** the highest two-hour flow expected under any operational conditions, including times of high rainfall (generally the two-year 24-hour storm) and prolonged periods of wet

weather.

(31) **Pressure sewer -** a sewer that is entirely pressurized by pumps at each service connection.

(32) **Private sewer -** a closed conduit which conveys wastewater flow and is constructed and maintained by a private entity(ies) such as a homeowner's association.

(33) **Project or proposed facility -** a TCEQ permitted wastewater treatment facility that has not been built or completed.

(34) **Public sewer -** a closed conduit which conveys wastewater flow and which is located within the public right-of-way or dedicated public easement.

(35) **Pump -** a device that raises, transfers and/or compresses fluids by suction or pressure or both.

(36) **Pump Station -** the location of in-use wastewater pumps.

(37) **Report -** Final engineering design report which must contain written descriptions to show compliance with all subsections of these rules.

(38) **Sequencing Batch Reactor (SBR) -** a fill and draw activated sludge treatment system, identical to conventional activated sludge systems, except the processes are carried out sequentially in the same tank. SBR systems have the following five steps carried out in sequence.

(A) Fill - The basin is filled with the influent;

(B) React - The influent in the basin is aerated;

(C) Settle - The mixed liquor within the basin is settled (clarification);

(D) Draw - The basin is decanted; and,

(E) Idle - The sludge is wasted from the basin.

(39) **Service connection -** a private sewer from a single source to the main or lateral sewer in the street, alley, or adjacent easement.

(40) **Service line -** the service line is the line work that hydraulically connects an on-site component to the off-site components and is a part of the alternative wastewater collection system.

(42) **Small diameter effluent sewer (SDES) -** a sewer that receives effluent from an interceptor tank and transports the flow by gravity and includes minimum grade effluent sewers (MGES) and variable grade effluent sewers (VGES). MGES have a constant downward slope. A VGES has no

slope restrictions, but effluent must not flow back into any service connection.

(43) **Uniformity coefficient -** the uniformity coefficient (U) is equal to the ratio D60/D10: D60 is the grain size corresponding to P = 60% on the plot of sample grain size, and D10 is the grain size corresponding to P = 10% on the plot of sample grain size. A low uniformity coefficient indicates a uniform grain size in a sample, while a high value indicates a wide variation in grain size.

(44) **Vacuum valve pit -** an on-site component that receives raw sewage by a building lateral and provides detention until accumulation of such volume to instigate operation of the vacuum valve. For EDUs as defined above, the vacuum valve pit and vacuum valve must be an integral unit.

(45) **Variance -** a deviation from a specific requirement of this chapter.

(46) **Wastewater -** a water borne human waste, waste from domestic activities such as washing, bathing, and food preparation and industrial waste.

(47) **Wastewater treatment system -** all on-site treatment components including but not limited to lift stations, treatment facilities, primary, secondary, tertiary treatment, and sludge treatment.

§217.4. Purpose.

(a) These design criteria are minimum requirements which shall be used for the comprehensive design of domestic sewage collection, treatment, or disposal systems.

(b) This chapter establishes the minimum design criteria pertaining to effluent quality necessary to meet state water quality standards. Plans, specifications, and reports for a proposed project must conform to the requirements of this chapter. These minimum criteria may not be appropriate for certain design situations. The engineer shall use best professional engineering judgment to determine whether the minimum criteria set forth in this chapter are sufficient to protect the public health and meet water quality requirements as established by the commission.

(c) The executive director may require more stringent criteria in order to meet public health and water quality goals.

§217.5. Variances.

(a) The engineer shall disclose in the report all variances from the requirements of this chapter to the executive director or appropriate review authority.

(b) Variances which are incorporated into the project after construction begins must be disclosed to the executive director or appropriate review authority in the completion certification required by §217.13 of this title (relating to Completion Notification). The engineer shall disclose all variances under the seal of an engineer and shall state that, based on the best professional engineering judgement of the engineer, the variances will not result in a risk to public health or water quality.

(c) The engineer shall submit technical justification for any variances under the engineer's seal.

(d) The executive director may request additional information regarding any variance disclosures.

(e) If the executive director determines that the variance would result in a situation which would contradict the state public health and water quality requirements, the executive director may deny the variance or require additional measures.

(f) If the executive director does not notify the engineer by fax or letter that additional information is requested or, that the variance is denied within thirty days of receiving a signed, dated, and sealed variance disclosure, the variance is approved.

(g) The executive director shall not grant or approve a variance from any express prohibition within this chapter.

§217.6. Relationship between Plans and Specifications Approval and Wastewater Discharge Permits.

(a) A plans and specifications approval must correspond to the flow and effluent limitations set forth in the associated discharge permit. A plans and specifications approval may correspond to any of the existing permit phases. If a plans and specifications approval is for an interim phase is obtained, the owner or operator of the facility must obtain additional plans and specifications approval before the facility may begin operating at the next permit phase.

(b) Approval of plans and specifications in accordance with this chapter does not relieve the facility owner of the responsibility to obtain a wastewater discharge permit or other authorization in accordance with Texas Water Code, Chapter 26. A facility is prohibited from bypassing partially treated wastewater during construction without a commission order for such discharge.

(c) Executive director approval of a wastewater discharge permit does not relieve the facility owner of the responsibility to obtain a plans and specifications approval of that facility before discharge in accordance with this chapter.

§217.7. Construction of Approved Facilities.

(a) Construction must not begin on a facility with approved plans and specifications until the executive director issues a wastewater discharge permit, unless the commission authorizes the applicant to construct before permit issuance, under Texas Water Code, §26.027(c).

(b) Phased construction of a facility must correspond to phases included in the associated wastewater discharge permit. The engineer shall disclose any other type of phased construction and request a variance under §217.5 of this title (relating to Variances).

§217.8. Pre-existing Facilities.

(a) Any facility constructed in accordance with a plans and specifications approval granted before the effective date of these rules without any modifications or proposed design-related permit changes are not subject to any additional requirements of this chapter. These facilities must meet the standards and criteria established at the time of the original plans and specifications approval and with any wastewater discharge permit requirements.

(b) New facilities or any modifications to existing facilities must comply with the requirements of this chapter which is effective on the date the plans and specifications are submitted.

(c) New facilities which are proposed for construction must comply with the requirements of this chapter.

(d) Existing facilities that never received a plans and specifications approval must comply with the requirements of this chapter.

§217.9. Submittal Requirements.

(a) The engineer shall submit to the executive director a summary transmittal letter which conforms to the requirements found in subsection (b) of this section, except as provided by §217.11(b) of this title (relating to Municipality Reviews).

(b) The engineer shall submit a summary transmittal letter by certified mail to the executive director and to the appropriate commission regional office. The engineer shall sign, date, and seal the summary transmittal letter. A summary transmittal letter must include, at a minimum:

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

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

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

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

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

(6) a statement verifying that the plans and specifications are in substantial compliance with all requirements of this chapter and which states that any variances from the requirements are based on the best professional judgment of the engineer who prepared the report and the project plans and specifications;

(7) a brief description of the project scope which includes the specifics of the facility, a description of variances from the requirements of this chapter, including the use of nonconforming or innovative technology, and an explanation of the reasons for such variances sufficient to satisfy the

requirements of §217.5 of this title (relating to Variances).

(c) Any project is subject to review by the executive director. The executive director may use the following factors to determine whether a review will be performed: whether or not a nonconforming or innovative technology is being proposed; the stream segment in which the project is located; and the applicant's compliance history.

(1) If the executive director does not notify the engineer who submitted the summary transmittal letter within 30 days of receipt that a review will occur, the project is deemed approved.

(2) If the executive director notifies the engineer of his intent to review, the engineer shall submit to the executive director a complete set of plans and specifications and a complete report. These submitted materials must include sufficient information to satisfy the executive director that the project is in substantial compliance with this chapter.

(3) If the executive director reviews a project, approval may be granted in accordance with §217.10 of this title (relating to Types of Approvals).

(d) The facility owner or person responsible for management of a collection system shall maintain and keep available for at least three years from the date the engineer certifies to the executive director that the project is complete the following:

(1) a complete set of plans and specifications;

(2) the final version of such plans and specifications with engineer's certification;

(3) a complete report;

(4) all change orders and test results;

(5) a copy of the written summary submitted to the executive director; and

(6) any written approvals granted by the executive director, a municipality, or another state agency.

(e) The engineer shall submit all materials in subsection (d) to the executive director, another state agency, or municipality upon request. Such materials must be readily available for inspection by the executive director upon request, during regular business hours at the facility.

(f) A proposed facility may receive a technical review to ensure compliance with this chapter and approval from a state agency other than the commission if:

(1) the review is performed under the supervision of an engineer, and the review ensures that the project substantially complies with this chapter; and

(2) state law has granted authority to another state agency in lieu of the commission.

§217.10. Types of Approvals.

(a) Approval given by the executive director or a participating municipality or state agency with review authority under §217.9(e) of this title (relating to Submittal Requirements), must not relieve the facility owner or the engineer of any liabilities or responsibilities with respect to the proper design, construction, or authorized operation of the facility in accordance with applicable commission rules. All facilities must operate under the regulations and restrictions of the facility's wastewater discharge permit(s). The executive director or other authorized review authority may grant the following types of approvals:

(1) Standard approval. Plans and specifications that comply with all applicable parts of these criteria are approved for construction.

(2) Approvals of innovative and nonconforming technologies.

(A) Innovative technology is a technology or a process not addressed in the design criteria of this chapter, or a technology or a process specifically identified as innovative by this chapter. Nonconforming technology is a technology or a process that does not conform to the design criteria of this chapter, or a technology or a process specifically identified as nonconforming by this chapter.

(B) Executive Director Approval.

(i) If an engineer requests approval for innovative or nonconforming technologies, the summary transmittal letter submitted in accordance with §217.9(c) of this title (relating to Submittal Requirements) must describe the engineering proposals for processes, equipment, or construction materials and the reasons for their selection.

(ii) The engineer shall receive written approval from the executive director before proceeding with any innovative or nonconforming technology.

(iii) Before approving or disapproving the request, the executive director may require a full review of a project which contains innovative or nonconforming technology.

(iv) The executive director may grant approval of processes, equipment, or construction materials which are considered to be innovative or nonconforming only in cases where the executive director or review authority determines, after an evaluation of the supporting information provided in the engineer's report, that the technology will not result in a threat to public health or the environment.

(v) The executive director may require nonconforming or innovative technologies to be supported by 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 must be submitted at the executive director's request in addition to, or in lieu of, pilot or small-scale demonstration studies.

(vi) The executive director 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 two-year period commences upon placement in service of the facility. The performance bond must cover:

(I) the full cost of removal or abandonment of the innovative or nonconforming facility and equipment;

(II) the replacement with a facility or equipment conforming to these rules; and

(III) all associated engineering fees necessary for the removal and replacement of the innovative or nonconforming technology.

(C) The executive director may require the engineer to submit a report detailing the performance of the nonconforming or innovative technology for a predetermined period of time after the installation and start-up. The report must include calculations and data detailing the technology's performance, and written submittals from the engineer and the facility owner which state that the nonconforming or innovative technology has satisfied the manufacturer's claims.

(3) Conditional approval.

(A) The executive director may grant approvals which contain conditions, stipulations, or restrictions 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.

(B) If a conditional approval is granted, both the wastewater treatment system owner and engineer are responsible for ensuring that the approval conditions outlined by the executive director have been met. Examples of such conditions and stipulations include, but are not limited to, testing requirements, reporting requirements, operational requirements, and additional installation and design requirements.

§217.11. Municipality Reviews.

(a) A municipality may perform technical reviews of a wastewater treatment collection system under Texas Water Code, §26.034.

(b) If a municipality seeks to perform technical reviews of a wastewater collection system after the effective date of this rule, the municipality shall submit at least 30 days before commencing review to the executive director maps that delineate the jurisdictional boundary of the municipality for the area for which they seek responsibility for review of plans and specifications.

(c) The municipality shall submit maps to the executive director detailing boundary changes within 90 days of a proposed change.

(d) If a municipality elects to stop its review authority, the municipality shall provide written notice to the executive director at least 30 days before the date of such election.

(e) A municipality with review authority shall incorporate the items in paragraphs (1) - (5) of this subsection into the review program:

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

(2) The municipality shall conduct its review by either an engineer or an employee under the direct supervision of an engineer who is ultimately responsible for the review and approval of each collection system submitted and installed in the municipality's jurisdiction.

(3) The responsible review engineer must 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 of the project under review. For purposes of this section, the term "separate" means that the responsible review engineer is not employed by and does not receive any compensation from the private consulting firm or from any parent companies, subsidiaries, or affiliates charged with the design. The municipality shall provide documentation of agreements with private consultants to the executive director, upon request, that is sufficient to determine the municipality's compliance with this subsection.

(4) A 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.

(5) The municipality shall maintain complete files of all review and approval activities and make any existing project files available to the executive director, upon request, during audits performed in accordance with subsection (b) of this section.

(f) The executive director may perform periodic audits of the review and approval process of a municipality with review authority to ensure that the approved projects are in compliance with this chapter.

(1) The executive director shall provide the municipality with a minimum of five working days advance notice of the pending audit.

(2) The executive director may review specific projects previously approved by the review authority for auditing purposes.

(3) The municipality shall provide to the executive director, upon request, documentation of all agreements between the private consultants and the municipality which relate to the wastewater collection system review program.

(4) 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 must address these findings within a time established by the executive director.

(5) The commission may revoke the review authority for a municipality that cannot achieve compliance.

(6) The executive director shall notify the municipality in writing of the intention to revoke the municipality's authority and shall include the justification for revoke the authority.

(7) If the authority of a municipality is revoked, all new projects proposed to be constructed within that municipality's jurisdiction must be submitted to the executive director in accordance with §217.9(c) of this title (relating to Submittal Requirements).

(8) If the authority of a municipality is revoked, the municipality shall inform all new projects in its jurisdiction of the requirement to seek approval from the commission.

§217.111. Other Review Authorities.

Other review authorities conducting a review in accordance with TWC §17.27(d) shall send a copy of the approval to the executive director.

§217.12. Substantial Design Changes.

(a) If an engineer seeks a substantial design change after the executive director has granted approval, the engineer shall notify the executive director with a written description of the extent of the changes. The notification must include the signed and dated seal of an engineer.

(b) The determination of what constitutes a substantial design change shall be made by the engineer based on best professional judgment.

(c) The executive director may request additional information regarding the proposed design change.

(d) The executive director may perform a technical review of these changes to ensure that the changes will meet its public health and water quality requirements.

(e) If the executive director does not request information from the engineer by mail or facsimile within 30 days of receiving a signed, dated, and sealed notification, the changes must be considered to be approved.

§217.13. Completion Notification.

Upon completion of construction of any facility, the design engineer, or other engineer appointed by the owner, shall provide a completion notice to the executive director:

(1) which is signed, sealed, and dated by an engineer, and attests that the completed work substantially complies with the approved plans, specifications, and any approved substantial design changes; and

(2) which states that the operations and maintenance manual, as required in §217.15 of this subchapter (relating to Operation and Maintenance Manual), has been prepared and delivered to the owner of the facility.

§217.14. Inspection.

The executive director may inspect a project during construction to determine compliance with the project plans and specifications, the report, any approval letters, or other requirements of this chapter.

§217.15. Operation and Maintenance Manual.

(a) The facility owner is responsible for having an operations and maintenance manual developed under the direction of the engineer.

(b) The operations and maintenance manual must include information specific to the project necessary to ensure efficient, safe operations and maintenance, monitoring, and reporting by the operators.

(c) The engineer shall provide the owner and operator of the proposed facility the opportunity to make comments and recommendations to the operations and maintenance manual before the final draft.

(d) The facility owner and operator shall keep a copy of the final operations and maintenance manual and any amendments at the treatment plant site.

(e) The facility owner shall submit a copy of the operations and maintenance manual to the executive director, upon request.

(f) The operations and maintenance manual must include the following items:

(1) Administrative and record keeping items including:

(A) a table of contents showing the location of the contents within the manual;

(B) a copy of the wastewater discharge permit;

(C) names and telephone numbers for pertinent contacts within the appropriate state and federal regulatory agencies;

(D) a sample of a typical Monthly Effluent Report applicable for the size and type of facility proposed;

(E) a sample daily activity report that contains spaces for the results of any internal monitoring done in association with internal process control, including flow rates from the various units, dissolved oxygen levels, pH, solids concentrations, settling test results, clarifier sludge blanket depths, sludge age or retention time, and disinfection residuals; and

(F) a description of the quality assurance/quality control record keeping requirements for all laboratory analyses performed. This daily activity report may be modified by the operators to include additional necessary information;

(2) Operation and maintenance requirements including:

(A) a section describing the typical flow pattern size and capacity of all units within the facility;

(B) the typical start-up procedures, routine operational procedures, and shut down procedures for all units;

(C) a description of the manner and the expected volumes in which solids return to aeration or waste;

(D) expected solids concentrations in all units;

(E) expected clarifier overflow rates;

(F) expected disinfectant and dechlorination usage and dosage amounts during normal and emergency operating conditions;

(G) descriptions and frequencies of routine in-situ and laboratory analyses to be performed and a list of references to standard testing procedures literature;

(H) descriptions of routine maintenance activities to be performed, including lubrication and inspection schedules for all pumps, motors, and other equipment; and

(I) a recommended spare parts inventory with the names and telephone numbers of manufacturers and suppliers; and

(3) Safety items including:

(A) all known or potential safety hazards within the facility;

(B) the location and method of use for all personal safety equipment;

(C) evacuation plans; and

(D) the appropriate contact names and phone numbers of entities or individuals to be contacted during emergency situations.

§217.16. Operational Considerations.

(a) The engineer shall consult with the relevant operations staff while designing the project.

(b) The engineer may include design elements suggested by the operations staff when such design elements are practical and in the best professional judgment of the engineer.

(c) When construction, start-up and shutdown situations threaten a facility's ability to remain in compliance with its discharge permit, the engineering and operational staff shall communicate to minimize the danger to public health and water quality during these periods.

(d) The engineer shall submit a statement certifying compliance with this section in the report.

§217.17. Final Engineering Design Report.

(a) An engineer shall develop a report for any wastewater facilities constructed.

(b) The report must include the signed and dated seal of the engineer who is responsible for the design.

(c) The report must demonstrate compliance with this chapter or to justify variances from this chapter in accordance with §217.5 of this title (relating to Variances) by including any calculations, analyses, graphs, formulas, constants, tables, geologic information, hydraulic and hydrological information, historical data, and technical assumptions.

(d) The report must include any other information required by this chapter.

(e) The report must include the following, if applicable:

(1) Wastewater collection systems must include the following:

(A) a map showing the existing service area and the area proposed for service;

(B) the terrain of general topographical features of present and future areas to be served;

(C) a description of how the design flow for the system was determined;

(D) the minimum and maximum grades for each size and type of pipe and calculations of expected minimum and maximum velocities in the pipe system for each size and type of pipe;

(E) the proposed system expansion's effect on the existing system capacity for both lift stations and pipes;

(F) the existing and anticipated inflow/infiltration, the hydraulic effect on the proposed and existing system, and, if needed, flow monitoring and inflow/infiltration abatement measures which will be taken to help ensure a properly functioning system;

(G) a description of the existing trunk and interceptor sewer's and lift station's ability to handle the peak flow under anticipated conditions and the capability of existing treatment facilities to receive and adequately treat the anticipated peak flows;

(H) an engineering analysis showing compliance with the pipe design requirements of §217.53 of this title (relating to Manholes and Related Structures), for structural design and minimization of odorous conditions;

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

(J) the calculations and curves showing the operating characteristics of any system lift stations at minimum, maximum, and design flows during both present and future conditions; and

(K) the safety considerations incorporated into the project design, including ventilation, entrances, working areas, and prevention of explosions.

(2) Wastewater treatment facilities must include the following:

(A) the quantity and characteristics of existing wastewater influent and any changes in characteristics anticipated in the future. If adequate records are not available, analyses must be made for the existing conditions and such information included in the report;

(B) the facility siting information, including:

(i) a map and/or sketch with the location of the proposed wastewater treatment facility, the area included in the facility site, the area that makes up the dedicated buffer zone, and the area surrounding the wastewater treatment facility;

(ii) a description of the surrounding area that discloses present and future housing developments, industrial sites, prevailing winds, highways and/or public thoroughfares, water treatment facilities, water supply wells and intakes, parks, schools, recreational areas, and shopping centers;

(iii) the location of the wastewater discharge which includes the immediate receiving stream, canal, major water course, or other waters in the state which will receive the wastewater;

(iv) the acreage which will be used for disposal of effluent if not by discharge to waters in the state; or

(v) documentation showing full compliance with the buffer zone criteria and the 100-year floodplain restrictions specified in §309.13 of this title (relating to Unsuitable Site Characteristics).

(C) the sludge management plan, including:

(i) the estimated quantity of sludge that will be handled, including future sludge loads based on flow projections;

(ii) the quality and sludge treatment requirements for ultimate disposal, and the sludge storage requirements for each alternative;

(iii) the method of sludge transport, use, storage, and disposal; and

(iv) what alternatives, contingencies, and mitigation plans exist to ensure reliable capacity and operational flexibility;

(D) the methods to control bypassing, including:

(i) information and data describing features to prevent bypassing such as auxiliary power, standby and duplicate units, holding tanks, storm water clarifiers, or flow equalization basins; and

(ii) operational arrangements such as flexibility of pipes and valves to control flow through the treatment units, and reliability of power sources to prevent unauthorized discharges of untreated or partially treated wastewater during construction.

(E) all information and calculations showing the facility’s compliance with the design requirements of this chapter, including:

(i) the types of units proposed and their capacities;

(ii) the detention times, surface loadings, and weir loadings as pertinent to the wastewater treatment units; and

(iii) hydraulic profiles for wastewater and sewage sludge, which include a plot of the hydraulic gradient at peak flow conditions for all gravity lines, the anticipated operation mode of the treatment facility, organic and volumetric loadings as pertinent to specific units, aeration demands, and how those demands will be supplied.

§217.18. Final Construction Drawings and Technical Specifications.

The engineer shall prepare construction drawings and technical specifications for any constructed wastewater treatment facility. The drawings must include the signed and dated seal of the engineer who is responsible for the facility design on each sheet and the title page of the bound technical specifications. The final construction drawings and technical specifications must include all items in paragraphs (1) - (3) of this section, which the engineer determines is applicable to the project.

(1) Construction Drawings for a Wastewater Collection System.

(A) The drawings for wastewater collection systems must include plan and profile drawings for both gravity lines and pressure pipes.

(B) Each sheet of the drawings must use an identified vertical and horizontal scale.

(C) The drawings must specify:

(i) the size, grade, and type of pipe materials; and

(ii) the location of any structural features of the collection system, including manholes to be installed, waterway crossings, bridge crossings, siphons, lift station locations, and air release valves.

(D) The drawings must locate all potable water distribution lines which are 9 feet or closer to any portion of the wastewater collection system, and indicate the actual separation distances.

(E) The drawings must include dimension section details of manholes, manhole covers, and any other collection pipe appurtenances.

(F) The drawings for any lift stations must show the location of the following:

(i) all pumps, valves, pumping control equipment, safety and ventilation equipment;

(ii) access operator points;

(iii) hatches and hoisting equipment for installing and removing equipment;

(iv) slope and location of any wet well floor grouting, valve vaults, valve vault pipes and gas migration prevention measures used between the wet well and the valve vault;

(v) location of pipe entrances and exits;

(vi) location of sump pumps;

(vii) levels of float switches; and

(viii) any other lift station-related appurtenances.

(2) Construction Drawings for the Wastewater Treatment Facility.

(A) The drawings for the wastewater treatment facility must include plan drawings of all pipes and treatment units applicable to the project.

(B) Each sheet of the drawings must use a vertical and horizontal scale.

(C) The drawings must include the dimensions of all wastewater treatment units.

(D) The drawings must include all mechanical, electrical, and construction details.

(E) The drawings must include a hydraulic profile of the treatment facility at both design and peak flows.

(F) The engineer may include provisions for future expansion of the plant.

(G) The engineer may clarify any complex details of pipe systems by inclusion of an isometric flow diagram as part of the construction drawings.

(3) The specifications for any existing collection system and facility must include technical descriptions of all equipment including the quantity and sizes of the equipment, any applicable materials specifications, installation procedures, construction, and installation safety measures, testing requirements, and national standards citations.

(4) The executive director may request more information as needed to allow a review of the project.

§217.19. Compliance With Other Regulations.

(a) These rules do not supersede or replace any other state statutes or local or federal requirements such as EPA requirements, Occupational Safety and Health Administration (OSHA) requirements, or the requirements of the Uniform Fire Code.

(b) The commission is not responsible for interpreting, reviewing, or enforcing the other rules and regulations, or any other rules and regulations which are not implemented under commission authority as provided by the Texas Water Code or other legislative directives.

SUBCHAPTER B : DESIGN REQUIREMENTS
§§217.31-217.37

STATUTORY AUTHORITY
The rules in Subchapter B, Design Basis, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.31. Applicability.

This subchapter details the design values which an engineer shall use when determining the sizes of the wastewater treatment system components. This subchapter applies to all wastewater treatment system designs for new facilities, upgrades of existing facilities, and re-ratings of existing facilities.

§217.32. Design of New Systems - Organic Loadings and Flows.

(a) A new system must use the flows and loadings in paragraphs (1) - (3) of this subsection, unless subsection (b) of this section applies. These values are permitted flows and loading concentrations which include an allowance for some infiltration.

(1) Design flow. The design flow is the permitted flow. For facilities equal to or greater than one million gallons per day (mgd), the permitted flow is the average annual flow value determined by multiplying the per capita flow in Table B.1 of this section by the number of people in the service area. For facilities less than one mgd, the permitted flow is the maximum 30-day average flow estimated by multiplying the average annual flow by a factor of 1.5 or greater.

(2) Two-hour peak flow. The instantaneous two-hour peak flow shall be estimated by multiplying the permitted flow by a factor of 4. If the system experiences unusual diurnal and/or seasonal variations, the engineer may use a higher ratio. In certain regions or systems with flow equalization, the facility may be designed for a lower ratio if the engineer provides supporting data. The supporting data in case of region justification should include flow data from at least three similar wastewater treatment systems from the region. All treatment units, pipes, weirs, flumes, disinfection units, or any other treatment unit which is flow limited shall be sized to transport and/or treat the estimated two-hour peak flow. The wastewater treatment facility must use a totalizing flow meter for flow measurement.

(3) Design organic loading. The engineer shall use the design organic loading when data is not available. The design organic load shall be determined by multiplying the projected uses by annual average flow determined from Table B.1. of this subsection and by using the appropriate influent

concentration found in Table B.1 of this subsection. This design organic load is the load used to determine the size of any treatment units intended to provide organic waste treatment. **(Figure 30 TAC §217.32(3))**

Table B.1 - Design Organic Loadings and Flows for New Wastewater Treatment Systems

Source	Remarks	Daily Wastewater Flow (Gallons Per Person)	Wastewater Strength (mg/L BOD_5)	Duration of Flow (Hours)
Municipality	Residential	100	200	24
Subdivision	Residential	100	200	24
Trailer Park (Transient)	2½ Persons per Trailer	50	300	16
Mobile Home Park	3 Persons per Trailer	75	300	24
School with Cafeteria	With Showers Without Showers	20 15	300 300	8 - 12 8 - 12
Recreational Parks	Overnight User Day User	30 5	200 100	16 16
Office Building or Factory	---	20	300	Length of Shift NOTE: The facility must be designed for largest shift.
Motel	---	50	300	12
Restaurant	Per Meal	5	1000*	12
Hospital	Per Bed	200	300	12 - 24
Nursing Home	Per Bed	100	300	12 - 24
Alternative Collection Systems (Subchapter D)	Per Capita	75	N/A	24

*Based on restaurant with grease trap

(b) For new systems being constructed to serve the same service area as an existing facility with sufficient historical data, the engineer may use the data from §217.33 of this title (relating to Design of Existing Systems - Organic Loadings and Flows) to design the wastewater treatment facility if justified in the report.

§217.33. Design of Existing Systems - Organic Loadings and Flows.

The modification or re-rating of an existing system in order to meet new permit conditions requires the use of historical data as the design basis for justifying the sizing of existing or proposed wastewater treatment system components. The compiled data must meet the criteria outlined in paragraphs (1) and (2) of this section.

(1) Flows.

(A) The volume of existing flow shall be determined when an existing treatment facility is to be re-rated, expanded, or upgraded.

(B) The engineer shall use the existing facility's past five years of data to determine the annual average flow, the maximum monthly 30-day average flow, the peak two-hour flow, the ratio of maximum monthly 30-day average flow to annual average flow, and the ratio of the peak two-hour flow to the annual average flow and include all calculations and assumptions in the report.

(C) The flow data for these analyses shall be collected by a totalizing meter regardless of size.

(D) The engineer shall indicate in the report the service area of existing development and future development.

(E) The engineer shall base the analysis for the two-hour peak flow on a frequency distribution analysis based on one of the methodologies outlined in clauses (i) - (iii) of this subparagraph.

(i) The flow charts for the individual day must determine the maximum sustained flow rate over any two-hour period.

(ii) Instantaneous flow rates at one-hour intervals are used to calculate progressive two hour interval volumes in order to determine maximum volume for any two-hour interval for each day. Based on individual two-hour peak flow values, the engineer shall use a frequency distribution with the two-hour peak flow not exceeded 98% to determine the ratio of two-hour peak flow to the annual average flow. Using this historical ratio, the engineer shall calculate the two-hour peak flow for the proposed facility provided that no major flow changes are anticipated within the service area.

(iii) The projected two-hour peak flow must be the result of collection system monitoring and/or modeling based on the design storm event for the service area. The design storm event is generally associated with a two-year, 24-hour storm event.

(2) Organic loadings.

(A) When an existing treatment facility is to be re-rated, expanded, or upgraded, the design organic loading must be based on the average daily organic load which the facility is required to treat during the design life. The calculation shall use historical data, plus one standard deviation. The historical database must conform at a minimum to the following:

(i) The historical data must document a minimum of one year, consisting of three samples per week taken during weekdays.

(ii) The samples must consist of a three-part grab sample taken at 10:00 a.m., noon, and 2:00 p.m. If the system experiences a peak load during another period of the day, the engineer may adjust the sampling times as deemed necessary to characterize the treatment plant's design organic loading.

(iii) If a sampling program is recommended by the engineer for a frequency less than three times per week or less than a three-part grab sample, the engineer shall document how the proposed sampling program was representative.

(iv) Sampling data must include a minimum of $CBOD_5$ or BOD_5, TSS, and NH_3-N, unless the engineer justifies a different program because of specific treatment requirements.

(v) The engineering analysis using the minimum sampling period must include a summary of the monthly data, annual-average monthly load, and standard deviation of the monthly data. The analysis may use a linear regression or other appropriate statistical method for predicting the design organic load when significant data exists.

(B) The engineer shall determine the future loading and flow to account for anticipated changes from the existing historical basis.

(C) The report must state the basis for the development of the design organic loading. The design organic loading must account for both dry weather and wet weather conditions. The engineer shall use the design organic loading to determine the size of any treatment units which are intended to provide treatment of organic wastes.

§217.34. 100-Year Flood Plain Requirements.

(a) 100-year flood plain shown on plans.

(1) The site plan for the proposed wastewater facility must mark the limits of the 100-year flood plain, based on the current effective Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS).

(2) The appropriate Flood Insurance Rate Map or FIS profile adjusted to the project's vertical datum determine flood elevations. The engineer shall base the limits of the flood plain on the superposition of the 100-year flood elevations on the most accurate, available topography and elevations of the proposed site.

(3) If the proposed site is adjacent to a FEMA 100-year flood delineation (no flood elevation published), a 100-year flood elevation may be determined by overlaying the effective FEMA delineation over a United States Geological Survey Quadrangle Map and interpolating a flood elevation.

(4) If the flood plain information is not available, the engineer shall provide a 100-year flood elevation based on the best information available.

(b) 100-year flood plain shown on profile.

(1) The engineer shall incorporate the FEMA 100-year water surface elevation by marking on the hydraulic profile of the wastewater facility in accordance with the vertical scale of the drawing.

(2) When the proposed plant will occupy less than 1,000 feet of shoreline along the flood plain, the profile must show a single line coincident with the elevation of the centerline of the outfall pipe.

(3) For 1,000 feet or more of shoreline, the profile must show the water surface elevation at both the upstream and downstream limits of any protective structure for the proposed plant.

(c) Requirements for plant site protection. The executive director may not approve a proposed treatment unit within the 100-year flood plain unless satisfactory measures to protect all open process tanks and electric units are provided as part of the proposed wastewater facility design.

§217.35. Backup Power Requirements.

(a) Reliability of existing commercial power service.

(1) The engineer shall determine the reliability of the existing commercial power service for the facility from the power outage records obtained from the appropriate power company(s).

(2) The records must:

(A) be in writing;

(B) bear the signature of an authorized utility employee;

(C) identify the location of the wastewater treatment systems or off-site lift station(s) being served;

(D) list the total number of outages that have occurred during the past 24 months; and

(E) indicate the duration of each recorded outage.

(b) The engineer shall submit the eligibility determination and all backup documentation for the approval of the executive director in the report.

(c) Unreliable power supplies.

(1) The executive director will notify the engineer in writing of a determination of unreliable power supply. If the executive director makes such a determination, the facility shall

incorporate an on-site, automatically-starting generator, capable of ensuring continuous operation of all critical wastewater treatment system units for a duration equal to the longest power outage in the power records.

(2) Off-site lift stations must incorporate an on-site, automatically-starting generator capable of ensuring continuous operation of the lift station for a duration equivalent to the longest power outage on record for the past 24 months.

(3) Exceptions to the auxiliary power generator requirements for wastewater treatment facilities are outlined in paragraph (A) of this subsection and for off-site lift stations in paragraph (B) of this subsection.

(A) Wastewater treatment facilities. The requirements for on-site, automatically-starting generators may be reduced as follows:

(i) Facilities do not require on-site generators if:

(I) reliable electrical service from two separate commercial power companies exists which ensures a power supply sufficient to power the entire facility continuously and, automatic switch-over capabilities exist; or

(II) Reliable electrical service from two independent feeder lines or substations of the same electric utility exists which ensures a power supply sufficient to power the entire facility continuously, and automatic switch over capabilities exist.

(ii) Facilities may use lift stations and collection systems to store wastewater in lieu of on-site generators where the report calculations show that sufficient volume exists in the lift stations, upstream gravity sewer lines, and manholes to store the volume of wastewater during a peak diurnal event of a duration equal to the longest outage in the power records.

(iii) If storage is used in lieu of backup power generators, the report must show that the hydraulic grade line of the collection system is such that in no case will wastewater be allowed to bypass the treatment plant during a peak diurnal event of a duration equal to the longest outage in the power records.

(iv) When upstream storage is used as a means of ensuring complete treatment of the influent wastewater, the design must include the following:

(I) Storage is prohibited as a substitute for on-site generators if any of the flow to the treatment plant is gravity flow.

(II) If the influent storage is between 0 and 2 hours and power outage records indicate a maximum outage of less than 2 hours, the on-site, automatically- starting generators need only provide sufficient power to operate all components of the disinfection system.

(III) If the influent storage is between 2 and 4 hours and the power outage records indicate an outage between 2 and 4 hours, the on-site, automatically-starting generator need only supply sufficient power to operate all or components of the disinfection system and return activated sludge pumps. Auxiliary generators are not required to supply power for return activated sludge pumps if the report shows sufficient volume in the clarifiers for storage of sludge.

(B) Off-Site Lift Stations. An off-site lift station does not require auxiliary generators in the following cases:

(i) If reliable electrical service from two separate commercial power companies and automatic switch over capabilities at the station exist; or

(ii) If reliable electrical service from two independent feeder lines or substations of the same electric utility and automatic switch over capabilities at the station exist;

(C) Portable generators or pumps. Facilities may substitute portable generators or pumps in combination with collection system storage for on-site generators in cases where the following criteria exist:

(i) the firm capacity of the lift station is less than 100 gallons per minute;

(ii) the station includes an autodialer or telemetry system;

(iii) operators knowledgeable in acquisition and startup of the portable units are on 24-hour call;

(iv) the station is accessible during a 25-year flood event;

(v) reasonable assurances exist as to the timely availability and accessibility of the proper portable equipment; and,

(vi) the station is equipped with properly designed and tested quick connection facilities.

(D) Exceptions to On-Site Generators.

(i) A facility may substitute collection system storage for on-site generators where calculations included in the report show that sufficient volume exists in the lift stations, upstream gravity sewer lines and manholes to store the volume of wastewater which would be received during a peak diurnal event of a duration equal to the longest outage in the power records.

(ii) If storage is used in lieu of backup power generators, the report must show that the hydraulic grade line of the collection system does not allow wastewater to overflow from the collection system during a peak diurnal event of a duration equal to the longest outage in the power records.

(iii) A facility must not use spill containment structures as a means of preventing lift station discharges during a power outage to qualify under this subsection.

§217.36. Buffer Zone and Design of Odor Abatement Facilities.

(a) The buffer zone restrictions in §309.13 of this title (relating to Unsuitable Site Characteristics) apply to all construction of wastewater treatment facilities. The report must include designs for odor abatement facilities intended to attain compliance with permit buffer zone requirements.

(b) The engineer shall submit the proposed odor abatement measures in the summary transmittal letter required by §217.9(c) of this title (relating to Submittal Requirements) to the executive director.

(c) The executive director will review all odor abatement facilities as nonconforming or innovative technologies in accordance with §217.10(2) of this title (relating to Types of Approvals).

§217.37. Effluent Reuse.

(a) All facilities designed after the effective date of this chapter must use reclaimed water in place of potable water used for wash down water, water used for the disinfection system operation, water used for chemical mixing, water for irrigating the plant grounds or any other use the engineer determines is appropriate.

(b) Reclaimed water must be taken after disinfection. The reclaimed water system must provide for screening or filtration, pumping backup with controls, and a pressure sustaining device such as a hydro-pneumatic tank.

(c) The facility must meet the requirements for Type II water as defined in Chapter 210 of this title (relating to the Use of Reclaimed Water).

SUBCHAPTER C : CONVENTIONAL COLLECTION SYSTEMS
§§217.51-217.72

STATUTORY AUTHORITY
The rules in Subchapter C, Conventional Wastewater Collection Systems, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.51. Applicability.

This subchapter covers the design, construction, and testing standards for conventional gravity wastewater treatment collection systems, conventional wastewater treatment lift stations, force mains, and reclaimed water conveyance system.

§217.52. Edwards Aquifer.

All collection systems to be located over the recharge zone of the Edwards Aquifer must be designed and installed in accordance with Chapter 213 of this title (relating to Edwards Aquifer Rules) in addition to these rules.

§217.53. Pipe Design.

(a) Flow Design Basis.

(1) The design of wastewater collection systems must handle the transport of the peak dry weather flow from the service area, plus infiltration and inflow.

(2) The engineer shall prepare calculations detailing the average dry weather flow, the dry weather flow peaking factor and the infiltration and inflow.

(3) The flow calculations must include the flow expected in the facility immediately upon completion of construction and at the end of its 50-year life.

(b) Gravity Pipe Materials. The report must identify the proposed wastewater collection system pipes with its appropriate ASTM, ANSI or AWWA standard numbers for both quality control (dimensions, tolerances, etc.) and installation (bedding, backfill, etc.). The choice of wastewater collection system pipes must be based on:

(1) the characteristics of the wastewater conveyed;

(2) the character of industrial wastes;

(3) the possibilities of septic,

(4) the exclusion of inflow and infiltration;

(5) the external forces;

(6) groundwater;

(7) internal pressures; and

(8) abrasion and corrosion resistance.

(c) Joints for Gravity Pipe.

(1) The technical specifications must include the materials and methods used in making joints.

(2) Materials used for pipe joints must have a satisfactory record of preventing infiltration and root entrance. The joints must include:

(A) rubber gaskets,

(B) PVC compression joints,

(C) high compression polyurethane,

(D) welded,

(E) heat fused, or

(F) other types of factory made joints.

(3) The technical specifications must include ASTM, AWWA or other appropriate national reference standards for the joints.

(d) Separation Distances Between Wastewater Lines and Water Lines; and Manholes and Water Lines. The wastewater lines and manholes must satisfy the separation requirements from water system of Chapter 290 of this title (relating to Public Drinking Water).

(e) Laterals and taps. Lateral and taps on all new installations must include a manufactured fitting that limit infiltration, prevent protruding service lines, and protect the mechanical and structural integrity of the wastewater collection system.

(f) Bore/Tunnel For Crossings. The spacing of supports for carrier pipe through casings must ensure and maintain grade, slope, and structural integrity as required by §217.53(k) and (l) of this title (relating to Pipe Design).

(g) Corrosion Potential. The pipes must incorporate appropriate linings if the corrosion analysis indicates that corrosion will reduce the facility life to less than 50 years.

(h) Odor Control.

(1) The engineer shall determine if odor control measures are necessary to prevent the wastewater collection system from becoming a nuisance to the public adjacent to the wastewater collection system based upon the hydrogen sulfide generation potential of the wastewater collection system.

(2) The odor potential determination must include the flows immediately following construction, at the end of its 50-year life, and any periods between these points.

(i) Active Geologic Faults.

(1) The engineer shall locate any active faults within the area of the collection system and minimize the number of sewers crossing faults. Where crossings are unavoidable, the report must specify design features to protect the integrity of the wastewater collection system. The design must use joints providing maximum deflection as required in §217.53(m)(1) and manholes on each side of the fault so that a portable pump may be used in the event of wastewater collection system failures.

(2) A wastewater collection system must not include service connections within 50 feet of an active fault.

(j) Capacity Analysis.

Wastewater collection system capacity must be sufficient to serve the estimated future population plus adequate allowance for institutional and commercial flows. The hydraulic capacity for the wastewater collection system must include the peak flow of domestic sewage, peak flow of waste from industrial plants, and maximum infiltration rates. A wastewater collection system must preclude surcharge at the expected peak flow. All gravity pipes must have a minimum diameter of 6-inches. A wastewater collection system is prohibited from allowing the connection of individual roof, street, or other types of drains other than domestic sewer drains.

(1) Existing Systems. The design of an extension to a wastewater collection system may use the data from the existing wastewater collection system. In the absence of existing data, the design must use data from similar systems or as described in paragraph (2) of this subsection.

(2) New wastewater collection systems.

(A) New wastewater collection system pipe sizing must use an appropriate engineering analysis of existing and future flow data.

(B) New wastewater collection system designs must use an estimated daily sewage flow contribution as shown in the Table B.1 in §217.32 of this title (relating to Design of New Systems - Organic Loadings and Flows).

(C) A wastewater collection system pipe capacity must handle the transport of wastewater at a rate approximately four times the system design daily average flow when full.

(k) Structural Analysis. The wastewater collection system design must provide a minimum structural life cycle of 50 years. The owner of the wastewater collection system must provide inspection under the direction of an engineer during the construction and testing phases of the project. A flexible pipe is one that will deflect at least 2 percent without structural distress. A rigid pipe is one that does not meet this criteria. The design analysis for flexible pipe installations is detailed in paragraph (1) and (2) of this subsection. The design analysis for rigid pipe installations is in paragraph (3) of this subsection.

(1) Flexible Pipe. The report must include:

(A) live load calculations;

(B) allowable buckling pressure determinations;

(C) prism load calculations;

(D) wall crushing determinations;

(E) strain prediction calculations;

(F) calculations which quantify long term pipe deflection; and

(G) all information pertinent to the determination of an adequate design including, but not limited to:

(i) the method of determining modules of soil reaction for bedding material;

(ii) the method of determining modules of soil reaction for in-situ material;

(iii) pipe diameter and material with reference to appropriate standards;

(iv) modules of elasticity,

(v) tensile strength,

(vi) pipe stiffness, or

(vii) ring stiffness constant converted to pipe stiffness

(viii) Leonhardt's zeta factor;

(ix) trench width;

(x) depth of cover;

(xi) water table elevation; and

(xii) unit weight of soil.

(H) The design procedure dictates the minimum pipe stiffness. For trench installations, the engineer shall specify a minimum stiffness requirement to ensure ease of handling, transportation, and construction. Pipe stiffness must be related to Ring Stiffness Constant (RSC) by the following equation:
(Figure 1: §217.53(H)(1))

$$PS = C * RSC * (8.337/D) \qquad \textit{Equation } 1.c$$

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

(2) Pipes that meet all the requirements in (A) - (H) of this paragraph are not required to perform the structural calculations in paragraph (1), provided that the pipe is installed and tested in accordance with all other requirements of this subchapter.

(A) Open trench design.

(B) Flexible pipe with a pipe stiffness of 46 psi or greater.

(C) Buried 17 feet or less.

(D) Diameter of 12-inches or less.

(E) A module of soil reaction for the in-situ soil of 200 psi or greater.

(F) No effects on the pipe due to live loads.

(G) A unit weight of soil of 120 pounds per cubic foot or less.

(H) A pipe trench width of 36 inches or greater.

(3) Rigid Pipe. The report must include a structural analysis of the pipe installation and any details necessary to verify that the structural strength of the rigid pipe is sufficient to withstand the stresses which the pipe is expected to experience. For rigid conduits, the engineer shall state the minimum strengths for the given class in the appropriate standard for the pipe material.

(l) Minimum/Maximum Slopes. All wastewater collection systems must contain slopes sufficient to allow a velocity when flowing full of not less than 2.0 feet per second. The grades shown in Table C.1 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 is 0.013. The "n" takes into consideration the slime, grit and grease layers that will affect hydraulics or hinder flow as the pipe matures. Where a velocity greater than 10 feet per second will occur when the pipe flows full, based on Manning’s formula and an n value of 0.013, special provisions must protect against pipe and bedding displacement. **Figure 2: §217.53 (k)**

Table C.1 - Minimum and Maximum Pipe Slopes		
Size of Pipe (inches)	Minimum Slope (%)	Maximum Slope (%)
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 is determined by Manning's formula (as shown below) to maintain a velocity greater than 2.0 feet per second and less than 10 feet per second when flowing full.

$$V = (1.49/n) * (R_h^{0.67}) * (\sqrt{S}) \qquad \textit{Equation } 2.c$$

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

(m) Alignment. Gravity wastewater collection systems must lay in straight alignment with uniform grade between manholes when possible. The designation must justify any variance from straight alignment by complying with the requirements of this section. Variance from uniform grade (i.e., grade breaks or vertical curves) without manholes with open cut construction is prohibited.

(1) Construction methods which use flexure of the pipe joint are prohibited. The engineer shall provide the calculations for horizontal pipe curvature in the report and detail the proposed curvature on the plans. The maximum allowable joint deflection is the lesser of the following:

(A) equal to 5°;

(B) 80% of the manufacturer's recommended maximum deflection; or

(C) 80% of the appropriate ASTM, AWWA, ANSI or nationally-established standard for joint deflection.

(2) The maximum allowable manhole spacing for sewers with horizontal curvature is 300 feet. A manhole must be at the P.C. and P.T. of the curve.

(n) Inverted Siphons/Sag Pipes.

(1) Sag pipes must include two or more barrels, a minimum pipe diameter of six inches, and the necessary appurtenances for convenient flushing and maintenance.

(2) The manholes must include adequate clearances for rodding.

(3) Sufficient head and pipe sizes must assure velocities of at least three feet per second at initial and design flows.

(4) The arrangement of inlet and outlet details must divert the normal flow to one barrel. The system must allow for any barrel to be taken out of service for cleaning.

(5) Provisions shall be made to allow cleaning across each bend with equipment available to the entity in charge of operation and maintenance of the facility.

(6) Sag pipes design must minimize nuisance odors.

(o) Bridged Sections.

(1) Wastewater collection systems pipes with restrained joints or monolithic pipe between a bridged section requires manholes on each end. A bridged section must withstand the hydraulic forces applied by the occurrence of a 100-year flood including buoyancy.

(2) Wastewater collection system pipe material must be capable of withstanding impacts from debris.

(3) Bank stabilization must prevent erosion of bank sections.

(4) The spacing for a bridge support must maintain that adequate grade, slope, and structural integrity are maintained.

§217.54. Pipe Bedding.

(a) Bedding Material.

(1) A rigid pipe must use Bedding Classes A, B, or C, as described in ASTM C 12 (ANSI A 106.2), Water Environment Federation (WEF) Manual of Practice (MOP) No. 9, or American Society of Civil Engineers (ASCE) MOP 37, provided that the proper strength pipe is used with the specified bedding to support the anticipated load(s).

(2) A flexible pipe must use Bedding Classes IA, IB, II, or III, as described in ASTM D-2321 or ANSI K65.171.

(3) Regardless of which bedding class is used, the wastewater collection system pipe strength must support the anticipated load when used with the specified pipe bedding as required by §217.53(i) of this title (relating to Pipe Design).

(4) Debris, large clods or stones greater than six inches in diameter, organic matter, or other unstable materials is prohibited as hunching or initial backfill.

(5) All backfill must not disturb the alignment of the wastewater collection system pipe.

(6) Where trenching encounters extensive fracture or fault zones, caves, or solutional modification to the rock strata, construction must halt until an engineer provides direction to accommodate site conditions.

(b) Bedding Compaction. Compaction of the bedding envelope must meet wastewater collection system pipe manufacturer’s recommendations and must provide the modules of soil reaction for the bedding material necessary to ensure the wastewater collection system pipe’s structural integrity as required by §217.53(i) of this title (relating to Active Geologic Faults). The placement of the backfill above the pipe must not affect the structural integrity of the pipe.

(c) Envelope Size. A minimum clearance of below and on each side of the bell of all pipes to the trench walls and floor must be 6 inches. The bedding or embedment material class used for haunching and initial backfill must be installed to a minimum depth of 12 inches above the crown of the pipe.

(d) Trench Width.

(1) A trench is the open cut portion of the excavation up to one foot above the pipe.

(2) The width of the trench must allow the pipe to be laid and jointed properly and must allow the backfill to be placed and compacted as needed.

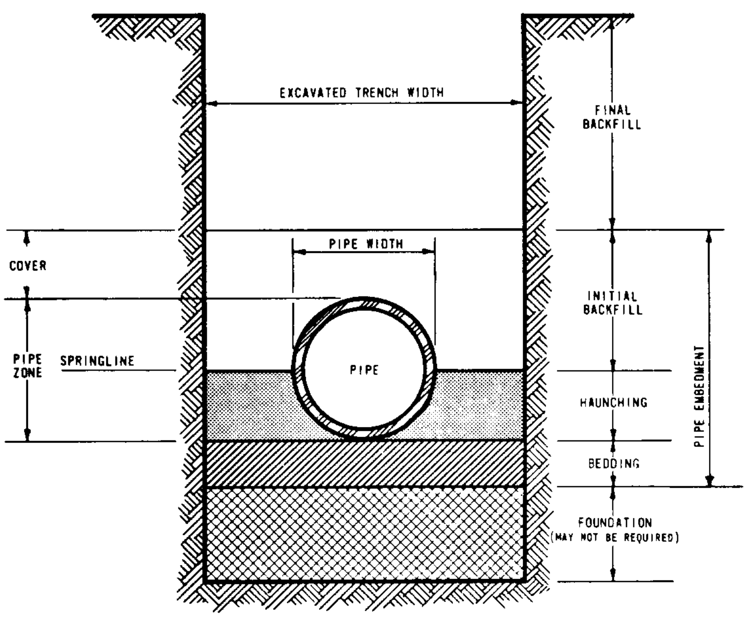
(3) The engineer shall specify the maximum and minimum trench width needed for safety and the pipe's structural integrity.

(4) The width of the trench must ensure working room to properly and safely place and compact hunching materials.

(5) The space between the pipe and the trench wall must be wider than the compaction equipment used in the pipe zone.

Figure 1: §217.54(d)

TRENCH CROSS-SECTION SHOWING TERMINOLOGY



§217.55. Manholes and Related Structures.

(a) The wastewater collection system must include manholes at:

(1) all points of change in alignment, grade or size;

(2) at the intersection of all pipes; and

(3) at the end of all pipes that may be extended at a future date.

(b) Manholes placed at the end of the wastewater collection system pipes that may be extended in the future must include pipe stub outs with plugs. Clean-outs with watertight plugs may be installed in lieu of manholes at the end of wastewater collection system pipes which are not anticipated to be extended. Cleanout installations must pass all applicable testing requirements outlined for gravity collection lines in this §217.57 of this title (relating to Testing Requirements for the Installation of Gravity Collection Lines.)

(c) Types of Materials. A manhole must use monolithic cast-in-place concrete, fiberglass, precast concrete, HDPE or of equivalent construction. A brick manhole or the use of bricks to adjust a manhole cover to grade is prohibited. A cast-in-place manhole must provide adequate structural integrity.

(d) Spacing. Table C.2 specifies the maximum required manhole spacing for a wastewater collection system with straight alignment and uniform grades. Tunnels are exempt from manhole spacing requirements due to construction constraints. **Figure 1: §217.55(2)**

Table C.2 - Maximum Manhole Spacings	
Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
6-15	500
18-30	800
36-48	1000
54 or larger	2000

(e) Diameter/Size. Manhole diameters must allow personnel to work within them and to allow proper joining of the sewer pipes in the manhole wall. The minimum inside diameter of a manhole is 48 inches.

(f) Covers/Inlets/Base.

(1) Manhole Covers.

(A) A manhole where personnel entry is anticipated requires a manhole cover of nominal 30 inch or larger diameter clear opening A manhole located within the 100-year flood plain must have a gasketed and bolted cover, or have another means of preventing inflow. A manhole cover construction must use impervious material.

(B) A manhole cover that is located in a roadway must meet the American Association of State Highways and Transportation Officials (AASHTO) standard M-306.

(2) Manhole Inverts.

(A) The bottom of the manhole must contain a "U" shaped channel that is a smooth continuation of the inlet and outlet wastewater collection system pipes.

(B) A manhole connected to wastewater collection system pipes less than 15 inches in diameter, must have the channel depth equal to at least half the largest pipe diameter.

(C) For manholes connected to wastewater collection system pipes 15 to 24 inches in diameter must have, the channel depth equal to at least three fourths the largest pipe diameter.

(D) A manhole connected to wastewater collection system pipes greater than 24 inches in diameter must have a channel depth equal to at least equal to the largest pipe diameter.

(E) A manhole with wastewater collection system pipes of different sizes must have the tops of the pipes at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe.

(F) The bench provided above the channel must slope at a minimum of 0.5 inch per foot.

(G) Where a wastewater collection system pipe enters a manhole higher than 24 inches above the manhole invert, the invert must be filleted to prevent solids deposition.

(H) A wastewater collection system pipe entering a manhole more than 30 inches above the invert must have a drop pipe. If the drop is inside the manhole, the drop pipe must maintain a minimum of 48 inches of clear space and be permanently affixed to the wall of the manhole.

(g) Manhole Steps. The inclusion of manhole steps in a manhole is prohibited.

(h) Connections. A manhole-pipe connection must use watertight, size-on-size resilient connectors allowing for differential settlement and must conform to ASTM C-923.

(i) Venting. Where gasketed manhole covers are required for more than three manholes in sequence, a system must use an alternate means of venting at less than 1,500 foot intervals. Vent design shall minimize inflow. Vents must be above the 100-year flood elevation. Tunnels are required to meet any venting requirements.

(j) Cleanouts. Cleanouts must equal the size of the main.

§217.56. Trenchless Design for Collection Systems.

A pipe installation using trenchless design is nonconforming technology subject to review under the requirements of §217.10(2) of this title (relating to Types of Approvals). The executive director must approve structural design and installation details of a trenchless design before construction.

§217.57. Testing Requirements for Installed Gravity Collection Lines.

The design must specify an infiltration/exfiltration or a low-pressure air test. The engineer shall make available the copies of all test results to the executive director or review authority upon request. Tests must conform to the following requirements:

(1) Low Pressure Air Test.

(A) A low pressure air test must follow the procedures described in ASTM C-828, ASTM C-924, or ASTM F-1417 or other acceptable procedures, except as to testing times as required in Table C.3 or Equation 3.c.

(B) For sections of wastewater collection system pipe less than 36-inch average inside diameter, the following procedure must apply, unless the pipe is to be joint tested as required by §217.57(a)(2) of this section.

(C) The pipe must be pressurized to 3.5 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 is computed from the following equation: **Figure 1:§217.57(1)**

$$T = (0.085 * D * K)/Q \qquad Equation\ 3.c$$

T	=	time for pressure to drop 1.0 pound per square inch gauge in seconds
K	=	0.000419×D×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 must be used

(D) Since a K value of less than 1.0 must not be used, the minimum testing times for each pipe diameter are as shown in Table C.3. **Figure 2: §217.57(1)(A)**

Table C.3 - Minimum Testing Times for Low-Pressure Air Test			
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	1020	133	7.693(L)
21	1190	114	10.471(L)
24	1360	100	13.676(L)
27	1530	88	17.309(L)
30	1700	80	21.369(L)
33	1870	72	25.856(L)

(E) The engineer may stop the test if no pressure loss has occurred during the first 25% of the calculated testing time.

(F) If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test must continue for the entire test duration, as outlined above, or until failure.

(G) Wastewater collection system pipes with a 27-inch average inside diameter and larger may be air tested at each joint instead of following the procedure outlined above.

(H) Pipe greater than 36-inch diameter must be tested for leakage at each joint. If the joint test is used, the engineer shall certify a visual inspection of the joint immediately after testing.

(I) The wastewater collection system pipe must 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 must be 10 seconds.

(2) Infiltration/Exfiltration Test.

(A) The total exfiltration, as determined by a hydrostatic head test, must 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.

(B) Following the exfiltration test, the engineer shall drain the wastewater collection system pipe, leave it empty for a period of 24 hours, and measure the amount of infiltration into the pipe. The total infiltration for this period of time must not exceed 50 gallons per inch diameter per mile of pipe.

(C) The engineer shall use an infiltration test in lieu of the exfiltration test when pipes are installed below the groundwater level.

(D) The total infiltration, as determined by a hydrostatic head test, must 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.

(E) For construction within the 25 year flood plain, the infiltration or exfiltration must not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

(F) If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, the engineer shall undertake remedial action in order to reduce the infiltration or exfiltration to an amount within the limits specified. The engineer shall retest the line following the remediation action.

(3) Deflection Testing.

(A) Deflection test.

(i) A flexible pipe requires a deflection test.

(ii) For wastewater collection system pipes with inside diameters less than 27 inches, deflection measurements require a rigid mandrel.

(iii) For wastewater collection system pipes with an inside diameter 27 inches and greater, other test methods may be used to determine vertical deflections.

(iv) The test method provides a precision of ± two tenths of one percent (0.2 %) deflection.

(v) The engineer shall not conduct the test until at least 30 days after the final backfill.

(vi) Wastewater collection system pipe deflection must not exceed five percent.

(vii) If a pipe section fails the deflection test, the engineer shall correct the problem and conduct a second test after the final backfill has been in place at least an additional 30-days.

(viii) The engineer shall not use any mechanical pulling devices during testing.

(ix) Upon completion of construction, the engineer or other engineers appointed by the owner shall certify to the executive director or review authority that the installation passed the deflection test.

(x) This certification may be made in conjunction with the notice of completion required in §217.13 of this title (relating to Completion Notification).

(B) Mandrel Sizing.

(i) The rigid mandrel must have an outside diameter (O.D.) not less than 95% of the base inside diameter (I.D.) or average inside diameter of the pipe, as specified in the appropriate ASTM, AWWA, UNI-BELL, or ANSI Standard, and any related appendix.

(ii) If a mandrel sizing diameter is not specified in the appropriate standard, the mandrel must have an O.D. equal to 95% of the I.D. of the pipe. In this case, the I.D. of the pipe, for the purpose of determining the O.D. of the mandrel, must equal be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe.

(iii) All dimensions must meet the appropriate standard.

(C) Mandrel Design.

(i) The rigid mandrel must be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed.

(ii) The mandrel must have nine or more odd number of runners or legs.

(iii) The barrel section length must equal at least 75% of the inside diameter of the pipe.

(iv) Each size mandrel must use a separate proving ring.

(D) Method Options.

(i) An adjustable or flexible mandrel is prohibited.

(ii) A test must not use television inspection as a substitute for a deflection test.
(iii) The executive director may approve the use of a deflectometer or a mandrel with removable legs or runners on a case-by-case basis.

§217.59. Testing Requirements for Manholes.

The engineer shall test all manholes after assembly and backfilling manholes for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, vacuum testing, or other methods acceptable to the executive director. If a manhole fails a leakage test, the engineer shall repair the manhole and retest until it passes.

(1) Hydrostatic Testing.

(A) The maximum leakage for hydrostatic testing or any alternative test methods is 0.025 gallons per foot diameter per foot of manhole depth per hour.

(B) To perform a hydrostatic exfiltration test, the engineer shall seal all wastewater lines coming into the manhole with an internal pipe plug, fill the manhole with water, and maintain the test for at least one hour.

(C) A test for concrete manholes may use a 24-hour wetting period before testing to allow saturation of the concrete.

(D) If the manhole fails the hydrostatic test, the engineer shall repair the manhole and retest until it passes.

(2) Vacuum Testing.

(A) To perform a vacuum test, the engineer shall plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering the manhole.

(B) No grout must be placed in horizontal joints before testing.

(C) Stubouts, manhole boots, and pipe plugs must be secured to prevent movement while the vacuum is drawn.

(D) The engineer shall use a minimum 60-inch/lb torque wrench to tighten the external clamps that secure the test cover to the top of the manhole.

(E) The test head must be placed at the inside of the top of the cone section, and the seal inflated in accordance with the manufacturer's recommendations.

(F) The engineer shall achieve a vacuum of 10 inches of mercury inside the manhole.

(G) The test does not begin until after the vacuum pump is off.

(H) The manhole passes the test if after 2 minutes the vacuum is at least 9 inches of mercury with all valves closed.

§217.60. Lift Station Site Selection.

(a) Site access.

(1) The lift station must include an access road located in a dedicated right-of-way or a permanent easement.

(2) The road surface must have a minimum width of 12 feet and must be constructed for use in all weather conditions.

(3) The road surface must be above the water level caused by a 25-year storm event.

(b) Security.

(1) The design of the lift station, including all mechanical and electrical equipment, must restrict access from any unauthorized person.

(2) The lift station must include an intruder resistant fence, enclosure or an entirely lockable structure.

(3) An intruder resistant fence must use a minimum of a 6-feet high chain link fence with a 1-foot section of 3 strands of barbed wire.

(c) Flood Protection. The design of the lift station, including all electrical and mechanical equipment, must protect against a flood event on a 100-year frequency including wave action, and be fully operational during such event.

(d) Odor Control. The design of the lift station must minimize odor potential. The engineer shall include any designs for odor control in the report. The engineer must design the incoming wet well gravity pipes to reduce turbulence and minimize retention times.

§217.61. Lift Station Wet Well/Dry Well Design Considerations.

(a) Pump Controls. All lift stations must operate automatically based on the water level in the wet well. The location of wet well level mechanisms must ensure that the mechanisms are unaffected by currents, rags, grease, or other floating materials. All level mechanisms must remain accessible without entering the wet well. Wet well controls with bubbler systems require dual air supply and controls.

(b) Flood Protection. All electrical equipment must be protected during a 100-year flood event and from potential flooding from the wet well. Motor control centers must be mounted on a 4-inch tall housekeeping pad. All electrical equipment and connections in wet wells and dry wells must be explosion proof unless continuous ventilation is provided.

(c) Wet Wells.

(1) Wet wells must be separated by a watertight and gas tight wall. All wall penetrations must be gas tight.

(2) A wet well must not contain equipment requiring regular or routine inspection and maintenance, unless maintenance can be made without entering the wet well.

(3) All gravity lines discharging to the wet well must be located where the invert elevation is above the liquid level of the pumps on setting.

(4) Gate valves and check valves are prohibited in the wet well.

(5) Gate valves and check valves may be located in a valve vault next to the wet well.

(6) Pump cycle time, based on peak flow, must equal or exceed those in Table C.4.

Figure 1: §217.61 (c)

Table C.4 - Minimum Pump Cycle Times	
Pump Horsepower	Minimum Cycle Times (minutes)
less then 50	6
50 - 100	10
Over 100	15

The evaluation of Minimum Wet Well Volume requires the following formula:

$$V = (T * Q) / (4 * 7.48) \qquad \textit{Equation } 4.c$$

V	=	Active Volume (ft^3)
Q	=	Pump Capacity (GPM)
T	=	Cycle Time (Minutes)
7.48	=	conversion factor in gallons/cubic foot

(d) Dry well access. Underground dry wells must be accessible. Stairways must use non-slip steps and conform to Occupational Safety and Health Administration (OSHA) regulations with respect to rise and run. Ladders must conform to OSHA requirements if used in lieu of stairways.

(e) Lift Station Ventilation.

(1) Passive Ventilation for Wet Wells.

(A) Gooseneck, turbine, or other types of passive ventilation must use screening to prevent the entry of birds or insects to the wet well.

(B) All mechanical and electrical equipment in the wet well with passive ventilation must have explosion-proof construction.

(C) The passive ventilation system must be sized to vent at a rate equal to the maximum pumping rate of the station and not exceed 600 fpm through the vent pipe.

(D) The minimum air vent is 4-inches in diameter.

(E) Vent outlets must be at least 1 foot above the 100-year flood elevation.

(2) Mechanical Ventilation in Lift Stations.

(A) Dry Wells. A dry well must use mechanical ventilation. Ventilation equipment under continuous operations must have a minimum capacity of six air changes per hour. Ventilation equipment under intermittent duty must have a minimum capacity of thirty air changes per hour and be interlocked with the station's lighting system.

(B) Wet Wells. A wet well must use continuous mechanical ventilation if explosion proof mechanical and electrical equipment is not provided throughout the wet well. The ventilation equipment must be sized for 12 air changes per hour and constructed of corrosion resistant material. The design of the wet wells must reduce odor potential in residential areas.

(f) Wet Well Slopes. Any wet well floors must have a minimum of 10 percent slope to the pump intakes and have a smooth finish. A wet well projection must prevent deposition of solids under normal operating conditions. A lift station with greater than 5 MGD firm pumping capacity must have anti-vortex baffling.

(g) Hoisting Equipment. A lift station must use hoisting equipment or be accessible for removal of pumps, motors, valves, pipes and other similar equipment.

(h) Dry Well/Valve Vault Drains. Floor drains from a valve vault to a wet well must prevent gas from entering the valve vault by including flap valves, "P" traps, submerged outlets, or a combination of these devices.

(i) Dry Well Sump Pumps.

(1) Pumps.

(A) A dry well must use dual sump pumps, each with a minimum capacity of 1000 gallons per hour and capable of handling liquid generated during peak operations.

(B) A pump must have submersible motors and water-tight wiring.

(C) A dry well floor must slope toward a sump sized for proper drainage.

(D) The minimum sump depth is 6 inches and must prevent standing water on the dry well floor under normal operation.

(E) A sump pump must operate automatically by use of a float switch or other level device.

(2) Pipes. A sump pump must use separate pipes capable of discharging more than the maximum liquid level of the wet well. A sump pump outlet pipe must be at least 1½ inches in diameter and include at least two check valves in series.

§217.62. Pumps for Lift Stations.

(a) General Requirements. All raw wastewater pumps must include following:

(1) a non-clog design;

(2) capable of passing an incompressible sphere of 2 ½ -inches in diameter or greater; and
(3) use greater than a 3 inch diameter suction and discharge openings.

(b) Submersible / Non-submersible Pumps.

(1) All non-submersible pumps must have inspection and cleanout plates, on suction and discharge sides of each pumping unit, are required to facilitate locating and removing blockage causing materials unless the pump design accommodates easy removal of the rotation elements.

(2) All pump supports must prevent movement or vibration during operation.

(3) All submersible pumps must use rail-type pump support systems, with manufacturer approved mechanisms designed to allow personnel to remove and replace any single pump without first entering or dewatering the wet well.

(4) Submersible pump rails and lifting chains must be constructed of Series 300 stainless steel.

(5) A pump for lift stations with a peak flow of less than 120 gallons per minute must be of submersible and use grinder pumps.

(c) Lift Station Pumping Capacity. The firm pumping capacity of all lift stations must handle the expected peak flow. Firm pumping capacity is defined as the lift station's maximum pumping capacity with the largest pumping unit out of service.

(d) Pump Head Calculations.

(1) The engineer shall select pumps based upon analysis of the system head and pump capacity curves which determine the pumping capacities alone and with other pumps as the total dynamic-head increases due to additional flows pumped through the force main.

(2) The engineer shall calculate pipe head loss using the Hydraulic Institute Standards

pertaining to head losses through pipes, valves, and fittings.

(3) The selected C factor used in friction head loss calculations must be based on the pipe material selected.

(4) For lift stations with more than two pumps, force mains in excess of one half mile, or firm pumping capacity of 100 gpm or greater, system curves must be provided for both the normal and peak operating conditions at C values for new and old pipe.

(e) Flow Control. A lift station or a transfer pumping station located at or discharging directly to a wastewater treatment system must have a peak pump capacity less than the peak design flow, unless flow splitting or equalization is provided. A wastewater treatment system with a peak two hour flow is greater than 300,000 gallon per day, must use three or more pumps, unless duplex automatically-controlled variable capacity pumps are provided.

(f) Self Priming Pumps. A self priming pump must be capable of priming at the design pump on wet well level without reliance upon a separate priming system, an internal flap valve, or any external means for priming. A self priming pump must use a suction pipe velocity between 3 and 7 feet per second (fps), and must incorporate its own suction pipe. A self priming pump must vent air back into the wet well during priming.

(g) Vacuum Priming Pumps. A vacuum primed pump must be capable of priming at the design pump on wet well level by using a separate positive priming system with a dedicated vacuum pump for each main wastewater pump. A vacuum priming pump must use a suction pipe velocity between 3 and 7 fps and must incorporate its own suction pipe.

(h) Vertical Positioning of Pumps. A raw wastewater pump must have positive static suction head during their normal on-off cycling. This requirement does not apply to submersible pump with "no suction" pipes, a vacuum-primed pump, or a self-priming unit capable of satisfactory operation under any negative suction heads anticipated for the lift station.

(i) Individual Grinder Pumps. A grinder pump station serving only one residential or commercial structure that is privately owned, maintained, and operated are not subject to the rules of this Chapter but must satisfy any local codes, ordinances, and other local requirements.

§217.63. Lift Station Pipes.

(a) Horizontal Pump Suctions. Each pump must have a separate suction pipe that uses an eccentric reducer. Pipes in wet wells must have a turn-down type flared intake.

(b) Valves. The discharge side of each pump followed by a full-closing isolation valve must have a check valve. The check valve must be swing type with an external lever. The valve must include a position indicator to show its open or closed position, unless the full-closing valve is a rising stem gate valve. A grinder pump installation may use rubber ball check valves in lieu of swing type check valves. Butterfly valves, tilting disc check valves, or other valves using a tilting disc in the flow line are prohibited.

(c) Pipes. Lift station pipes must have flanged or flexible connections to allow for removal of pumps and valves without interruption of the lift station operations. Wall penetrations must allow for pipe flexure while excluding exfiltration or infiltration. Pipe suction velocities must be between 3 and 7 feet per second.

§217.64. Emergency Provisions for Lift Stations.

Lift station designs must prevent upstream overflows or by-passing of surcharge of raw wastewater and must include an alarm system. The alarm system must transmit all alarm conditions through use of an auto-dialer system, supervisory control and data acquisition (SCADA), or telemetering system, to a 24-hour assistance location. The alarm system must activate during an event involving a power outage, pump failure, or a specified high wet well water level. All collection system lift stations must be equipped with properly designed and tested quick connection facilities to connect to a portable generators . All lift station must be provided with service reliability based on paragraphs (1)-(5) of this section.

(1) Retention Capacity.

(A) The retention capacity in the lift station's wet well and incoming gravity pipes must prevent discharges of untreated wastewater at the station or any point upstream for a period of time equal to the longest electrical outage recorded during the past 24 months.

(B) If no records are available, the retention capacity of the wet well and gravity pipes must control 120 minutes of off-line time at peak flow. The minimum retention period is 20 minutes.

(C) Power outage records require the utility company letterhead, bear the signature of a utility representative, identify the location of the lift station, list the total number of outages that have occurred in the past 24 months, and indicate the duration of each power outage.

(D) For calculation purposes, the start of the outage period begins at the wet well elevation at which the last normally operating pump, excluding the standby pump, has just begun to operate.

(2) Dual-Feed Electrical Power. The lift station meets the emergency power requirement if the facility can receive electrical service through one of the following:

(A) two separate electrical distribution circuits that are physically separated, not carried on the same pole, and obtain power from different substations; or

(B) separate power companies which have a fully automatic switch- over capability designed to assure continuous service. If separate distribution circuits originate from the same substation, overall substation reliability must be demonstrated.

(3) On-Site Generators. The lift station may provide emergency power by on-site, automatic electrical generators sized to operate the station at its firm pumping capacity.

(4) Portable Generators or Pumps. A lift station may use portable units to guarantee service if report includes:

(A) the location of the unit(s);

(B) the amount of time which will be needed to transport the unit(s) to the lift station(s);

(C) the number of lift stations for which each unit is dedicated as a backup;

(D) the type of routine maintenance and upkeep is performed on the portable units to ensure that they will be operational when needed and the power reliability records; and,

(E) information detailed in paragraph (1) of this section.

(F) Portable units must meet the following criteria:

(i) The lift station must have an automatic device for operator notification;

(ii) Operators shall be on call 24 hours per day and knowledgeable in operation of the portable units;

(iii) The lift station must be fully accessible during the 25 year flood event; and

(iv) The size of the portable unit must handle the firm pumping capacity of the lift station.

(5) Spill Containment Structures.

(A) The use of a spill containment structure as a means of providing service reliability is prohibited.

(B) A lift station may use a spill containment structure in addition to one of the service reliability options detailed in this section.

(C) The report must include detailed management plan for cleaning and maintaining the spill containment structure.

(D) A spill containment structures must have a six-foot high chain link fence and topped with a minimum of 3 strands of barbed wire and which has a locked gate.

§217.65. Materials For Force Main Pipes.

Force main pipes material must withstand the pressure generated by instantaneous pump stoppage due to power failure under maximum pumping conditions. The use of pipe and fittings rated at working pressure of less than 150 psi is prohibited. All pipe must be identified in the technical specifications with the appropriate ASTM, ANSI, or AWWA specification number for both quality control and installation. Pipe material specified for force mains must have an expected life of at least as long as that of the lift station and must be suitable for the material being pumped.

§217.66. Force Main Pipe Joints.

Force main pipe joints in buried service must include either push-on rubber gaskets or mechanical joints with a pressure rating equal or greater than the force main pipe material. Exposed force main pipe joints must be flanged or flexible and adequately secured to prevent movement due to surges. ASTM, AWWA, or other accepted national reference standards for the joints must be included in the project specifications.

§217.67. Force Main Pipe Bedding.

Bedding for force mains must comply with §217.54 of this title (relating to Pipe Bedding).

§217.68. Identification of Force Main Pipes.

A detector tape must be laid, in the same trench, above and parallel to the force main. The tape must state continuously in a minimum of 1½ inch tall letters "pressurized wastewater".

§217.69. Force Main Design.

(a) Velocities.

(1) A force main must be a minimum of 4 inches in diameter unless used in conjunction with a grinder pump station.

(2) For duplex pump stations, the minimum velocity is 3 feet per second with one pump in operation.

(3) For pump stations with 3 or more pumps, the minimum velocity in the force main is 2 feet per second with the smallest pump only in operation, unless special facilities are provided for cleaning the line, or a flushing velocity of five feet per second or greater will occur once or twice daily.

(4) The engineer shall certify that pipelines with velocities greater than 6 feet per second can withstand high and low negative surge pressures in event of sudden pump failure.

(b) Detention Time. The engineer shall calculate the detention time of the force main. This calculation shall be performed using a range of flow rates which represent the flows expected to be delivered to the force main by the upstream pump station during a 24-hour period.

(c) Water Hammer. A force main must include surge control measures to manage pressures due to water hammer that may exceed the working strength of the force main pipe.

(d) Connection to Gravity Main. A force main must terminate either at a manhole on the wastewater collection system or at the wastewater treatment system in an appropriate structure or manhole. The discharge end of a force main inside a manhole must remain steady and produce non-turbulent flow. The receiving wastewater collection system must accept the maximum pump discharge without surcharging.

(e) Pipe Separation. The separation distance between the force main and any waterline must meet the minimum separation requirements established in §290.44 (e) of this title (relating to Water Distribution).

(f) Odor Control. Force main discharge points must be arranged to reduce turbulence. Force mains must terminate at or near a manhole invert with the top of pipe matching the water level in the manhole at design flow. The engineer shall design the force main to activate if the detention time in the wet well creates an odor problem.

(g) Air Release Valves in Force Mains. All high points along the vertical force main alignment must include air release valves or combination air release/air vacuum valves. These air valves must have an isolation valve between the air valve and the force main. The air valves must be inside of a vault at least 48 inches in diameter with a vented access opening at 30 inches in diameter.

§217.70. Force Main Testing.

The final plans and specifications must state the required pressure testing procedures.

(1) A pressure test must use 50 psi above the normal operating pressure of the force main.

(2) A temporary valve for pressure testing may be installed near the discharge point of the force main and removed after the successful completion of the test.

(3) The pump isolation valve may be used as the opposite termination point.

(4) The test must involve filling the force main with water. The pipe must hold the designated test pressure for a minimum of 4 hours, and the equivalent leakage rate must not exceed 10 gallons per inch diameter per mile of pipe per day.

§217.71. Reclaimed Water and Irrigation Facilities.

(a) In accordance with §217.9 of this title, (relating to Submittal Requirements), the design of the distribution system which will convey reclaimed water to a user must be submitted, reviewed, and approved by the executive director.

(b) A municipality is the review authority in accordance with §217.11 (relating to Municipality Reviews) and may approve a reclaimed water distribution system.

(c) A distribution system designed to transport Type II reclaimed water, as defined by Chapter 210 of this title (relating to Use of Reclaimed Water), must comply with §217.52 through §217.70 of this subchapter, as applicable to the project.

(d) A distribution system designed to transport Type I reclaimed water, as defined by Chapter 210 of this title must meet the following requirements:

(1) Gravity Pipes in Type I Reclaimed Water Facilities. A pipe which transports Type I reclaimed water in gravity sewers under gravity flow must meet the requirements detailed in paragraphs (A)-(E) of this section.

(A) Type I reclaimed water gravity pipes must comply with subsections §§217.53(c), (f), (h), (j), (l), (n), 217.54, 217.55(1), 217.55(5), 217.58, and 217.59 of this title (relating to Pipe Design, Pipe Bedding, Manholes and Related Structures, Testing Requirements for Installed Gravity Collection Lines, Testing Requirements for Manholes).

(B) Where velocities greater than 10 feet per second will occur when the pipe is flowing full based on Manning's formula and an "n" value of 0.013, the design must prevent pipe and bedding displacement.

(C) The engineer shall design the pipe to prevent the deposition of solids in the gravity conveyance.

(D) Appurtenances Identification.

(i) Above-ground hose bibs (spigots or other hand operated connections) are prohibited. Hose bibs must be:

(I) located in locked, below-grade vaults, clearly labeled as being of non-potable quality; or

(II) hose bibs which may be only operated by a special tool in non-lockable, underground service boxes clearly labeled as non-potable water.

(ii) Storage areas, hose bibs, and faucets reading must include signs in both English and Spanish reading "Non-Potable Water, Do Not Drink." All hose bibs and faucets must be painted purple and prevent connection to a standard water hose.

(E) Cross Connection Control - Separation Distances. A Type I reclaimed water pipe must be separated from potable waterline by a distance of at least nine feet, as measured from the outside surface of each of the respective pieces. Physical connection between a potable waterline and a reclaimed water pipe is prohibited. An appurtenance must prevent any possibility of reclaimed water entering the drinking water system. Where the nine foot separation distance cannot be achieved, the reclaimed water pipe must meet the following requirements:

(i) New Type I Reclaimed Water Pipe - Parallel Pipes.

(I) Where a new Type I reclaimed water pipe is installed parallel to an existing potable waterline, the horizontal separation distance must be no less than three feet with the potable waterline at the same level or above the reclaimed water pipe.

(II) The Type I reclaimed water pipe must have a minimum pipe stiffness of 115 psi with compatible joints, or a pressure rating of 150 psi for both pipe and joints.

(III) The Type I reclaimed water pipe which parallel the potable waterline may be placed in the same benched trench, provided the reclaimed water pipe is embedded in cement stabilized sand.

(IV) Where cement stabilized sand is used, the sand must have a minimum of 10 percent cement per cubic yard of cement stabilized sand mixture, based on loose dry weight volume (at least 2.5 bags of cement per cubic yard of mixture).

(V) The cement stabilized sand bedding must be a minimum of 6 inches above and one quarter of the pipe diameter on either side and below the reclaimed water pipe.

(ii) New Type I Reclaimed Water Pipe - Crossing Pipes.

(I) Where a new Type I reclaimed water pipe is installed crossing an existing potable waterline, one segment of the Type I reclaimed water pipe must be centered on the potable waterline such that the joints of the reclaimed water pipe are equidistant from the center point of the potable waterline, and the crossing must be centered between the joints of the potable waterline.

(II) The Type I reclaimed water pipe must have either a pressure rating of 150 psi for both pipe and joints or a pipe stiffness of at least 115 psi with compatible joints for a minimum distance of 9 feet in each direction as measured perpendicularly from any point on the potable waterline to the Type I reclaimed water pipe.

(III) The minimum distance between a reclaimed water pipe and any potable waterline is 6 inches.

(IV) Any portions of reclaimed water pipe within 9 feet of a potable waterline must be embedded in cement stabilized sand.

(V) The cement stabilized sand must comply with the same requirements as those listed in subparagraph (A) of this paragraph.

(2) Site Selection of Type I Reclaimed Water Pump Stations. The design must comply with §217.60(a)-(c) of this title (relating to Lift Station Site Selection).

(3) Design of Type I Reclaimed Water Pump Stations. The design must comply with §§217.61(d), (g), 217.62(d), 217.63(a), (c) of this title (relating to Lift Station Wet Well/Dry Well Design Considerations, Pump for Lift Stations, Lift Station Pipes) and paragraphs (1)-(3) of this section.

(A) Pump Controls. All electrical equipment must be operable during a 100-year flood event and be protected from potential flooding from the wet well. Motor control centers must be mounted on a 4-inch tall housekeeping pad.

(B) Pumps. A pump support must prevent movement or vibration during operation. A submersible pump must use a rail-type pump support incorporating manufacturer-approved mechanisms designed to allow the operator to remove and replace any single pump without first entering or dewatering the wet well. Submersible pump rails and lifting chains must use Series 300 stainless steel.

(C) Lift Station Valving. The discharge side of each pump must include a check valve followed by a full-closing isolation valve. Check valves must be swing type with an external lever. All valve types other than rising stem gate valves must include a position indicator to show their open or closed position.

(4) Force Main Pipe for Type I Reclaimed Water. The engineer shall design a force main pipe for Type I reclaimed water to comply with §§217.65, 217.66, 217.67, 217.69(a)-(c), (e), (h), 217.70, of this title (relating to Materials for Force Main Pipes, Force Main Joints, Force Main Pipe Bedding, Force Main Design, and Force Main Testing) and the following:

(A) The force main pipe must be purple in color or contained in a 8 milimeter purple polyethylene sleeve conforming to AWWA C105, Class C; and

(B) In-line isolation valves for reuse pipes must open clockwise to distinguish them from potable water isolation valves. Valve casings for underground isolation valves must include "REUSE" or "NPW." cast into the iron lid.

§217.72. Ground Level and Elevated Storage Tanks.

A ground level and elevated storage tank must be designed, installed, and constructed in accordance with current AWWA standards with reference to materials to be used and construction practices to be followed, except for health-based standards strictly related to potable water storage and contact practices.

SUBCHAPTER D : ALTERNATIVE WASTEWATER COLLECTION SYSTEMS §§217.91-217.100

STATUTORY AUTHORITY
The rules in Subchapter D, Alternative Wastewater Collection Systems, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.91. Applicability.

This subchapter establishes the design criteria for alternative wastewater collection systems.

§217.92. Design of Alternative Collection Systems - Component Sizing.

The engineer shall size components based on existing flow data from similar types of systems and service areas, whenever such data is available. If flow data from similar service areas with conventional wastewater collection systems are used, consideration shall be given to the effects of inflow and infiltration on the peak flows of the system. Design and construction of alternative wastewater collection systems must minimize excess flows from inflow and infiltration. Roof, street, or other types of drains that permit entrance of surface water into the wastewater collection system are prohibited.

(1) On-Site Components. In the absence of existing data, sizing on-site components in residential systems must use Table B.1 in §217.32 of this title (relating to Design of New Systems - Organic Loadings and Flows), in conjunction with the following formula: **Figure 1: §217.92(1)**

$$Q = X * (1 + B) \qquad \textit{Equation } 1.d$$

Where: Q = flow in gallons per day
X = per capita wastewater production
B = number of bedrooms

(2) Off-Site components. Design of the off-site components must be based on the maximum flow rate expected, calculated by the following formula: **Figure 2: §217.92(2)**

$$Q = A * N + B \qquad \textit{Equation } 2.d$$

Where: Q = Design flow rate (gallon per minute)
A = Design coefficient, typically 0.5
N = Number of EDUs served by the off-site component
B = Safety factor, assumed to be 20.0

(A) An equivalent dwelling unit (EDU) is assumed to have an occupancy of 3.5 people. For EDU population greater than 3.5, the following formula must be used: **Figure 3: §217.92(2)(A)**

$$Q = A_1 * P + B \qquad \textit{Equation } 3.d$$

Where: Q = Design flow rate (gallon per minute)
A_1 = Derived from A in previous equation, typically 0.15
P = population to be served
B = Safety factor, assumed to be 20.0

(B) The safety factor, B, may be adjusted if high wastewater flows are anticipated. A discharge from commercial or institutional dischargers must be measured directly or calculated under this subsection.

§217.93. General Requirements for Alternative Wastewater Collection Systems.

(a) Except where specifically modified in this subchapter, the design for the alternative wastwater collection system must comply with the applicable requirements of Subchapter C of this chapter.

(b) The manager/operator of the alternative collection system shall comply with all the requirements of this subchapter.

(c) The engineer shall provide the owner with an operations and maintenance manual covering the recommended operating procedures and maintenance practices for the alternative collection system and record drawings indicating the location of all on-site components of the alternative wastewater collection system.

(d) The engineer shall certify by letter to the executive director that the requirements in subsection (c) have been performed and the letter must include:

(1) A copy of the operations and maintenance manual, and/or the record drawings to the executive director upon request; and

(2) The permit number and names of the permittee.

§217.94. Management.

The owner of the alternative wastewater collection system shall comply with either paragraphs (1) or (2) of this section.

(1) An alternative wastewater collection system must discharge to wastewater facility permitted by the commission. The owner of an alternative wastewater collection system may contract with another entity permitted by the commission for wastewater treatment. The contract must address the responsibility for management and operation of the alternative collection system.

(2) The owner of the alternative wastewater collection system may contract for management and operation services with a public or private service provider. The manager/operator may terminate the contract at any time if the service provider's services are in conflict with the owner's requirements or wastewater discharge permit, the requirements of this chapter, or other commission requirements.

(3) This section does not cover grinder pumps and septic tank effluent pumps discharging directly into a conventional collection system.

§217.95. Alternative Wastewater Collection System Service Agreements.

An alternative wastewater collection system service agreement must be executed between the owner and the property owner that allows for the placement and maintenance of system components located on private property. The alternative wastewater collection system service agreement must specify that proper construction and competent maintenance of the on-site components. The on-site components may be owned by the property owner, or the manager/operator. The manager/operator shall submit the alternative wastewater collection system service agreement to the commission with the summary transmittal letter required in §217.9(c) of this title (relating to Summary Transmittal Letter). Regardless of the ownership of the on-site components, a alternative wastewater collection system service agreement must include the following provisions.

(1) Any existing alternative wastewater collection system components and building laterals that are to be incorporated into a system must be cleaned, inspected, tested, repaired, modified or replaced, as necessary, to the satisfaction of the manager/operator before connection of these components to the collection system.

(2) The owner shall approve all materials and equipment before the incorporation of the materials and equipment into any construction or repair of alternative wastewater collection system components.

(3) The owner shall inspect and approve the actual installation of all alternative

wastewater collection system components before placing the components into service.

(4) The owner shall have access at all reasonable times to inspect alternative wastewater collection system components.

(5) The owner shall have the right to make emergency repairs and perform emergency maintenance to any alternative wastewater collection system components, including building laterals, and utility-owned on-site collection system components. The cost of such repairs or maintenance are charged to the owner of the property, as determined by a schedule of payment, and provide for a methodology for cost recovery in the agreement.

(6) For those alternative collection system designs with components that use power, the service agreement must provide a delineation for responsibility for power costs. An EDU may supply power from the electrical service equipment serving the EDU. A multiple equivalent dwelling unit (MEDU) must supply power separately from the MEDU.

(7) The ownership and responsibility for the operation and maintenance of the facilities must remain with the MEDU that employs pre-treatment units, unless otherwise agreed to by the manager/operator of the alternative wastewater collection system.

(A) The agreement must:

(i) provide that the cost of such repairs or maintenance will be charged to the owner of the pre-treatment units;

(ii) provide a means to determine the cost of such repairs or maintenance;

(iii) provide a schedule of payment; and

(iv) provide for a methodology to recover costs.

(B) The agreement must grant the owner of the alternative collection system:

(i) the right to inspect and approve the installation of any pre-treatment units;

(ii) allow access for inspection of the units to determine their operational and maintenance status; and

(iii) allow the owner of the alternative wastewater collection system to make emergency repairs or perform emergency maintenance when required to protect the integrity or operation of the alternative wastewater collection system.

(8) Any utility-owned, on-site component must have an upstream isolation valve. Any privately-owned, on-site component, must have a service isolation valve located on the service line from the on-site components to the collection system. The location of the service isolation valve must be accessible at all times by the utility through an easement granted by the property owner to the utility. The

manager/operator shall have access to the isolation valve at all times.

(9) The owner shall have the ability to collect, transport, and dispose of any residual materials.

§217.96. Design of Small Diameter Effluent Sewer (SDES).

(a) Interceptor tank design. Septic tanks used as interceptor tanks must be designed and constructed in accordance with Chapter 285 of this title (relating to On-site Sewage Facilities). The outlet of the interceptor tank must have a commercially available effluent filter designed to remove particles larger than 1/16 inch. The volume of an EDU interceptor tank must be based the criteria in Chapter 285 of this title (relating to On-site Sewage Facilities). MEDU interceptor tank sizing is calculated from the formula: **Figure 1: 217.96(a)**

$$VT = VR + VN \qquad \textit{Equation } 4.d$$

Where: VT = Total Volume
VR = Reserve Volume = 0.75 x average daily flow (ADF)
VN = Nominal Volume

$$VN = VIE + VCZ + VSO \qquad \textit{Equation } 5.d$$

Where: VIE = Volume in gallons between elevation of the tank inlet and the tank outlet ($\leq$.165 ADF)
VCZ = Volume in gallons of the clear zone between maximum sludge depth and scum accumulation (ADF)
VSO = Volume in gallons dedicated to scum and sludge storage (1.85 ADF)

(b) Pre-treatment units. A MEDU must provide a method for trapping and removing fats, oils, or grease from the wastewater before the interceptor tanks. A grease trap must use a double compartment design. Construction requirements of a grease trap must meet the same requirements as interceptor tanks with regard to water tightness, materials of construction and access to contents. Grease retention capacity in pounds must be equal to at least twice the unit's flow capacity in gallons per minute. The grease retention capacity of the trap is defined as the amount of grease that it can hold before its efficiency drops below 90%. The primary compartment volume must equal at least 60% of the total tank volume. Plumbing for the grease trap must be designed to exclude waste from other fixtures, specifically blackwater, from entering the trap.

(c) Tank monitoring. The owner of the SDES must monitor the sludge volume in each interceptor tank. The sludge level must be at least 6 inches below the outlet.

(d) Service pipe design.

(1) Pipe materials used for service pipe must meet the performance characteristics of ASTM D 2241 Class 200 PVC pipe.

(2) An interceptor tank with outlet elevations below the main pipe elevation, or the hydraulic grade line in the depressed section of a main pipe, must include a pumping unit.

(3) The minimum diameter for a service pipe serving an EDU is 2 inches.

(4) The minimum diameter for a service pipe for an MEDU is 2 inches, but must be designed based on the actual hydraulic requirements.

(5) The diameter of a service pipe must be no greater than the connected collection pipe.

(6) A service pipe of a low-lying interceptor tank, subject to periodic back flow must include a check valve located immediately adjacent to the collection pipe. A check valve must be made from a corrosion resistant material and provide an unobstructed flow way.

(7) The design must provide a means to prevent the migration of odors from the collection pipe by use of traps or other in-line odor control devices. The odor control devices must be accessible for maintenance.

(e) Collection system design.

(1) Hydraulic design.

(A) A SDES system with open channel flow must use a design depth of flow of 100% of pipe diameter. Flow velocities in collection pipes must be between 1.0 and 8 feet per second at peak flows without velocity protection. The maximum flow velocity in any portion of the SDES system is 13 feet per second.

(B) The report must include velocity calculations for each pipe segment.

(C) The SDES design must insure that the elevation of the hydraulic grade line at peak flow conditions is lower than the outlet invert of any upstream interceptor tank, unless the design incorporates the use of septic tank effluent pumps as on-site conveyance equipment.

(D) The report must include a system analysis for each pipe showing the hydraulic grade line, energy grade line, and ground elevation in relationship to the outlet elevations of the interceptor tanks being served by the collection pipe.

(E) The engineer shall perform a separate analysis for each segment of a variable grade effluent sewer (VGES). Open pipe flow design must use a Manning's "n" value of 0.013. Pressure flow design must use a Hazen-Williams "C" value of 120 must be used. The minimum pipe diameter for an SDES must be 2-inches.

(2) Vertical Alignment.

(A) The vertical alignment of an SDES may be variable; however, the overall gradient must provide sufficient fall such that the pipes have the capacity to transport the expected peak flows.

(B) The invert elevation of a section of a collection pipe, which is depressed below the static hydraulic grade line, must be at an elevation that does not permit the hydraulic grade line to rise above any upstream interceptor tank outlet invert at peak flow, unless the collection pipe has septic tank effluent pumps.

(C) Venting must be provided upstream and downstream of pipe segments that are below the hydraulic grade line. The pipes must have uniform profile with no abrupt or sharp changes.

(D) A cleanout must be used instead of a manhole at upstream termini of collection pipes, minor junctions of collection pipes, changes in collection pipe diameter, and at intervals along a collection pipe. Maximum spacing of cleanouts along a collection pipe must be 1,000 feet. A cleanout must extend to ground level and terminate in watertight valve box.

(E) An intersection of 3 or more collection pipes must have a manhole.

(F) A manhole must not be in the flow path of water courses, nor in areas where ponding of surface water is probable.

(G) Venting at collection pipe summits must use wastewater service air release or combination air release/vacuum valves. The valves must be constructed of corrosion resistant material and located in watertight vaults.

(H) Pipe materials used in the collection system must meet the performance requirements of ASTM D 3034 SDR 26 PVC pipe, except for those segments under pressure flow conditions where pipe materials must meet the performance requirements of ASTM D 2241 Class 200 PVC pipe.

§217.97. Design of Pressure Sewers.

A pressure sewer system includes a grinder pump or a septic tank effluent pump system. Except where this section specifically states otherwise, the requirements of this section apply to both of these types of systems.

(1) Service Pipe Requirements.

(A) A pressure sewer service pipe buried at a depth of less than 30-inches must incorporate a check valve and a fully closing gate or ball valve at the junction of the collection pipes to allow isolation of the service pipe.

(B) A check valve must allow an unencumbered flow.

(C) All valves must be manufactured from corrosion resistant material and must incorporate a position indicator to show their open and closed position.

(D) The minimum size service pipe for an EDU is 1.25 inches.

(E) The minimum size service pipe for a MEDU is 1.5 inches.

(F) A junction to collection pipes must be made with a tee or service saddle and may use solvent weld fittings.

(G) The diameter of a service pipe must be no greater than the collection pipes.

(H) Materials used in service pipe must at least be equivalent to the performance characteristics of ASTM D 2241 Class 200 PVC pipe.

(2) On-Site Pressure Sewer System Mechanical Equipment Requirements.

(A) Pump discharge rates must allow the capacity of the pump and the volume of the wet-well dedicated for flow attenuation and storage to accommodate the expected wastewater peak flow. The report must include an analysis which justifies the selected pump(s).

(B) Simplex units may be provided for an EDU. A MEDU must be at least a duplex unit capable of pumping the peak flow with the largest pump out of service.

(C) The engineer shall provide calculations to show that lift stations and pump chambers are protected against buoyancy forces.

(D) Control panels for all pumps must be at least 2 feet above the ground floor elevation of the structure being served by the equipment.

(E) All pipes and appurtenances within the wet wells must be corrosion resistant.

(F) An EDU grinder pump wet well or a STEP wet well must have a reserve volume of at least 100 gallons after the activation of the high water alarm level. The reserve volume of a MEDU grinder pump wet well must equal the volume accumulated during the peak 2-hour period, or 100 gallons, whichever is greater. Pumps located in STEP chambers that are integral with the interceptor tank may use the reserve volume of the interceptor tank for the required reserve volume. Housings that contain the mechanical equipment or its controls must be watertight when immersion would cause failure.

(G) All wetwells must include a visual and audio alarm. The alarms for EDUs must activate at a specified high water level. The alarms for MEDUs must activate in the event of unit failure or high water level.

(H) The control panels and other electrical enclosures must be constructed from corrosion resistant materials, must be water tight, and must prevent the migration and venting of odors and corrosive or explosive gases to the panel. All electrical equipment must bear the seal of the Underwriter Laboratory, Inc., or must comply with the National Electric Code.

(I) On-site mechanical equipment used in a septic tank effluent pump (STEP) system may be either housed in the interceptor tank or in a separate stand alone unit. A pump used in a STEP system must be located in a hydraulically independent chamber. The pump chamber must be hydraulically connected to the interceptor tank to allows the liquid elevation in the pumping chamber to be independent of the liquid elevation in the interceptor tank. A design that allows a variable liquid elevation in the interceptor tank are prohibited.

(J) All on-site mechanical equipment and their control mechanisms must be housed in lockable or similar tamper-resistant structures. Vaults, chambers, wet-wells or other structures used to detain wastewater must be watertight and able to withstand all expected structural loadings. Materials used for equipment housings and detention of wastewater must be corrosion resistant and meet the requirements in §217.53(g) of this title (relating to Pipe Design).

(3) Discharge Pipe Requirements. All discharge pipes and connections used to join the on-site mechanical equipment to the service line must be pressure rated at a minimum of 2.5 times the maximum system design pressure. Pipe material and valves must be corrosion resistant. For discharge pipes that incorporates the use of plastic hoses, direct burial of the hose is prohibited. Discharge pipes for pressure systems must include a check valve, pipe union and a full closing gate or ball valve. The check valve must precede the full closing valve. All valves must incorporate a position indicator to show their open and closed position. All valves used in a MEDU must be located in a valve box separate from the on-site mechanical equipment.

(4) Collection System Design.

(A) A grinder pump pressure system main pipe must achieve velocities of 3 feet per second at least once per day. Velocities in a grinder pump main pipe must not exceed 8 feet per second or fall below 2 feet per second.

(B) A septic tank effluent pump (STEP) pressure system main pipe must achieve a velocity of 1 foot per second.

(C) The collection system headloss calculation must use a Hazen-Williams “C” factor appropriate to the pipe material, but “C” factors of greater than 120 are prohibited.

(D) The size of the pipes used in a pressure collection system must be at least 1.5 inches in diameter.

(E) Pipe materials must have the performance characteristics or at least the equivalent of ASTM D 2241 Class 200 PVC pipe.

(F) A pipe equal to or greater than 3 inches in diameter requires Elastomeric pipe joints.

(G) A location where air may accumulate due to a transition between full and partially full flow conditions requires air release. Pumping units affected by the partially full flow conditions must incorporate anti-siphon devices.

(H) Each isolation valve must be located at intersections of the collection system main pipe, both sides of stream crossings, both sides of areas of unstable soil, and at maximum intervals of 2,500 feet on long routes. Isolation valves must be resilient seated gate valves or ball valves, with a position indicator, and be constructed from corrosion resistant materials and located in locked valve boxes.

(I) All peaks in elevation require wastewater type air release valves constructed from corrosion resistant materials. The valve orifice must not be less than 0.25 inches in diameter. Air release valves in close proximity to residences must incorporate a method to control odor released by their operation.

(J) When intermediate pumping of the wastewater is required, the design of the collection system lift stations must meet the requirements of Subchapter C.

§217.98. Vacuum Sewer Systems.

A vacuum sewer system is nonconforming technology. The executive director may review a vacuum sewer in accordance with §217.10(b) of this title (relating to Types of Approvals) and the criteria described in this section.

(1) Design of Vacuum Sewers.

(A) On-Site Components.

(i) The building lateral must be constructed from a pipe material that is at least equivalent in performance to ASTM D 2241 Class 160 PVC pipe.

(ii) The building lateral must use a screened, auxiliary vent, no less than 4-inches in diameter located no closer than 10-feet from the vacuum valve.

(iii) Vacuum valve controls must be housed in tamper resistant, watertight, corrosion resistant structures.

(iv) Vacuum valve pits must be watertight with regard to surface and groundwater inflow.

(v) Control mechanisms that incorporate pressure differential for operation must use atmospheric air supplied by a screened breather vented externally to the equipment housing.

(vi) Vacuum valves must have a minimum capacity of 30 gallons per minute.

(vii) A service pipe must be a minimum of 3-inches in diameter.

(viii) The material used in the construction of a service pipe must have performance characteristics at least equivalent to ASTM D 2241 Class 200 PVC pipe. All joints must be made be either vacuum-rated Elastomeric gaskets, or by solvent welding. At least 5 feet of service pipe must exist between the vacuum valve and the main pipe. When a vertical profile change is incorporated in a service pipe, the system must incorporate a minimum of 5-feet between the vacuum valve and first profile change, and between the last profile change and the main pipe.

(ix) A service pipe must have a minimum slope equal to the greater of:
(I) a 2-inch drop; or

(II) a 0.2% slope between the vacuum valve and main collection pipe or between vertical profile changes.

(x) The connection of a service pipe to a main pipe must use a wye and a long radius elbow, oriented so that the invert of the service pipe is higher than the crown of the collection pipe, and must not be made within 6-feet of a collection pipe vertical profile change.

(B) Collection System Design.

(i) All pipes used in vacuum sewers must be equivalent to the performance characteristics to ASTM D 2241 Class 200 PVC pipe.

(ii) Joints must have a vacuum-rated rubber gasket or be solvent welded.

(iii) The minimum pipe size used in a vacuum sewer must be 4-inches in diameter, except for service pipes which may be 3-inches in diameter. The length of a 4-inch diameter pipe must not exceed 2,000 feet. The length of a pipe larger than 4-inches in diameter must be dictated by friction and lift head loss.

(iv) The total available head loss in a system must not exceed 18 feet. The friction head loss limit for any sized pipe is 0.0025 ft./ft.

(v) Vacuum sewer systems must be laid out in a branched pattern. The pipe work must have a sawtooth profile that slopes toward the vacuum station.

(vi) The design of an upgrade mainline transport must reduce the risk of completely blocking the pipe bore with trapped sewage.

(vii) A collection pipe depressed in order to avoid an obstruction must have a minimum 20-foot segment centered on the obstruction. The intersection of collection pipes must include a division valve at both sides of a watercourse crossing and areas of unstable soils, and at intervals of 1,500 feet.

(viii) A plug valve or a resilient-seated gate valve, capable of sustaining a vacuum of 24 inches of mercury is acceptable.

(ix) Gauge taps must be provided downstream of the division valve.

(x) The design must use a cleanout at changes in pipe diameter, and on collection pipe segments of 1,500 feet or more where there are no service connections.

(C) Vacuum station design. The vacuum pump capacity must be at least 150 gpm, and must be the greater of the capacities calculated using the following equations: **Figure 1: §217.98(1)(D)**

$$Q_{vp} = [A\ Q_{max}/7.5\ \text{gal./ft.}^3] + B\ N_v$$

Where:

Qvp	=	Minimum vacuum pump capacity
A	=	Variable based on line length
Q_{max}	=	Station peak flow (gal./min.)
B	=	Bleed rate of vacuum valve controller (ft.^{3}/min.)
N_v	=	Number of vacuum valves in system

The appropriate values of A must be as follows:

Longest Line Length (ft.)	A
0 - 3,000	5
3,001 - 5,000	6
5,001 - 7,000	7
7,001 - 10,000	8
10,001 - 12,000	9
12,001 - 15,000	11

Or,

$$Q = V/PDT \ln (H_1/H_2)$$

Where:

Q	=	Flow rate of vacuum pump ($ft.^3/sec.$)
PDT	=	Time to reduce head from H_1 to H_2 (sec.)
V	=	Volume of closed system ($ft.^3$)
H_1	=	Initial absolute pressure head (in. mercury)
H_2	=	Final absolute pressure head (in. mercury)

(D) Vacuum Pumps. A vacuum pump must evacuate the system in less than 180 seconds. The design must include duplicate pumps, each capable of delivering 100% of required air-flow, and capable of continuous duty. A vacuum pump may include either liquid-ring or sliding-vane type. Liquid-ring pumps must be sized 15% larger than the needed vacuum pump capacity. An electrically or pneumatically controlled plug valve between the collection tank and reservoir tank must be included in the station pipes to prevent carry over of liquid into the pumps.

(E) Duplicate discharge pumps.

(i) Duplicate discharge pumps are required and must have the capacity to deliver the peak flow.

(ii) Pumps must be designed for vacuum sewage duty, and have equalizing pipes installed.

(iii) Pumps must be capable of passing a 3-inch sphere and be constructed from corrosion resistant materials.

(iv) A discharge pump must use double mechanical shaft seals. Discharge pumps must include shut off valves on both the suction and discharge pipes.

(v) The total dynamic head calculation must include the head attributed to overcoming the vacuum in the collection tank.

(vi) The available Net Positive Suction Head (NPSH) must be greater than required NPSH for the expected vacuum operating range.

(vii) The pump suction pipe must be sized 2 inches larger than the discharge pipe to prevent vortexing of wastewater in the collection tank.

(viii) The engineer shall submit pump design calculations and pump curves in the report.

(F) Vacuum Reservoir.

(i) A vacuum reservoir tank is required in addition to the collection tank for vacuum systems that require a collection tank of 1,600 gallons or greater.

(ii) The vacuum pumps must be piped to the top of the vacuum reservoir tank.

(iii) The minimum size for a reservoir tank is 400 gallons.

(iv) A vacuum reservoir tank must include internal access for periodic cleaning and inspection.

(v) All main pipes must connect to the collection tank.

(vi) The wastewater pump suction pipes must lie at the lowest point on the collection tank and away from the main pipe inlets.

(vii) The main pipe must enter at the top of the collection tank with the inlet elbows inside the tank turned at an angle from the pump suction opening.

(viii) The collection tank must include probes for liquid level sensing for operation of the discharge pumps.

(ix) Vacuum pumps must include vacuum switch controls located in the reservoir tank.

(x) The collection tank and low system vacuum must include alarms for high liquid level.

§217.99. Testing Requirements for Alternative Wastewater Collection Systems.

All components of alternative wastewater collection systems must be tested for water tightness by methods as shown in Table D.1. **Figure 1: §217.99**

Table D.1 - Testing Requirements For Alternative Wastewater Collection Systems	
Component	Type of Test(s)
Interceptor Tanks	H.H.T. or V.T.T.
Buffer Tanks	H.H.T. or V.T.T.
Vaults, Pits, Wet Wells	H.H.T. or V.T.T.
Service Pipes (Pressure)	P.L.T.
Service Pipes (SDES)	H.H.P.
Collection Pipes (Pressure)	P.L.T.

Collection Pipes (SDES)	L.P.A. or H.H.P.

Where:

H.H.P. = Hydrostatic head test for linework
H.H.T. = Hydrostatic head test for tanks
L.P.A. = Low pressure air test for linework
P.L.T. = Pressure line test
V.T.T. = Vacuum test for tanks

(1) Hydrostatic Head Test for Linework. The total infiltration or exfiltration, as determined by the hydrostatic head test, must not exceed 10 gallons per inch diameter per mile of pipe per 24-hours at a minimum head of two feet. If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, the engineer shall take remedial action to reduce the infiltration or exfiltration to an amount within the specified limits.

(2) Hydrostatic Head Test for Tanks. The hydrostatic heat test is required before the placement of backfill around the rigid tanks. The test for tanks constructed from flexible or semi-rigid material is required after placement and backfilling according to the manufacturer's recommendations. The test includes filling the tank to the top of the lid and holding the water for 24- hours without any leakage.

(3) Low Pressure Air Test. The low pressure air test must conform to the requirements of §217.58(1) of this title (relating to Testing Requirements For Installed Gravity Collection Lines).

(4) Pressure Pipe Test. The test pressure must be either a minimum of 25 pound per square inch gauge or 1.5 times the maximum pipe design pressure, whichever is larger. Leakage is the quantity of water that must be supplied into the pipe or valved section to maintain pressure within 5 pounds per square inch of the specified test pressure after the air in the pipeline has been expelled. The calculations for the maximum allowable leakage must use the formula in Figure 2. If the quantity of leakage exceeds the maximum amount calculated, the engineer shall take remedial action to reduce the leakage to an amount within the allowable limit. **Figure 2: §217.99 (4)**

$$L=(S*D*P^{0}.5)/133{,}200 \qquad \textit{Equation } 5.d$$

Where:

L = Leakage (gal./hr.)
S = Length of pipe (ft.)
D = Inside diameter of pipe (in.)
P = Pressure (psi)

(5) Vacuum Test for Tanks. The total vacuum loss during a vacuum test must not exceed

1 inch loss of mercury vacuum after 5 minutes. A tank constructed of flexible or semi-rigid material, must not exceed the 3% change in tank dimensions in any direction. The test must begin after establishing an initial stable vacuum of 4-inches of mercury. If the quantity of vacuum loss or if tank deformation equals or exceeds the maximum quantity specified, then the engineer shall take remedial action to reduce the amount of vacuum loss or amount of deformation to comply with this subchapter.

§217.100. Termination Facilities for Alternative Wastewater Collection Systems.

The termination of an alternative wastewater collection system at treatment facilities or into an existing conventional collection system within 500 feet of human habitation must minimize the potential for odors. Release of gases must be controlled by incorporating methods that minimize turbulent discharge of the alternative wastewater collection system into manholes, and discharge must be into manholes that have a high ratio of conventional flow to alternative flow. An alternative wastewater collection system that discharges at a wastewater treatment system must discharge below the liquid level at the headworks. The engineer shall include a description of the material's anti-corrosive protections in the report.

SUBCHAPTER E : PRELIMINARY TREATMENT UNITS
§§217.121-217.138

STATUTORY AUTHORITY
The rules in Subchapter E, Preliminary Treatment Units, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.121. Applicability.

This subchapter regulates preliminary and primary treatment systems used at wastewater treatment facilities.

§217.122. Coarse Screening Devices.

All wastewater treatment facilities must use a coarse screening device, unless otherwise provided in this subchapter.

§217.123. Coarse Screening Devices - Redundancy Requirements.

A coarse screening device must include bypass channels sized to handle the two-hour peak flow of the facility and a means of diverting flow to the bypass channel. If the primary channel uses a mechanically-cleaned coarse screening device, the bypass channel must have a manually-cleaned coarse screening device.

§217.124. Design of Coarse Screening Devices.

(a) Location Requirements. All coarse screening devices installed in an enclosed structure containing other equipment or offices must have with a separate entrance away from all areas by gas tight partitions. All screening device enclosures must use a vent fan capable of provided at least 30 air exchanges per hour when the space is configured to allow personnel entry. All screening devices must be readily accessible for maintenance and screenings removal. Screening devices located four or more feet below ground level must include equipment capable of lifting the screenings to ground level.

(b) Screen Openings. Coarse screen bar openings must equal between one-half inch for manually-cleaned screens or one-quarter inch for mechanically-cleaned screens, and 1¾ inches. A manually-cleaned screen must use a bar rack sloped at 30 to 60 degrees from the horizontal, and attached to a horizontal platform with provisions to drain and temporarily store the screenings.

(c) Hydraulics. The velocity through the coarse screen bar racks must be between one and three feet per second at design flow. The inlet channel for screening devices must minimize deposition of solids. The flow line of the inlet channel must not exceed 6-inches below the invert elevation of the incoming influent.

(d) Corrosion Resistance of Screens and Related Structures. All coarse screening devices and related structures must resist the effects of corrosive environments, including long-term exposure to hydrogen sulfide.

§217.125. Coarse Screening Devices - Screenings and Debris Handling.

Coarse screening devices must have a minimum storage capacity of one-day of screenings and debris. Screenings and debris containers must have a tight-fitting cover. All storage areas must drain to the head of the facility and include runoff control. All screenings and debris collected must be managed and disposed of in accordance with Chapter 330 of this title (relating to Municipal Solid Waste).

§217.126. Fine Screens.

(a) A fine screen may be used in lieu of a coarse screening device.

(b) A fine screen is any screen with a clear opening less than or equal to one-quarter inch.

§217.127. Fine Screens - BOD_5 Removal.

A fine screen is not equivalent to primary sedimentation. The use of a fine screen in lieu of a primary sedimentation unit is acceptable only if the engineer's design of a downstream treatment unit is based on reduction by the fine screen with the reduction percentage developed through testing and studies conducted on actual full scale operation of the fine screen unit proposed. The report must include the justification for reductions in treatment unit sizes, based on removal of BOD_5 from the use of fine screens.

§217.128. Fine Screens - Redundancy Requirements.

(a) A fine screen must include dual screen treatment when the engineer claims a BOD_5 reduction credit.

(b) An engineer who claims a BOD_5 reduction credit must include a sufficient number of fine screen units so that any BOD_5 reductions claimed in the report may occur with the largest fine screen unit out of service.

(c) A fine screen design may include a single unit where BOD_5 reduction is not credited if the design includes a bypass channel with a coarse screening device to accept flow when the fine screen is out of service.

§217.129. Fine Screen Design Parameters.

(a) A fine screen must follow a coarse screening device unless the manufacturer's recommendations include installation of the unit without such preliminary screening devices.

(b) The engineer shall design facilities for the removal of oils and grease before the fine screen.
(c) A moving or rotating fine screen must use a continuous cleaning device, such as water jets or wiper blades.

(d) The fine screen must have provisions for the automatic conveyance of material removed by the fine screen to a process which complies with §217.125 of this title (relating to Coarse Screening Devices - Screenings and Debris Handling).

(e) A fine screen must meet the manufacturer's recommendation with respect to velocity and head loss through the fine screen.

(f) A fine screen opening must not exceed 1/4 inch.

(g) A fine screen may use a bar rack or perforated plate.

§217.130. Fine Screens - Screenings and Debris Handling.

Screenings and debris from fine screens must be managed and disposed of in accordance with §217.125 of this title (relating to Coarse Screening Devices - Screenings and Debris Handling).

§217.131. Grit Removal Systems.

All wastewater treatment systems using anaerobic digesters require grit removal systems. Grit removal includes those units and processes capable of removing inert unbiodegradable particles. Grit removal facilities are optional for all other facilities.

§217.132. Grit Removal Chambers - Redundancy Requirements.

A grit removal system must include dual processes. The dual grit removal units must be capable of operation at the permitted two hour peak flow of the wastewater treatment system. A single grit removal unit must include a bypass channel to accept flow when the grit removal facilities are off line and a means of diverting flow to the bypass channel.

§217.133. Design Requirements for Various Types of Grit Chambers.

(a) Horizontal Flow Grit Chambers. Velocity through the grit chamber must range between 0.8 feet per second and 1.3 per second. The grit chamber channel design must minimize turbulence and provide uniform velocity across the channel. The channel size must accommodate the grit removal equipment capacity and grit storage.

(b) Aerated Grit Chambers. The air diffuser and baffle arrangement design must separate the size of grit planned for removal. The aeration equipment must vary air feed rates along the length of the chamber from 3 to 8 scfm per linear foot. The chamber must use a minimum hydraulic detention time of

3 minutes. The chamber must include a grit hopper located under the air diffuser.

(c) Mechanical Grit Chambers. The velocity through mechanical grit chambers must equal 1 foot per second at the design flow. The channel must include a grit hopper at the side of the tank contiguous to the grit removal mechanism. The inlet must include baffles to prevent short circuiting. Grit removal must be provided by one of the following:

(1) reciprocating rake;
(2) screw conveyor; or
(3) air lift pump.

(d) Cyclonic Degritters. The cyclone must prevent entry-to-overflow short circuits. The unit must include an adjustable apex with a quick disconnect assembly to remove oversized objects. Detention time in the chamber must be at least one minute at the design flow. The flow velocity must range between one and two feet per second at the design flow. A screening unit must be installed upstream of the cyclonic degritter.

(e) Vortex Grit Chamber. Inlet channels must include straight length in order to deliver smooth flow into the units. Minimum initial inlet velocity at the 2-hr peak flow must be at least 2.0 fps. The vortex system include rotating paddles in the center of the grit chamber and must rotate at a maximum 21 rpm. The outlet channel must maintain a constant elevation. Grit removal from the grit storage chamber located below the grit separation chamber must be by pumps specifically designed to handle grit.

§217.134. Grit Handling.

The need for grit washing is determined by the type of grit removal system and the final means of grit disposal. The drainage from grit washing facilities and grit storage areas must return to the head of the facility. A grit chamber located below ground level must include mechanical grit removal equipment. Grit must be stored in containers with a tight fitting cover and must be managed and disposed of in accordance with §217.125 of this title (relating to Coarse Screening Devices - Screenings and Debris Handling).

§217.135. Preaeration Facilities.

Preaeration may be used for odor control, flocculation of solids, reducing septicity, grease separation, and promoting uniform distribution of solids to clarifiers. The report must include the basis for preaeration system designs.

§217.136. Flow Measurement.

All wastewater treatment facilities must include a means of accurate effluent flow measurement. Effluent flow measurement devices must incorporate an open channel to allow for easy inspection, calibration, and cleaning. Flow measurement must use a combination of primary and secondary devices.

(1) Primary measuring devices. Primary measuring devices include weirs and flumes. A primary measuring device must have a non-corrosive ruler (staff gauge), graduated in ¼-inch increments

and clearly visible, installed upstream to permit the manual measurement of water depth.

(A) Weirs. The channel approach section to a weir must be straight for at least 20 times the maximum expected head on the weir. The minimum height between the channel bottom to the weir crest must be the greater of twice the maximum expected head on the weir or 1 foot. The upstream edge of the weir must be sharp. The crest of the weir must be exactly level to ensure a uniform depth of flow. The upstream face of the weir must be smooth and perpendicular to the axis of the channel in both the horizontal and vertical directions. The weir must have:

(i) a secondary measuring device located upstream; and

(ii) a minimum distance of 3 times the maximum expected head on the weir or as recommended by the equipment manufacturer.

(B) Flumes. A flume must be located in a straight section of an open channel and must be installed in accordance with manufacturer's recommendations. A flume must distribute the approaching flow evenly across the flow channel and preclude turbulence and waves.

(2) Secondary measuring devices. A secondary measuring device must measure the liquid level in the primary measuring device, and must convert this liquid level into a flow rate which is integrated to a totalized volume. Secondary measuring devices must be installed in accordance with manufacturer's recommendations and include a display of the instantaneous flow rate and a means of reading the totalized flow.

§217.137. Flow Equalization Basins.

(a) A facility must use a flow equalization basin if one of the following occurs:

(1) a facility's total daily influent flow volume occurs during a period of time less than or equal to 10 hours of a day for any day of any week;

(2) whenever a facility experiences periods of time where it receives an influent flow of less than 10% of its design capacity for a period of time greater than or equal to 48 hours in any one week; or

(3) at any other time that flow equalization is necessary to minimize random or cyclic peaking of organic or hydraulic loadings.

(b) A flow equalization basin must have an upstream coarse screening device.

(c) Aeration. A flow equalization basin must include an aeration system sized to maintain a dissolved oxygen level of at least 1.0 mg/l in the flow equalization basin.

(d) Mixing. A flow equalization basin must include a mixing system sufficient to prevent solids deposition. Mixing must be provided by mixing equipment, a diffused aeration system, or a mechanical aeration system.

(e) Volume. The size of a flow equalization basin must be based on diurnal flow variation and downstream process unit sizing and capabilities. The report must include the calculations justifying the sizing of the flow equalization basin.

(f) Pumped flow. For pumped flow to an equalization basin, the effluent from the basin must be controlled by a flow-regulating device capable of maintaining the flow rate within an acceptable range for downstream process units. For pumped flow from the equalization basin, variable-speed pumps, or multiple pumps are required in order to deliver a constant flow to downstream process units.

§217.138. Primary Clarifiers - Design Basis.

(a) Inlets. A primary clarifier inlet must provide uniform flow and stilling. Vertical flow velocity through the inlet stilling well must not exceed 0.15 feet per second at peak flow. Inlet distribution channels must not have dead-end corners and must prevent the settling of solids in the channels. The inlet structures must allow floating material to enter the clarifier.

(b) Scum removal.

(1) A primary clarifier must have scum baffles and a means of collecting and disposing of scum.

(2) A primary clarifier must be discharge scum to a sludge digester or other approved method of disposal.

(3) The discharge of scum to any open drying area is prohibited.

(4) A primary clarifier with a design flow greater than 25,000 gallons per day must include a mechanical skimmer.

(5) A smaller system may use hydraulic differential skimming provided that the scum pickup is capable of removing scum from the entire operating surface of the clarifier.

(6) Scum pumps must be specifically designed for this purpose.

(c) Effluent weirs. An effluent weir must prevent turbulence or localized high vertical flow velocity in the primary clarifier. Weirs must be located to prevent short circuiting flow through the primary clarifier and be adjustable for leveling. Weir loadings, for plants with a design flow of 1.0 mgd or less, must not exceed 20,000 gallons per day per linear foot of weir length. Weir loadings for plants with a design flow in excess of 1.0 mgd must not exceed 30,000 gallons per day peak flow per linear foot of weir length .

(d) Basin sizing. The surface area of the clarifiers determines the proper overflow rates. The actual clarifier size is based on whichever is the larger size from the two surface area calculations: peak flow and design flow surface loading rates. The design criteria for primary clarifiers in subparagraphs (1) through (4) for primary clarifiers are based upon a minimum side water depth of 10 feet.

(1) Maximum Surface Loading @ Peak Flow = 1800 gal/day/ft^2 and does not include recirculation flow.

(2) Maximum Surface Loading @ Design Flow= 1000 gal/day/ft^2 and does not include recirculation flow.

(3) Minimum Effective Detention Time @ Peak Flow = 0.9 hrs. Overflow rate and side water depth (SWD) may be adjusted over a range of 10 to 18 feet, but keeping the detention time unchanged. 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 at the top of the cone. For flat bottom tanks, a sludge blanket of 3 feet must be allowed for development of maximum return sludge concentration.

(4) Minimum Effective Detention Time @ Design Flow = 1.8 hrs. Overflow rate and side water depth (SWD) may be adjusted over a range of 10 to 18 feet, but keeping the detention time unchanged. 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 at the top of the cone. For flat bottom tanks, a sludge blanket of 3 feet must be allowed for development of maximum return sludge concentration.

(e) Sidewater depth. The minimum sidewater depth for primary clarifiers is 10 feet.

(f) Freeboard. The walls of a primary clarifier must extend at least 6 inches above the surrounding ground surface and must provide minimum freeboard of 12 inches at peak flow.

(g) Drains. A primary clarifier must have the capability of complete dewatering to an appropriate point in the wastewater treatment facility. Portable dewatering pumps are acceptable for complete dewatering. Devices such as hydrostatic relief valves to prevent flotation of structures must be considered.

(h) Accessibility. A primary clarifier must be accessible to facilitate routine operation and maintenance.

(i) BOD_5 Removal. The report must have an assumed BOD_5 reduction in a primary clarifier of 35 percent, unless other satisfactory evidence proves a higher efficiency.

(j) Sludge Pumps and Pipes. A primary clarifier unit must include mechanical sludge collection equipment designed to assure rapid removal of the sludge and a means for sludge transfer for subsequent processing. The gravity sludge transfer pipe must be at least eight inches in diameter.

SUBCHAPTER F : ACTIVATED SLUDGE SYSTEMS
§§217.150-217.165

STATUTORY AUTHORITY.

The rules in Subchapter F, Activated Sludge, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.150. Applicability.

This subchapter regulates the design requirements for activated sludge systems. Systems may use:

(1) a traditional design involving sizing the aeration basin and clarifier based on values which have been used historically as standard engineering practice; or

(2) a volume-flux design involving sizing the aeration basin and clarifiers based on the relationship between the volume flux of solids in the secondary clarifier, the sludge volume index, and the sludge blanket depth.

§217.151. General Requirements for Activated Sludge Aeration Basins.

(a) Minimum Dissolved Oxygen Concentration in Aeration Basins. An aeration system must maintain a minimum dissolved oxygen concentration of 2.0 mg/l throughout the basin at the maximum diurnal organic loading rate determined in §217.32(3) or §217. 33(2)of this title (relating to Design of New System - Organic Loading Flows, Design of Existing System - Organic Loading and Flows, and Table B.1).

(b) Alternate Aeration Volume. An activated sludge system may use the volume in aerated influent wastewater channels and aerated mixed liquor transfer channels may be used to meet aeration basin volume requirements, provided the system uses aeration by diffused air and the diffuser depth conforms to the requirements of §217.156(b)(5)(A) of this title (relating to Aeration Equipment Sizing.)

(c) The use of contact stabilization systems for nitrification is prohibited.

§217.152. General Requirements for Activated Sludge Clarifiers.

(a) Inlets. All clarifiers must have inlet valves or gates. Clarifier inlets must provide uniform flow and stilling. The transfer pipes must not trap or entrain air. Vertical flow velocity through the inlet stilling well must not exceed 0.15 feet per second at peak flow. Inlet distribution channels must prevent the settling of solids in the channels.

(b) Scum removal.

(1) A clarifier must include scum baffles and a means for the collection and disposal of scum.

(2) Scum collected from clarifiers in plants utilizing the activated sludge process and aerated lagoons may be discharged to aeration basin(s), digester or other approved disposal methods. Scum from all other clarifiers must be discharged to a sludge digester or a disposal method which complies with Chapter 312 of this title (relating to Sludge Use, Transportation and Disposal).

(3) Discharge of scum to any open drying area is prohibited.

(4) A system with a design flow equal to or greater than 10,000 gallons per day must use a mechanical skimmer. Smaller systems may use hydraulic differential skimming if the scum pickup is capable of removing scum from the entire operating surface.

(5) Scum pumps must be specifically designed to pump scum.

(c) Effluent weirs.

(1) An effluent weir must prevent turbulence or a localized high vertical flow velocity in the clarifier.

(2) A weir must be located a minimum of six inches (horizontally) from an outer wall or baffle and must prevent the short circuiting of flow through the clarifier.

(3) A weir must adjust to allow the change of water surface elevation in the clarifier.

(4) For systems with a design flow of less than 1.0 mgd, the weir loadings must not exceed 20,000 gallons per day at the two-hour peak flow per linear foot of weir length.

(5) For systems with a design flow equal to or greater than 1.0 mgd, the weir loadings must not exceed 30,000 gallons per day two-hour peak flow per linear foot of weir length.

(6) Circular clarifiers must have peripheral overflow weirs around the entire perimeter of the clarifier. Circular clarifiers are not limited to the weir overflow rates as listed in this subsection.

(d) Sludge Lines.

(1) The means for sludge transfer from clarifiers for subsequent processing must not

negatively affect treatment efficiency.

(2) A sludge line must be a minimum of four inches in diameter.

(3) The flow velocity in the sludge line must be greater than two feet per second to prevent settling of solids.

(e) Sludge Collection Equipment. A clarifier that treats flow from a wastewater treatment facility with a design flow of 10,000 gallons per day or greater must include mechanical sludge collecting equipment.

(f) Pumped Inflow.

(1) For wastewater treatment systems with pumped inflow, a clarifier must have adequate capacity for two-hour peak flow or "firm pumping capacity." This flow rate may also include skimmer flow, thickener overflow, and filter backwash.

(2) All treatment systems must hydraulically accommodate peak flows without adversely affecting the treatment processes.

(g) Side Water Depth (SWD).

(1) The SWD is defined as the water depth from the top of the cone in cone bottom tanks, or from 2 feet above the bottom in flat bottom tanks with a hydraulic sludge removal mechanism to the water surface.

(2) A clarifier with mechanical sludge collector and a surface area greater than 300 ft^2 must have a minimum SWD of 10 feet.

(3) A clarifier with a mechanical sludge collector with a surface area less than 300 ft^2 must have a minimum SWD of 8 feet.

(4) A clarifier with a hopper bottom must compute SWD using equation 1.f. The SWD computed using equation 1.f excludes the hopper portion of the clarifier. The upper third of the hopper portion of the hopper bottom clarifier may be counted as part of the SWD only if the surface area of the hopper bottom clarifier is increased by 15% over the surface area determined from the design surface loading calculated using Table F.2, and if the activated sludge plant includes a flow equalization basin. The SWD of a hopper bottom clarifier must never be less than 5 feet. **Figure 1: §217.152(g)**

*SWD=160*Q+4* *Equation 1.f*

Where: SWD = side water depth required (ft)
Q = annual average flow in MGD as determined in §217.31(a)

(h) Restrictions on Hopper Bottom Clarifiers.

(1) A hopper bottom clarifier without mechanical sludge collection equipment is prohibited for a wastewater treatment facility with a maximum flow greater than 10,000 gallons per day.

(2) When a hopper bottom clarifier is used, each hopper cell must have individually-controlled sludge removal equipment.

(3) A hopper bottom clarifier must have a smooth wall finish and an upper hopper slope of not less than 60 degrees measured from the horizontal.

(i) Restrictions on Short Circuiting. The influent stilling baffle and effluent weir must prevent short circuiting.

(j) Return Sludge Pumping Capacity.

(1) The capacity of a return sludge pumping unit must be calculated on the basis of the area of the activated sludge clarifiers, and the pumping capacity is designated as the clarifier underflow rate in gallons per day per square foot.

(2) The maximum underflow rate is 400 gpd/sf.

(3) Systems must control capacity through throttling, variable speed, or multiple pumps, in order to operate over the range of 200 gpd/sf to 400 gpd/sf.

§217.153. General Requirements Which Apply to both Aeration Basin and Clarifier.

(a) Construction of Aeration Basin and Clarifier. Construction materials for an aeration basin and a clarifier must resist the effects of corrosive wastewater environment.

(b) Freeboard. An aeration basin must have a minimum freeboard of 18 inches at the two hour peak flow. A clarifier must have a minimum freeboard of 1 foot at the two-hour peak flow.

(c) Flow Splitting.

(1) A new installation which proposes a design flow of greater than or equal to 0.4 mgd must include a minimum of two aeration basins and two clarifiers, except a single aeration basin is allowed if the aeration equipment is removable without taking the basin out of service.

(2) The pipes must be capable of hydraulically passing the two hour peak flow with either the largest clarifier or the largest aeration basin out of service.

(3) The individual aeration basin and clarifier must have gates or valves to allow them to be hydraulically isolated.

(4) An aeration basin and clarifier must have a dedicated means for dewatering.

§217.154. Aeration Basin and Clarifier Sizing - Traditional Design.

(a) Aeration Basin Sizing.

(1) The aeration reactor must be sized using the organic loads calculated in §217.32(3) or §217.33(2) of this title (relating to Design of New Systems - Organic Loadings and Flow and Design of Existing Systems - Organic Loadings and Flow). Based on these organic loads, the aeration basin volume must ensure that the organic loading on the aeration basins does not exceed the rates in Table F.1.

(2) When identifying the reactor temperature for the process design in Table F.1, the engineer shall use the average of the lowest consecutive seven-day mean reactor temperature from a similar wastewater treatment facility located within 50 miles of the proposed site. **Figure 1: §217.154(1)**

Table F.1 - Design Organic Loading Rates For Sizing Aeration Basins Based On Traditional Design Methods		
Process	Applicable Permit Effluent Sets BOD_5/TSS/Ammonia Nitrogen	Maximum Organic Loading Rates lbs BOD_5/day/1,000 cf
Conventional Activated Sludge Process Without Nitrification	10/15 or 20/20	45
Conventional Activated Sludge Process With Nitrification When Reactor Temperatures Exceed 15 degrees C	10/15/3,2, or 1	35
Conventional Activated Sludge Process With Nitrification When Reactor Temperatures are 13 to 15 degrees C	10/15/3,2, or 1	25
Conventional Activated Sludge Process With Nitrification When Reactor Temperatures are 10 to 12 degrees C	10/15/3,2, or 1	20
Extended Aeration Basins Including Oxidation Ditches (MCRT over 20 days)	10/15/3,2, or 1	15

(b) Clarifier Sizing.

(1) Table F.2 establishes the maximum surface loading rates and the minimum detention times used to determine the size of an activated sludge clarifier.

(2) The clarifier must meet both the detention time and overflow rate criteria. When calculating overflow rates for a proposed clarifier, sludge recycle flow must not factor into compliance with Table F.2. When calculating the overflow rate for a proposed clarifier, the surface area of the stilling well is included as part of the clarifier surface area. **Figure 2: §217.154(2)**

Table F.2 - Maximum Clarifier Overflow Rates Based Upon Traditional Design Methods				
Applicable Permit Effluent Sets BOD_5/TSS/ Ammonia Nitrogen	Aeration Basin Organic Loading (lbs BOD_5/day/1000 cf) (from Table F.1)	Process - Treatment Level	Maximum overflow rate at 2-Hour Peak Flow (gal/day/sf)	Minimum Detention Time at 2-Hour Peak Flow (hrs)
20/20 or 10/15	45	Fixed Film - Secondary or Enhanced Secondary	1200	1.8
20/20, 10/15, or 10/15/3	45, 35, 25 or 20	Activated Sludge - Secondary, Enhanced Secondary, or Secondary with Nitrification	1200	1.8
20/20	15	Extended Air - Secondary	900	2.0
10/15/3	15	Extended Aeration - Enhanced Secondary	800	2.2

§217.155. Aeration Basin and Clarifier Sizing - Volume-Flux Design Methods.

Volume Flux Design is in Appendix I of this subchapter.

§217.156. Aeration Equipment Sizing.

(a) Oxygen Requirements (O_2R) of the Wastewater.

(1) Mechanical and diffused aeration systems must provide sufficient dissolved oxygen to the wastewater to meet the demands of wastewater in the aeration basin.

(2) An aeration system must provide a minimum dissolved oxygen concentration in the aeration basin of 2.0 mg/l.

(3) Mechanical and diffused aeration systems must supply the O_2R calculated by Equation 2.f or use the recommended values presented in Table F.3. The O_2R in Table F.3. use

concentrations of 200 mg/l BOD5 and 45 mg/l NH_3-N in equation 2.f. **Figure 1: §217.156(a)**

$$O_2R=[1.2(BOD_5)+4.3(NH_3\text{-}N)]/(BOD_5) \quad \textit{Equation 2.f}$$

Table F.3 - Minimum O_2R	
Process	O_2R, lbs O_2/lb BOD_5
Conventional Activated Sludge Systems which are not Intended to Nitrify	1.2
Conventional Activated Sludge Systems which are Intended to Nitrify; and, Extended Aeration Systems (including all Oxidation Ditch Treatment Systems)	2.2

(b) Diffused Aeration Systems. The engineer shall use either paragraph (1) or (2) of this section when designing air flow requirements.

(1) Design Air Flow Requirements - Default Values. A diffused air system may use Table F.4 to determine the air flow for sizing. The values in Table F.4 were calculated using equation 4.f with the following assumptions: a transfer efficiency of 4.0 percent in wastewater for all diffused air activated sludge processes; a diffuser submergence of 12 feet; a wastewater temperature of 20° C; and the oxygen requirements in Table F.3. **Figure 2: §217.156(b)(1)**

Table F.4 - Minimum Air Flow Requirements for Diffused Air	
Process	Air Flow/BOD_5 load, standard cubic feet (SCF)/day/lb BOD_5
Conventional Activated Sludge Systems which are not Intended to Nitrify	1800
Conventional Activated Sludge Systems which are Intended to Nitrify; and, Extended Aeration Systems	3200

(2) Design Air Flow Requirements - Equipment and Site Specific Values. A diffused air system may base calculations of the air flow requirements for the diffused air equipment in accordance with subparagraphs (A)-(D) of this paragraph.

(A) Determine Clean Water Oxygen Transfer Efficiency (CWOTE).

(i) A diffused air system may have a clean water oxygen transfer efficiency greater than 4% if the full scale diffuser performance data from a certified testing laboratory, or sealed by an independent licensed professional engineer is presented which demonstrates the diffusers' transfer efficiencies.

(ii) The testing laboratory or licensed engineer shall use the oxygen transfer testing methodology described in the ASCE publication entitled, “A Standard for the Measurement of Oxygen Transfer in Clean Water” (1984).

(iii) The executive director will review a diffused air system with a clean water transfer efficiency greater than 18% for coarse bubble systems and greater than 26% for fine bubble systems as innovative technology subject to §217.10(b) of this title (relating to Approvals of Innovative and Nonconforming Technologies).

(iv) The engineer shall adjust clean water transfer efficiencies obtained at temperatures other than 20 degrees Celsius for a diffused air system to reflect the approximate transfer efficiencies and air requirements under field conditions by use of equation 3.f. **Figure 3: §217.156(b)(2)(A)**

$$FTE=(T_e)*(WOTE/CWOTE)*1.024^{T-20}*(C_f/C_t) \quad \textit{Equation } 3.f$$

Wh
ere:

T_e	=	Test Efficiency
FTE	=	Field Transfer Efficiency (decimal)
WOTE	=	Wastewater Oxygen Transfer Efficiency (decimal)
CWOTE	=	Clean Water Oxygen Transfer Efficiency (decimal)
T	=	Temperature (degrees C)
C_f	=	Oxygen Saturation in Field (Includes temperature, dissolved solids, pressure etc.)
C_t	=	Oxygen Saturation in Test Conditions

(B) Determine Wastewater Oxygen Transfer Efficiency (WOTE).

(i) The engineer shall estimate the wastewater oxygen transfer efficiency from clean water test data by multiplying the clean water transfer efficiency by 0.65 for coarse bubble diffusers and by multiplying the clean water transfer efficiency by 0.45 for fine bubble diffusers.

(ii) The executive director may require additional testing and data to justify actual wastewater transfer efficiencies for a wastewater treatment facility treating greater than 10 percent industrial wastes.

(C) Determining Required Air Flow (RAF). The engineer shall use equation 4.f to calculate the RAF to determine the size needed for a 12-foot diffuser submergence. If the diffuser submergence is other than 12 feet, a diffused air system must correct the RAF detailed in subparagraph D of this paragraph. **Figure 4: §217.156(b)(2)(C)**

$$RAF=[(PPD\,BOD_5)*(O_2/lb\,BOD_5)]/[WOTE*0.23*0.075*1440] \quad \textit{Equation } 4.f$$

Wher

e:

RAF	=	Required Air Flowrate (SCFM)
PPD $CBOD_5$	=	Influent Organic Load in Pounds per Day
0.23	=	lb 0_2/lb air @ 20 degrees C
1440	=	minutes/day
0.075	=	lb air/(cubic foot)*
WOTE	=	Wastewater Oxygen Transfer Efficiency (decimal)

* If the design inlet temperature is above 24 degrees C, the specific weight of air must be adjusted to the specific weight at the intake temperature.

(D) Corrections to RAF Based on Varying Diffuser Submergence Depths. If the diffuser submergence differs from 12 feet, the engineer shall adjust the minimum air flow rate calculated in subparagraph (C) of this paragraph by multiplying the calculated values by the factors in Table F.5.

Figure 4: §217.156(b)(2)(D)

Table F.5 - Diffuser Submergence Correction Factors	
Diffuser Submergence Depth (ft)	Air Flow Rate Correction Factor
8	1.82
10	1.56
12	1.00
15	0.91
18	0.73
20	0.64

(3) Mixing Requirements for Diffused Air. The engineer shall calculate the air requirements for mixing design organic loading using:

(i) Chapter 11 of *Design of Municipal Wastewater Treatment Plants*, a joint publication of the American Society of Civil Engineers and the Water Environment Federation, for mixing requirements; or

(ii) greater than or equal to 20 SCFM/1000 cf for coarse bubble diffusers and greater than or equal to 0.12 SCFM per square foot for fine bubble diffusers.

(4) Blowers and Air Compressors.

(A) Blowers and compressors must have sufficient capacity to provide the required aeration rate and the requirements of all supplemental units.

(B) The report must include blower or compressor calculations which show the actual air requirements for the expected temperature range (both summer and winter conditions) and the impact of the actual site elevation on the air supply.

(C) A diffused air system must have multiple compressor units arranged to provide an adjustable air supply to meet the variable organic load to be placed on the wastewater treatment facility. The compressors must be capable of handling the maximum design air requirements with the largest single unit out of service. The blower/compressor units must restart automatically after a power outage or a telemetry or an auto-dialer must notify the operator or owner of the outage.

(D) The engineer shall design the blowers or air compressors with sufficient capacity to handle air intake temperatures that may exceed 100 degrees F (38 degrees C), and pressures that may be less than standard (14.7 pounds per square inch absolute). The engineer shall design the capacity of the motor drive to handle air intake temperatures that may be 20 degrees F (-7 degrees C) or less.

(5) Diffuser Systems - Additional Requirements.

(A) Diffuser Submergence. The submergence depths for diffusers must meet the minimum depths in Table F.6 for new plants. The diffuser submergence depths, for additions to existing plants, may vary from Table F.6 to match existing air pressure, delivery rate, and hydraulic requirements. A submergence depth for a diffuser of less than 7 feet is prohibited. **Figure 6: §217.156(b)(5)(A)**

Table F.6 - Minimum Diffuser Submergence Depth	
Design Flow, mgd	Minimum Submergence Depth, feet
0.01 or less	8.0
0.01 to 0.10	9.0
Greater than 0.10	10.0

(B) Grit Removal. Systems which use diffusers and have wastewater with high concentrations of grit must include a grit removal unit upstream of the aeration process or must include multiple trains which may be taken out of service to allow for grit removal.

(C) Aeration System Pipes.

(i) Each diffuser header must include a control valve. These valves may be open/close or throttling type. The valves must withstand the heat of the compressed air.

(ii) An air header must withstand temperatures up to 250 degree F.

(iii) The capacity of an air diffuser system, including pipes and diffusers, must equal 150 percent of design air requirements.

(iv) The engineer shall design the aeration system to minimize head losses. The report must include a hydraulic analysis of the entire air pipe system which quantifies head loss through the pipe system and details the distribution of air from the blowers to the diffusers.

(v) The air hydraulic analysis must demonstrate that the air system can deliver sufficient air to the aeration basin to supply the air demand requirements of this section.

(vi) An aeration system may use non-metallic pipes only in the aeration basin, but the pipes must be a minimum of four feet below the average water surface elevation in the aeration basin.

(c) Mechanical Aeration Systems.

(1) Required Air Flow - Equipment and Site Specific Values. The engineer shall calculate the air flow requirements for a mechanical aeration system in accordance with subparagraphs (A) and (B) of this paragraph.

(A) Determine Clean Water Oxygen Transfer Efficiency.

(i) The report must include the oxygen transfer efficiency rates for the mechanical equipment.

(ii) Clean water oxygen transfer rates must not exceed 2.0 pounds of oxygen per horsepower-hour, unless justified by full scale performance data conducted by a certified testing laboratory, or sealed by an independent, licensed professional engineer using the oxygen transfer testing methodology described in the ASCE publication, “A Standard for the Measurement of Oxygen Transfer in Clean Water” (1984).

(iii) The executive director will review mechanical equipment with proposed clean water transfer efficiencies in excess of 2.0 pounds of oxygen per horsepower-hour as innovative technology subject to the requirements of §217.10(b) of this title (relating to Approvals of Innovative and Nonconforming Technologies).

(B) Determine Wastewater Oxygen Transfer Efficiency.

(i) The report must include data to justify actual wastewater transfer efficiencies.

(ii) The engineer shall estimate the wastewater transfer efficiency from the clean water transfer efficiency by multiplying the clean water transfer efficiency by 0.65 for all mechanical aeration equipment for a plant treating greater than 10 percent industrial wastes.

(2) Mixing Requirements. The mechanical aeration devices must provide sufficient mixing to prevent deposition of mixed liquor suspended solids (MLSS) under any flow conditions. The mechanical aeration devices must be capable of re-suspending the MLSS after a shutdown period caused

by power outage or outage for maintenance purposes. Mechanical aeration devices with channel or basin type layouts must have a minimum of 100 horsepower per million gallons of aeration basin volume, or 0.75 horsepower per 1000 cubic feet of aeration basin volume.

(3) Mechanical Components.

(A) Process reliability. A basin must include a minimum of two mechanical aeration devices in each basin. The mechanical aeration devices must meet the maximum design oxygen transfer requirements with the largest single unit out of service. The mechanical aeration devices must automatically restart after a period of power outage or a telemetry or an auto-dialer must notify the operator or owner.

(B) Operations and maintenance.

(i) A mechanical aeration device must have two speed or variable speed drive units, unless otherwise provided.

(ii) A mechanical aeration device may use single speed units with timer controlled operation if the device also includes an independent means of mixing.

(iii) The operator must be able to perform routine maintenance without the danger of coming into contact with raw or partially-treated wastewater.

(iv) Any bearings, drive motors, and gear reducers must be accessible and contain splash shields or other types of splash prevention devices. Any gear reducers must have a drainage system to prevent contact with mixed liquor.

§217.157. Sequencing Batch Reactors (SBR).

(a) System Sizing and Reliability.

(1) A SBR must meet the reliability requirements in §217.156(b) and §217.156(c)(3) of this title(relating to Aeration Equipment Sizing) and power source reliability requirements in §217.35 of this title (relating to Backup Power Requirements).

(2) A SBR must have a minimum decantable volume to pass the design flow on a continuous basis without changing cycle times with the largest basin out of service.

(3) A two-basin treatment facility without removable aeration devices requires separate aerated storage of mixed liquor from the SBR tank(s).

(4) A SBR with fixed level decanters must have more than two basins and additional decantable storage volume to account for the added settling time before a discharge may occur. A SBR with fixed decant equipment where decant volumes do not accommodate the design flow requires

equalization basins.

(5) Organic space loadings must conform to §217.154(1) Table F.1 of this title (relating to Aeration Basin and Clarifier Sizing- Traditional Design Approach). Maximum space loadings must be below 35 pounds of $CBOD_5$ per 1,000 cubic feet of tank volume.

(6) The reactor MLSS level at the low water level (normal operating level) must range between 3,000 mg/l to 5,000 mg/l.

(7) The minimum depth of the REACT volume is 9 feet.

(8) The minimum side water depth of the tanks is 12 feet.

(9) The SBR must include sludge digestion pursuant to the requirements in Must of this chapter (relating to Sludge).

(b) Decanter Design.

(1) The decanter design must allow velocities at the inlet port or at the edge of submerged weirs that prohibit vortexing, disturbance of the settled sludge, or entry of floating materials.

(2) The entrance velocity to the decanter must not exceed 1.0 feet per second.

(3) The decanter must draw effluent from below the water surface, and include a device which excludes scum.

(4) The decanter must maintain a zone of separation between the settled sludge and the decanter height of no less than 12 inches.

(5) Decanters must have a means of excluding solids from entering the decanter during the REACT cycle, including the following:

(A) recycle treated effluent to wash out solids trapped in the decanter;

(B) physically remove a decanter from the mixed liquor except during decanting;

(C) mechanically close the decanter when it is not in use; or

(D) fill the decanter with air except during the decant period.

(6) The decanter and related pipes and valves must include freeze protection.

(7) A fixed decanter is prohibited in a basin where simultaneous fill and decant may occur.

(8) The size of the decant system must handle the design flow without changing the cycle time with the largest tank out of service. This sizing is applicable to any system of tanks that are fed sequentially.

(9) System flexibility and outfall pipes must be provided to allow the decant of at least two tanks simultaneously for all SBR systems utilizing more than two basins.

(10) Downstream treatment units size must handle peak flow rates.

(11) Flow equalization downstream of the batch reactors, to dampen the higher flow rates associated with the decanting cycle, must be provided in order to minimize disinfection basin volume and size of disinfection equipment unless those downstream units and the receiving stream are sufficiently capable of accepting the peak flowrate of the decanter.

(c) Tank Details.

(1) An SBR requires multiple tanks.

(2) Influent baffling and physical separation from the decanter must be provided for an SBR with two tanks, or an SBR system operating with a continuous feed during settling and decanting phases.

(3) Elongated tanks must be used for systems where influent baffling is required.

(4) All SBR tanks must have a minimum freeboard of 18 inches and protect against uplift when empty.

(5) Structures using common walls must handle the stress condition of one basin at maximum liquid level and the adjacent basin completely empty. All SBR walls must be hydrostatically sound.

(6) A sump must be provided in all basins with flat bottoms.

(7) An SBR system must have the capability to transfer sludge from each basin to the other aeration basins and include a means of scum removal from each aeration tank.

(8) Each SBR tank must include a dewatering system and an overflow to the other aeration tank(s) or to a storage tank. An SBR tank(s) requiring manual activation by operating personnel must include a high water overflow alarm and notify plant operating personnel at plants not manned 24-hours a day, in accordance with §217.162 of this title (relating to Electronics and Instrumentation System).

(9) The engineer shall determine the means and frequency for removal of grit and other debris from the basins.

(10) The engineer shall design adequate space for equipment access.

(11) An SBR may use fine screens pursuant to Subchapter E, §217.126 thru §217.130 of this title (relating to Preliminary Treatment Units).

(12) A SBR preceded by primary clarifiers may use a communicator.

(d) Aeration and Mixing Equipment.

(1) In addition to the requirements of §217.156 of this title (relating to Aeration Equipment Sizing), aeration equipment must handle the cyclical operation in a sequencing batch reactor.

(2) The aeration and mixing equipment must produce flow patterns within the aeration tank which does not interfere with quiescent settling.

(3) Oxygen transfer rates for the aerators, at average water depth, during the fill cycle must provide a residual of 2.0 mg/l D.O. in the basin.

(4) The engineer shall determine blower discharge pressure at the maximum water depth.

(5) A SBR used for biological nutrient removal or reduction must meet the design requirements of §217.164 of this title (relating to Advanced Nutrient Removal).

(6) The design of the SBR must allow for the removal of air diffusers or mechanical aeration devices without dewatering the tank.

(7) An SBR must have a sufficient number of tanks if one tank is out of service.

(e) Control Systems.

(1) The motor control center (MCC) must include programmable logic controllers (PLC) with limited operator adjustment and programmed to meet the required effluent limitations for the design loadings. A hard-wired backup means of operating the SBR is required. The PLC must include battery backup and a duplicate set of all circuit boards to the facility.

(2) Adequate controls for the separate operation of each reactor tank must be provided. Tank level systems must include floats or pressure transducers. Float systems must be protected from prevailing winds and freezing. Bubbler systems in level systems are prohibited.

(3) The control panel switches must include at least:

(A) Pumps - Hand/Off/ Automatic.

(B) Valves - Open/Closed/Auto.

(C) Blowers or Aerators - Hand/Off/Automatic.

(D) Selector switch for tank(s) in operation/standby.

(4) The control panel visual displays must include:

(A) Mimic diagram of the process showing status and position of pumps, valves, blowers or aerators, and mixers, if used;

(B) Process cycle and time remaining;

(C) Instantaneous and totalized flow to the plant and discharge;

(D) Tank level gauges or display of levels;

(E) Sludge pumping rate and duration; and

(F) Air flow rate and totalizer.

(5) The required alarm condition indicators for the annunciator panel must include:

(A) High and Low water level in each tank;

(B) Valve - failure of all automatically operated valves;

(C) Decanter - failure;

(D) Blowers, if used - low pressure, high temperature, and failure;

(E) Mechanical Aerator, if used - high temperature, and failure;

(F) Pump - high pressure and failure; and

(G) Mixers, if used - failure.

§217.158. Membrane Bioreactor Treatment Systems (MBR)

The commission is currently working on minimum design factors for MBR.

§217.159. Solids Management.

(a) Solids Recycling and Monitoring. The return sludge system must operate satisfactorily within all flow conditions. The monitoring and control system must provide a means to control return and waste sludge flows from each clarifier, to control return sludge flows into each aeration basin, to meter return sludge flows, and to measure waste sludge flows.

(b) Solids Wasting. The engineer shall design adequate treatment facilities to store and/or process the waste activated sludge under all flow conditions.

(c) Return Activated Sludge (RAS) Pump Design. A centrifugal sludge pump must have a positive suction head, unless the pump is self-priming. An airlift pump must allow for cleaning the without removal from the basin. A RAS must have sufficient pumping units to maintain the maximum design return pumping rate with the largest single pumping unit out of service.

(d) Waste Activated Sludge (WAS) Pump Design. A WAS design requires at least two pumping units and must prevent excessive solids storage within the clarifiers.

(e) Sludge Pipe System. The design of the sludge pipe system must allow cleaning and flushing. The sludge pipe system must provide a pipe line velocity of at least 3 ft/sec. at the maximum waste/return rate to prevent solids settlement and must provide scouring at anticipated normal operating conditions. The sludge pipe system must have a minimum nominal diameter of four inches.

§217.160. Process Control.

(a) Solids Retention Time (SRT) Control. The wastewater treatment facility must include the necessary equipment for the operator to control the SRT in the aeration tanks by wasting a measured volume of surplus activated sludge regularly (at least weekly) from either the mixed liquor tank, a sludge re-aeration tank, or from the return sludge. The report and the operating manual must provide the formulas for determining the SRT. The SRT required for nitrification applies to the aerobic portion of the plant.

(b) Aeration System Control. Aeration control involves the total air supplied and the distribution of air to the aeration tanks. In order to conserve energy, the wastewater treatment plant may provide the ability to adjust the airflow in proportion to the load demand of the plant. If this type of control is installed the aeration equipment must be easily adjustable in increments and must maintain solids in suspension within the limits of this section.

§217.161. Operability and Maintenance Requirements.

(a) Temperature. All equipment must operate at the temperature extremes of the wastewater treatment facility location and may require enclosures to allow operation of the equipment at all times.

(b) Maintenance. All buildings that contain equipment must have adequate means to position the equipment for removal, repair and reinstallation, including the ability by overhead lifting eyes to mount a portable hoist, by overhead cranes, or by adequate building openings to allow access of truck mounted or other lifting equipment.

§217.162. Electrical and Instrumentation Systems.

(a) All three-phase motors must have protection against a single-phase electrical condition. Instrumentation and monitoring equipment must have power surge protection.

(b) A wastewater treatment facility must conduct fault monitoring and reporting on high wet well, power interruption, disinfection failure, blower failure, and return sludge pumping failure.

(c) For a wastewater treatment facility not staffed 24 hours a day, a telemetering or SCADA system must be able to notify the operator or a responsible person 24-hours a day.

§217.163. Internal Process Flow Measurement.

Plants with design flows greater than 0.4 mgd must provide process control measurement at the following operational control points return sludge of each clarifier and waste sludge flow.

§217.164. Advanced Nutrient Removal.

The executive director will consider a wastewater treatment facility which has advanced nutrient removal as innovative and nonconforming technology subject to §217.10(b) of this title (relating to Innovative and Nonconforming Technology).

§217.165. Appendix I.

The following design approach is an alternative to the traditional design approach. The engineer may determine the aeration tank volume and the clarifier volume by selecting a mixed liquor suspended solids and floc volume (at SVI = 100) for the required minimum solids retention time. Larger values of mixed liquor suspended solids require less aeration tank volume and greater clarifier volume. By examining a range of values of the mixed liquor suspended solids and the floc volume, the engineer may select the most favorable arrangement for the wastewater treatment facility. When using the volume-flux design method, the engineer shall size the aeration basins and clarifiers in accordance with the requirements of this section. **Figure 1:§217.165**

APPENDIX I : Volume-Flux Design Approach.

(a) Design approach.

(1) Determine the solids retention time (SRT) needed to meet the permit requirement for effluent CBOD and ammonia-nitrogen.

(2) Select a trial value mixed liquor floc volume, (for example mixed liquor suspended solids (MLSS) at sludge volume index (SVI) of 100.

(3) Using the design organic loading rate, the required SRT and yield, and the trial MLSS, determine the aeration tank volume.

(4) Using the trial value of mixed liquor flow volume, determine the clarifier area.

(5) For clarifiers overloaded in thickening at two hour peak flow, determine the final MLSS during storm flow and the resulting sludge blanket depth.

(6) Observing limitations, determine the side water depth (SWD) and volume of the clarifier.

(7) Repeat items 2 through 6 of this subsection at different mixed liquor floc volumes and select the most favorable conditions for the plant design.

(b) Aeration Basin Sizing.

(1) For wastewater treatment facilities that do not require nitrification, the minimum SRT is as follows:

(A) For wastewater treatment facilities with effluent CBOD values of 20 mg/l, the minimum SRT is 3 days;

(B) For extended aeration plants with effluent CBOD values of 20 mg/l, the minimum SRT is 22 days;

(C) For wastewater treatment facilities with effluent CBOD values less than 20 mg/L, the minimum SRT is 4.5 days; and

(D) For extended aeration plants with effluent CBOD values less than 20mgl, the minimum SRT is 25 days.

(2) For plants that require nitrification, the minimum SRT is based on the winter reactor temperature as set forth in §217.154(a)of this title (relating to Aeration Basin and Clarifier Sizing - Traditional Design Approach) and the values of SRT and net solids production, Y, as listed in Table 1. The maximum CBOD loading for single-step plants is 50 lb. CBOD/1000 cf and for the first step of two-

step plants is 100 lb. CBOD/1000 cf.

(3) Above-ground steel or fiberglass tankage requires 2° C lower minimum operating temperature than systems utilizing reinforced concrete tankage. Systems must be designed for an MLSS concentration between 2000 and 5000 mg/l. The net solids production, Y, in Table 1 includes both coefficients for yield and endogenous respiration.

Table 1 - Effect of Temperature on SRT, Net Solids Production, and F/M Rate

Temperature, °C	SRT, days	Net Solids Production, Y = .965-0.013(SRT)	F/M Rate, #BOD/#SS/day = 1/(Y*SRT)
18	4.76	0.90	0.233
17	5.25	0.90	0.212
16	5.79	0.89	0.194
15	6.38	0.88	0.178
14	7.04	0.87	0.163
13	7.77	0.86	0.150
12	8.56	0.85	0.137
11	9.45	0.84	0.126
10	10.42	0.83	0.116

Where: Table 1 uses on the maximum growth rate of *Nitrosomonas* calculated using Equation 3-14 from EPA Manuel, *Nitrogen Control*, EPA/625/R-93/010, Sept. 1993, p. 90, shown below as equation 1.

$$Max.\ Growth\ Rate\ =\ 0.47e^{0.098(T-15)}, days^{-1}\quad Equation\ 1$$

The necessary SRT is calculated using equation 2 as follows:

$$SRT\ =\ SF/(Max.\ Growth\ Rate)\qquad Equation\ 2$$

SF is a safety factor and includes the design factor for the ratio of average to maximum diurnal ammonia loading. A value of 3.0, as recommended in the EPA manual, was is used in calculating Table 1.

Determine the Volume of the Aeration Basin. Select a trial value of MLSS. The aeration basin volume is calculated as the maximum value from equations 3 and 4.

$$V_a = 1{,}000{,}000(CBODL)(Y)(SRT)/(62.4MLSS) \quad \textit{Equation } 3$$

$$V_a = 1{,}000(CBODL)/(\textit{maximum allowable lb CBOD/kcf}) \quad \textit{Equation } 4$$

Where:	V_a	=	Volume of aeration basin, cubic feet
	CBODL	=	Design CBOD load, per day
	Y	=	yield of solids per unit CBOD removed
	SRT	=	required solids retention time, days
	MLSS	=	mixed liquor suspended solids, mg/L
	lb CBOD/kcf	=	maximum CBOD load/thousand cf

(c) Clarifier Sizing. The clarifier basin sizing is based on volume flux from the floc volume of solids entering the clarifier. Biological solids may occupy different volumes for the same mass of solids as indicated by the SVI. The design flow and two-hour peak flow must include any return flows from units downstream of the clarifier, including flow from skimmer, thickeners and filter backwash for purposes of determining overflow rates for clarifier sizing. All clarifier sizing must prevent overloading in clarification under any design condition. The settling velocity of the mixed liquor solids must equal or exceed the two-hour peak overflow rate. All clarifier sizing must prevent overloading in thickening at the design flow. The operating instructions must state the design maximum mixed liquor floc volume.

(1) Dimensions for Clarifiers Designed for No Solids Storage (i.e., not overloaded in thickening at the two hour peak flow).

(A) Determine Overflow Rate and Area. The engineer shall use Table 2 to determine the maximum surface loading rates. The MLSS concentration must include the same concentration assumed for sizing the aeration basin. The engineer must choose the underflow rate. The engineer shall calculate the maximum overflow rate for the clarifier, at the two hour peak flow, using Table 2, the aeration basin MLSS concentration and a selected underflow rate. The area of the clarifier is determined as follows:

$$A_c = 1{,}000{,}000 \; Q_p/0R_p \quad \textit{Equation } 5$$

Where:	A_c	=	area of the clarifier(s), sq ft.
	Q_p	=	two hour peak flow, MGD
	OR_p	=	overflow rate from Table 2, gpd/sf

(B) Determine Volume of Clarifier. The volume of the clarifier must exceed the values determined from the minimum SWD or the minimum detention time.

$$V_c,\; minSWD = A_c(minSWD) \quad \textit{Equation } 6$$

$$V_c,\ minDT = (1{,}000{,}000Q_p/24)(minDT)/(7.48) \qquad \textit{Equation } 7$$

Where: V_c = volume of the clarifier(s), cf
A_c = area of the clarifier(s), sq ft.
minSWD = 10 ft, except as allowed in §217.152(g)
minDT = minimum detention time per Table F.2, hr

(2) Dimensions for Clarifiers Designed for Solids Storage Capabilities. The design of a clarifier that may be overloaded in thickening at the design flow, must include the ability to store solids during peak flow events. The engineers must use Tables 2, 3, and 4 in the design. The process for designing a clarifier based on this concept is as follows:

(A) Determine Area of the Clarifier. The area calculations must be based on the trial MLSS selected for the sizing of the aeration basin in paragraph (1) of this subsection. The area of the clarifier must exceed the greater of the areas determined from Table 3 for the two hour peak flow and the area determined from Table 2 for the design flow using a selected underflow rate.

$$A_c,2\text{-}hr\ peak\ flow = 1{,}000{,}000Q_p/0R_{T5} \qquad \textit{Equation } 8$$

$$A_c,\max\ 30\text{-}day\ average\ flow = 1{,}000{,}000Q_{mx30av}/0R_{T4} \qquad \textit{Equation } 9$$

Where: Q_{mx30av} = design flow (MGD)
OR_{T5} = overflow rate from Table 3 for selected MLSS (gpd/sf)
OR_{T4} = overflow rate from Table 2 for selected underflow rate and MLSS (gpd/sf)

(B) Determine the Final MLSS as the result of the transfer of solids from the aeration tank to the clarifier by the two hour peak flow. The clarifier design must allow for greater rates of flow that will transfer solids from the aeration tank to the clarifier when the clarifier becomes overloaded in thickening above the design flow until the mixed liquor solids are reduced to the concentration that no longer causes the overload.

Using Table 4 and the selected underflow rate, the MLSS concentration at peak flow is determined using equation 10.

$$MLSS_p = (UR_{T6} * RSSS_{T6})/(0R_p + UR_{T6}) \qquad \textit{Equation } 10$$

Where: UR_{T6} = Underflow rate from Table 4 (gpd/sf)
Or_p = Overflow rate at 2-hr peak flow (gpd/sf)
$MLSS_{pf}$ =Diluted MLSS during peak flow (mg/l)
$RSSS_m$ = Maximum Return Sludge Concentration from Table 4 for the selected UR (mg/l)

(C) Determine Depth of Sludge Blanket at Two Hour Peak Flow. The depth of the sludge blanket is determined by the aeration basin volume, the change in MLSS, the area of the clarifier and the concentration of the blanket solids at the selected underflow rate as shown in equation 11.

$$SBD = v_a(MLSS_{av} - MLSS_{pf})/(A_c BKSS) + 1.0 \qquad Equation\ 11$$

Where: SBD = Sludge Blanket Depth (ft)
Va = Volume of aeration basins (cu ft.)
Ac = Area of clarifier (sq ft.)
$MLSS_p$ = Diluted MLSS during peak flow (mg/l)
$MLSS_{av}$ = Diluted MLSS during average flow (mg/l)
BKSS = Blanket concentration from Table 4 at the selected underflow rate (mg/l)
1.0 = Assumed sludge blanket depth during design flow conditions

(D) Determine the SWD. The SWD of the clarifier is the maximum value resulting from the following conditions:

(I) 10 ft., unless a lower depth is allowed by §217.152(g),

(II) minimum detention time per Table F.2,

$$SWD_{DT} = 0R_p(DT)/180 \qquad Equation\ 12$$

(III) 3.0 times the Sludge Blanket Depth.

(E) Determine Clarifier Volume. The volume of the clarifier is the area multiplied by the SWD determined in subparagraph (D) of this paragraph.

$$V_c = A_c(SWD) \qquad \textit{Equation } 13$$

Where: Vc = Volume of Clarifier, (cf)
Ac = Area of the Clarifier, (sq ft)
SWD = Side Water Depth determined in (D) above, (ft)

(F) The formulas for Tables 2, 3, and 4 Table 3 gives calculate the rates that are equal to the settling velocity of activated sludge at various floc volume concentrations. For values less than 30 percent, the floc volume is the 30-minute settled volume in an unstirred 1-liter graduated cylinder. For values greater than 30 percent, the sample is diluted so that the settled volume is between 15 and 30 percent, and the result multiplied by the dilution factor.

(I) For floc volume less than 40 percent,

$$0R_{T5} = 5053.8(1 - fv/100)^{3.83} gpd/sf \qquad \textit{Equation } 14$$

(II) For floc volume greater than 40 percent,

$$0R_{T5} = 9003610(fv^{-2.56}) gpd/sf \qquad \textit{Equation } 15$$

Where: OR_{T5} = Settling Velocity of Table 3 (gpd/sf)
fv = Floc Volume (percent) = SVI(MLSS)/10,000 SVI (ml/g),MLSS (mg/L)

Table 2 and Table 4 are based on an analysis of the floc volume flux, i.e. floc volume times settling velocity, calculated from Equations 14 and 15. Table 4 is a tabulation of the maximum concentration of the underflow at different underflow rates. The equation for Table 4 is as follows:

$$RSSS_m = 10{,}170{,}000(UR^{-0.391})/SVI \qquad \textit{Equation } 16$$

Where: $RSSS_m$ = Return Sludge Suspended Solids (mg/L)
UR = Underflow Rate (gpd/sf)
SVI = Sludge Volume Index (ml/g)

Table 2 determines the overflow rate which, along with the underflow rate and MLSS, determines the same floc volume flux as shown in Table 4.

Table 2

Allowable Clarifier Surface Loading Rates For Given Underflow Rates With No Provisions For Sludge Storage In The Clarifier
OR
The Maximum Surface Loading Rate At The Design Flow For Clarifiers Designed To Store Solids During Peak Events

MLSS mg/l	UNDERFLOW RATE (gpd/sq.ft.) 200	250	300	350	400
2000	1081	1218	1340	1452	1554
2100	1020	1148	1262	1366	1461
2200	965	1084	1191	1288	1377
2300	914	1026	1126	1217	1299
2400	868	973	1067	1151	1229
2500	825	924	1012	1091	1163
2600	786	879	962	1036	1103
2700	749	837	915	985	1048
2800	715	798	872	937	996
2900	684	762	831	893	948
3000	654	729	793	851	903
3100	627	697	758	812	861
3200	601	667	725	776	821
3300	577	640	694	742	784
3400	554	613	665	710	750
3500	532	589	637	680	717
3750	483	533	575	611	642
4000	441	484	520	551	577
4250	403	441	472	498	520
4500	369	402	429	451	469
4750	340	368	391	409	423
5000	313	337	356	371	382

Table 3

Maximum Allowable Clarifier Overflow Rate Allowed For Clarifiers Which Are Designed To Store Solids

SVI=100
(minimum allowable SVI)

MLSS (mg/l)	SURFACE LOADING RATES (gpd/sq.ft.)
2000	2000
2150	2000
2200	1952
2300	1858
2400	1767
2500	1680
2600	1596
2700	1514
2800	1437
2900	1362
3000	1290
3100	1220
3200	1154
3300	1090
3400	1029
3500	971
3750	836
4000	715
4250	611
4500	528
4750	459
5000	403

Table 4 - Values For Use In Determining Sludge Storage Requirements

UNDERFLOW (gpd/sq.ft.)			200	250	300	350	400

RSSS MAX (mg/l)			12813	11743	10935	10295	9771
BLANKET CONC. (mg/l)			7816	7163	6670	6280	5961
POUNDS/CUFT (Blanket)			0.488	0.447	0.416	0.392	0.372

SUBCHAPTER G : FIXED FILM AND FILTRATION
§§217.180-217.192

STATUTORY AUTHORITY

The rules in Subchapter G, Fixed Film and Filtration, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.180. Applicability.

This subchapter establishes the requirements for trickling filters, rotating biological contactors, submerged biological contactors, and filtration systems.

§217.181. Trickling Filters - General Requirements.

Trickling filters are secondary aerobic biological processes are used for wastewater treatment. Biofilters or biotowers are trickling filters which use random or stackable modular synthetic media.

(1) Process Applicability. Trickling filters are classified according to applied hydraulic loading in million gallons per day (including recirculation) per acre of filter media aerial cross section surface area (mgd/acre), and influent organic loadings in pounds BOD per day per 1000 cubic feet of filter media, (lb BOD/day - 1000 cu ft). The engineer shall consider the following factors in the selection of the design hydraulic and organic loadings:

(A) strength of the influent wastewater;

(B) effectiveness of pretreatment;

(C) type of filter media; and

(D) treatment efficiency required.

(2) Trickling filters. Trickling filters may be classified as:

(A) roughing filters providing 50-75% removal of soluble BOD;

(B) secondary treatment filters providing the required settled effluent BOD and TSS;

(C) combined BOD/nitrifying filters providing the required settled effluent BOD, NH_4-N, and TSS; and

(D) tertiary nitrifying filters which provide the required settled effluent NH_4-N (where the influent to the trickling filter is a clarified secondary effluent).

(3) Table G.1 applies to the hydraulic and organic loadings for different classes of trickling filters. **Figure 1: §217.181(1)**

Table G.1 - Typical Design Loadings					
Operating Characteristics	Standard Rate	Intermediate Rate	High Rate	High Rate	Roughing
Media	Rock	Rock	Rock	Manufactured	Either
Hydraulic Loading: mgd/acre	1-4	4-10	10-40	15-90	60-180
Hydraulic Loading: gpd/sf	25-90	90-230	230-900	350-1000	1400-4200
*Organic Loading: lb BOD_5/acre-ft/day	200-1000	700-1400	1000-1300	--	--
*Organic Loading: lb BOD_5/day/1000cf	5-25	15-30	30-150	up to 300	100+
†BOD_5 Removal (%)	80-85	50-70	40-80	65-85	40-85
*Does not include recirculation † Includes subsequent settling					

(4) Pretreatment. Rock media trickling filters must be preceded by primary clarifiers equipped with scum and grease removal devices. All trickling filters must have upstream preliminary treatment units that remove all grit, debris, suspended solids, oil, grease, and all particles with a diameter greater than 3 millimeters, and controls the release of hydrogen sulfide.

(5) Rock Filter Media.

(A) Materials. Rock media using crushed rock, slag, or similar material containing more than five percent by weight of pieces whose longest dimension is greater than three times the least dimension are prohibited. Rock media must conform to the following size distribution and grading when mechanically graded over a vibrating screen with square openings in accordance with the following:

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

(ii) retained on three inch sieve - 95-100 % by weight;

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

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

(v) the loss of weight by a 20-cycle sodium test, as described in American Society of Civil Engineers Manual of Engineering and Engineering Practice No. 13, must be less than 10%.

(B) Placement.

(i) Rock media must not be less than four feet in depth at the shallowest point.

(ii) The dumping of rock media directly on the filter is prohibited. The engineer shall include instructions in the specifications for the placement of rock media.

(iii) Crushed rock, slag, and similar media must be washed and screened or forked prior to placement to remove clays, organic material, and fines.

(iv) Rock media must be placed by hand to a depth of 12 inches above the underdrains. The remainder of the material may be placed by means of belt conveyors or equal mechanical methods approved by the engineer.

(v) The placement of all materials must not damage the underdrains.

(vi) Trucks, tractors, or other heavy equipment must not drive over the filter media.

(6) Synthetic (Manufactured or Prefabricated) Media Materials.

(A) All synthetic media materials must be used in accordance with all manufacturer's recommendations.

(B) The executive director may consider synthetic media materials to be innovative or nonconforming technology subject to §217.10(b) of this title (relating to Innovative and Nonconforming Technology).

(i) Suitability. The suitability of synthetic media materials must be evaluated on the basis of experience with installations treating similar strength wastewater under similar hydraulic and organic loading conditions. The report must include any case histories involving the use of the synthetic media.

(ii) Durability. A synthetic media must be insoluble in wastewater and resistant to flaking or spalling, ultraviolet degradation, disintegration, erosion, aging, all common acids and alkalies, organic compounds, and biological attack.

(iii) Structural Integrity. The structural design must support the synthetic media, water flowing through or trapped in voids, and the maximum anticipated thickness of wetted biofilm. The synthetic media must also support the weight of a person when the trickling filter is in operation, unless separate provisions are made for maintenance access to the entire top of the trickling filter media and to the distributor.

(iv) Placing of Synthetic Media. Modular synthetic media must be placed as nearly as possible with the edges matched, to provide consistent hydraulic conditions within the trickling filter, and must be installed to provide a close fit to adjacent modules.

(7) Filter Dosing.

(A) The engineer shall design suitable flow characteristics for the application of wastewater to the filters by siphons, pumps, or by gravity discharge from preceding treatment units. The engineer shall design provisions for new facilities to control instantaneous dosing rates under both normal operating conditions and filter-flushing conditions.

(B) The dosing intensity must control the distributor speed and the recirculation rate as a compensatory measure under low-flow conditions. Table G.2 provides design ranges of dosing intensity for normal usage periods and for flushing periods.

(C) The engineer may circulate instantaneous dosing intensity for rotary distributors using Equation 1.g. **Figure 2: §217.181(5)**

$$SK=[(q+r)*(1000mm/m)]/[(a)(n)(60\min/hr)] \qquad \textit{Equation } 1.g$$

Where:

SK	=	dosing intensity, mm/pass of an arm;
q	=	influent flow/filter top surface area, $m^3/m^2/hr$;
r	=	recycle flow/filter top surface area, $m^3/m^2/hr$;
a	=	number of arms; and,
n	=	revolutions per minute

Table G.2 - Trickling Filter Dosing Intensity Ranges (SK)		
BOD_5 loading $kg/m^3/day$	Design SK mm/pass	Flushing SK mm/pass
0.25	10-100	≥200
0.50	15-150	≥200

1.00	30-200	$\geq$300
2.00	40-250	$\geq$400
3.00	60-300	$\geq$600
4.00	80-400	$\geq$800

(8) Distribution Equipment.

(A) The engineer shall design a rotary, horizontal, or traveling system that distributes wastewater uniformly over the entire surface of the filter at the design and flushing dosing intensities. The engineer shall design the filter distributors to operate properly at all anticipated flow rates.

(B) The engineer shall not deviate from a calculated uniformly distributed volume per unit surface area at the design dosing intensity by more than 10%.

(C) A new facility or upgrade of an existing trickling filter must include electrically driven, variable speed filter distributors to allow operation at optimum dosing intensity independent of recirculation pumping. If existing rectangular trickling filters are retrofitted with rotary distributors, any media which will not be fully wetted must be removed.

(D) The center column of rotary filter distributors must have adequately sized overflow ports to prevent water from reaching the bearings in the center column.

(E) Filter distributors must include cleanout gates on the ends of the arms and an end nozzle to spray water on the wall of the filter to wet the edge of the media.

(F) The filter walls must extend at least 12 inches above the top of the ends of the distributor arms.

(G) Seals. The use of mercury seals in the distributors of a trickling filter is prohibited in new facilities. If an existing treatment facility is to be modified, any mercury seals in the trickling filters must be replaced with oil or mechanical seals.

(H) Distributor Clearance. The minimum clearance between the top of the filter media and the distributing nozzles is six inches.

(I) Rate of Travel. Rotary distributors must operate at speeds as low as one revolution per 30 minutes or greater.

(J) Maintenance. Trickling filters with a height or diameter which do not allow distributors to be removed and replaced by a crane must provide jacking columns and pads at the distributor column.

(9) Recirculation.

(A) Low Flow Conditions.

(i) All designs must include minimum recirculation during periods of low flow.

(ii) A minimum recirculation is required in order to ensure that the biological growth on the filter media remains active at all times. The engineer shall not include the minimum recirculation in the evaluation of the efficiency of the filter, unless it is part of the proposed specified continuous recirculation rate

(iii) Minimum flow to the filters must not be less than 1.0 mgd per acre of filter aerial surface and must keep the distribution nozzles properly operating.

(iv) The minimum flow rate for designs using hydraulically driven distributors must keep rotary distributors turning at the minimum design rotational velocity.

(v) For facilities with a design capacity greater than or equal to 0.4 mgd and in which recirculation is included in design computations for BOD_5 removal, the recirculation system must include variable speed pumps and a method of conveniently measuring the recycle flow rate.

(B) Compensatory Recirculation. Designs must provide recirculation to supplement influent flow if design and flushing dosing intensities are not achieved solely by control of distributor operation. Controls for the distributor speed and recycle pumping rate must provide optimum dosing intensity under all anticipated influent flow conditions.

(C) Process Calculations. The report must:

(i) describe designs which propose recirculation for removal of remaining organic matter in the wastewater;

(ii) identify the effect of dilution of the influent on the rate of diffusion of dissolved organic substrates into the biofilm; and

(iii) identify the effect of reduced influent concentrations on reaction rates in sections of the filter having first order kinetics.

(D) Maximum Recirculation Rate. Recirculation rates may not exceed four times design flow, unless the report provides calculations to justify the higher rate.

(E) Configuration.

(i) Where influent organic loadings are constant, a system must use direct recirculation of unsettled trickling filter effluent. The engineer shall design the distributor nozzles to handle the recirculated sloughed biofilm.

(ii) Where influent organic loadings are variable, a system must recirculate effluent from the final clarifier to either the primary clarifier or to the trickling filter to equalize organic loading.

(10) Average Hydraulic Surface Loading.

(A) The report must include calculations of the maximum, design, and minimum aerial cross section surface loadings on the filters in terms of million gallons per acre of filter area per day for the initial year and design year.

(B) The average hydraulic surface loadings of filters with crushed rock, slag, or similar media must not exceed 40 mgd per acre based on design flow, except in roughing applications.

(C) The minimum surface loading is 1.0 mgd per acre.

(D) The loading rate for synthetic filter media must be within the ranges specified by the manufacturer.

(11) Underdrain System Design.

(A) A trickling filter must include an underdrain with semicircular inverts that cover the entire floor.

(B) An underdrain must be vitrified clay or precast reinforced concrete.

(C) An underdrain constructed of half tile is prohibited.

(D) An underdrain must be capable of draining at least 15% of the filter volume.

(E) A modular synthetic media design must be supported above the filter floor by beams and grating with support and clearances in accordance with the media manufacturer's recommendations.

(12) Underdrain Slopes.

(A) An underdrain and filter effluent channel floor must have a minimum slope of one percent.

(B) The effluent channel must produce a minimum velocity of two feet per second at design flow rate of application to the trickling filter.

(C) Floors of new trickling filters using stackable modular or synthetic media must slope toward the drainage channel at one to five percent based upon filter size and hydraulic loading.

(13) Passive Ventilation.

(A) The effluent channel and effluent pipe of the underdrain system or the synthetic media support structure must permit free passage of air.

(B) Any drains, channels, and effluent pipes must have a cross sectional area with not more than 50% of the cross area submerged at peak flow plus recirculation.

(C) The effluent channels must accommodate the specified flushing hydraulic dosing intensity and allow the possibility of increased hydraulic loading.

(D) The ventilation system may include extensions of underdrains through the filter side walls, ventilating openings through the side walls, and effluent discharge conduits designed as partially full flow pipes or open channels.

(E) Vent openings through the trickling filter walls must include hydraulic closure to allow flooding of the filter for nuisance organism control.

(F) A passive ventilation design must provide at least 2.5 square feet of ventilating area per 1000 lbs. of primary effluent BOD_5 per day.

(G) The underdrain system for rock media filters must provide at least one square foot of ventilating area for every 250 square feet of plan area.

(H) The minimum required ventilating area for synthetic media underdrains is the area recommended by the manufacturer.

(I) The ventilating area must be the greater of one square foot for every 175 square feet of synthetic media trickling filter plan area or 2.6 square feet for every 1000 cubic feet of media volume.

(14) Forced Ventilation.

(A) Forced ventilation is required for trickling filters designed for nitrification, for all trickling filter designs with media depths in excess of six feet, or for locations where seasonal or diurnal temperatures do not provide sufficient difference between the ambient air and wastewater temperatures to sustain passive ventilation.

(B) The engineer shall determine the minimum air flows needed for forced ventilation and optimized process performance, and shall include all calculations associated with this determination in the report.

(C) A downflow forced ventilation system must include provisions for removal of entrained droplets, or for return of air containing entrained moisture to the top of the trickling filter and must include reversible fans or other provisions to allow reversal of air flow when wide temperature differences between the ambient air and wastewater create strong natural updrafts.

(D) Ventilation fans and controls must enable flooding of the filter without sustaining damage.

(E) The engineer may use equation 2.g and the values in table G.3 to determine minimum air flow rates.

Figure 3: §217.181(12)

$$MAFR = [(R_A) * (L)(P_F)]/(1440 \min/day) \qquad Equation\ 2.g$$

Where:

MAFR = Minimum air flow rate, SCFM
R_A = Aeration rate, scf/lb Table G.3
L = Loading rate, lb/day, Table G.3
P_F = Loading peaking factor

Table G.3 - Aeration Rate and Loading Rate Factors		
Filter Application	R_A (scf/lb BOD_5)	L (lb BOD_5/1000cf/day)
Roughing Filter at 75-200 lb BOD_5/1000cf/day	1080	BOD_5 loading on the filter
Secondary Treatment Filter at 25-50 lb BOD_5/1000cf/day	1200	BOD_5 loading on the filter
Combined or Tertiary Filter	2400	1.25*BOD_5 loading on the filter + 4.6*TKN loading on the filter

(15) Maintenance.

(A) Cleaning and Sloughing.

(i) All flow distribution devices, underdrains, channels, and pipes must allow maintenance, flushing, and drainage.

(ii) A trickling system must be capable of hydraulically accommodating the specified flushing hydraulic dosing intensity, and the units must facilitate cleaning and rodding of the distributor arms.

(iii) The trickling filter system must prevent recirculation of sloughed biomass in pieces larger than the distributor nozzle size or the filter media voids.

(B) Nuisance Organism Control. A trickling filter system must control nuisance organisms by operation of trickling filters at proper design dosing intensities, with periodic flushing at higher dosing intensities.

(i) Filter Flies. The structural and hydraulic design of new trickling filters must enable flooding of the trickling filters for fly control. The executive director may approve alternate methods of fly control for filters exceeding six feet in height provided that the effectiveness of the alternate method is documented in the report and verified at a full-scale installation.

(ii) Snails. A trickling filter system must minimize areas where sludge may accumulate. The system must include a low velocity, open channel between the trickling filter and final clarifier, for manual removal of snails.

(iii) Corrosion Protection. The engineer must design all equipment and materials used in construction of trickling filters, including ventilation equipment and covers, to minimize corrosion and use corrosion-resistant materials.

(16) Flow Measurements. A trickling filter system must include a means to measure flows to the filter and recirculation flows.

(17) Odor Control. A trickling filter system must use ventilation to minimize odors at design flow with periodic flushing at higher dosing intensities.

(A) Covers.

(i) The executive director may require a facility having a history of odor complaints to install a covered trickling filter.

(ii) A cover must allow access to the entire top of the filter media and to the distributor for maintenance and removal.

(iii) A covered trickling filter must have a forced ventilation system with odor control using scrubbers or adsorption columns.

(B) Stripping. A trickling filter with high influent organic loadings must have forced ventilation in a downflow mode to minimize odors. Odorous off-gases may be:

(i) recycled through the trickling filter;

(ii) used to ventilate tertiary nitrifying trickling filters in an upflow mode;

(iii) diffused into aeration basins; or

(iv) treated separately for odor control using scrubbers or adsorption columns.

(18) Final Clarifiers. The size of the final clarifiers for a trickling filter must allow for the

required effluent total suspended solids (TSS) removal at the maximum influent flow and the maximum recirculation with all pumps in operation.

(19) Treatment Process Design Requirements.

(A) The report must specify the filter efficiency formula used in the design calculations.

(B) The report must include operating data from existing trickling filters of similar construction and operation to justify projected treatment efficiency, kinetic coefficients, and other design parameters.

(C) The report may include more than one set of applicable design equations to allow cross-checking of predicted treatment efficiency.

§217.182. Nitrifying Trickling Filters - Additional Requirements.

In addition to the requirements in §217.181 of this title (relating to Trickling Filters - General Requirements), a trickling filter that provides nitrification sufficient to meet the requirements of a discharge permit must meet the following requirements:

(1) Ventilation. A nitrifying trickling filter must include forced ventilation distributing air flow throughout the underdrain area. Minimum design air flow rates must provide the greater of:

(A) 50 lbs. O_2 provided per lb. O_2 required at average loading based on stoichiometry; or

(B) 30 lbs. O_2 provided per lb. O_2 required at peak loading based on stoichiometry.

(2) Temperature. The report must justify the temperature used in the design equations. The design may include deep towers or other means to minimize recirculation while providing the design hydraulic dosing intensity to lessen the effects of temperature on removal efficiency.

(3) pH. The report must verify that the design recirculation rates are appropriate for dealing with the effects on pH.

(4) Predation. A nitrifying trickling filter must include a means for effective control of biomass predators.

(5) Hydraulic Application Rates. A nitrifying trickling filter must operate at a design dosing intensity of at least 1.47 gpm/ft^2 and provide operational control of dosing intensity.

(6) Media. Crossflow synthetic media is required for new tertiary nitrification filters or for the nitrifying section of new combined nitrification filters.

(7) Tertiary Nitrification Filters. A trickling filter treating influent that has a BOD_5 to total kilgone nitrogen (TKN) ratio of $\leq$ 1.0 and soluble $BOD_5 \leq$ 12 mg/L is a tertiary nitrification filter.

(A) Design Justification. The report must include process design calculations and selection of kinetic coefficients for tertiary nitrifying filters and must be justified by operating data from existing trickling filters of similar construction and operation.

(B) Tower Depth. A tertiary nitryfying filter must use:

(i) a tower greater than or equal to 20 feet deep; or

(ii) towers less than 20 feet deep operating in series where the design includes provisions to readily switch the operating sequence of the filters.

(8) Combined BOD/Nitrification Filters. A trickling filter intended to perform nitrification and treating influent, having a BOD_5 to TKN ratio of $\geq$ 1.0, or soluble $BOD_5 \geq$ 12 mg/L, is a combined BOD/nitrification filter.

(A) Design Justification. The report must justify the projected treatment efficiency and other design parameters by including operating data from existing trickling filters of similar construction and operation.

(B) BOD Removal Requirements. A combined BOD/nitrification filter must achieve effluent total $BOD_5 \leq$ 15 mg/L. The engineer shall not take credit for nitrification in sections of the filter having soluble $BOD_5 \geq$ 20 mg/L.

(C) Recirculation Combined nitrification filter designs must enable high recirculation rates, with turndown capability.

§217.183. Dual Treatment Systems Using Trickling Filters.

(a) Classification. Trickling filters or other attached growth treatment units in series with suspended growth processes are dual treatment processes which are classified as on of the following:

(1) Activated Biological Filter (ABF). An ABF consists of a tricking filter and final clarifier. An ABF system recirculates settled solids from the final clarifier through the trickling filter with no separate aeration basin or solids contact basin.

(2) Trickling Filter/Solids Contact (TF/SC). A TF/SC system consists of a trickling filter sized to perform the majority of the soluble BOD removal for the system, followed by an aerated solids contact basin sized to provide polishing and improved sludge settleability, followed by a final clarifier. A TF/SC system recirculates activated sludge to the solids contact basin. The design may include a sludge re-aeration basin.

(3) Roughing Filter/Activated Sludge (RF/AS). A RF/AS system consists of a trickling filter

sized to perform roughing and concentration dampening, followed by an aeration basin sized to provide the majority of the soluble BOD removal for the system, followed by a final clarifier. A RF/AS system circulates activated sludge to the aeration basin.

(4) Activated Biological Filter/Activated Sludge (ABF/AS). An ABF/AS system consists of a trickling filter sized to perform roughing and concentration dampening, followed by an aeration basin sized to provide the majority of the soluble BOD removal for the system, followed by a final clarifier. An ABF/AS system recirculates activated sludge to the trickling filter.

(5) Trickling Filter/Activated Sludge (TF/AS). A TF/AS system consists of a trickling filter sized to perform roughing and concentration dampening, followed by an intermediate clarifier, followed by an aeration basin sized to provide the majority of the soluble BOD removal for the system, followed by a final clarifier. A TF/AS system circulates activated sludge to the aeration basin.

(b) Process Design.

(1) Attached and suspended growth subprocesses in dual systems must be designed in an integrated process which includes the effluent quality from the first stage in determining the design basis of the second stage process.

(2) The engineer shall estimate the performance of the second stage of dual systems using data from existing similar installations or applicable pilot studies.

(3) For treatment process designs in which activated sludge is recycled to first-stage trickling filters, the engineer shall not claim reduction of oxygen demand to the second-stage aeration basin as a result of sludge recirculation to the trickling filters.

(4) The engineer may estimate the applicable design equations and methodology used for design of single stage processes.

(c) Treatment Unit Design. The detailed design of suspended and attached growth systems must include all of the features and operational capabilities required for the same treatment units if used for single-process treatment, as well as the following items:

(1) Pretreatment. Pretreatment of a dual system must conform to requirements for the first-stage process.

(2) Snail Control. A dual system must include a low-velocity channel between the first stage and second stage treatment units for control of snails.

(3) Return sludge. A dual system that includes recirculation of activated sludge or sloughing to trickling filters must prevent recirculation of pieces larger than will pass through the distributor nozzles or the filter media voids. The trickling filters in a dual system where sludge is recirculated to the trickling filters must be high-rate, vertical flow, fully corrugated media. Sludge must be pre-incorporated into influent prior to application to trickling filters, and must be pre-incorporated into the effluent from first-stage processes

prior to being introduced into second-stage aeration basins.

(4) Aeration. The aeration system for second-stage treatment units in a dual system not designed for nitrification must transfer at least 1.2 lbs. of O_2 per lb. of first stage effluent BOD_5 per day. The aeration system for second-stage treatment units in systems designed for nitrification must transfer sufficient oxygen to meet stoichiometric requirements for:

(A) biomass growth;

(B) respiration for both carbonaceous material oxidation and nitrification; and

(C) oxygen demand due to biomass sloughing events from the first stage.

(5) Sludge Age.

(A) The design of second-stage suspended growth processes must operate in a way that varies the age of the sludge.

(B) The mean cell residence time must be:

(i) at least 1.5 days for the suspended growth process for TF/SC systems; or

(ii) of up to at least 3 days if the second process is an activated sludge aeration basin.

(C) A nitrifying dual system must control a total combined mean cell residence time in the attached and suspended growth systems of up to at least 10 days with capability to provide at least 6 days mean cell residence time in the suspended growth process alone.

(6) Hydraulic Residence Time. The design of second-stage processes must have a

(A) minimum hydraulic residence time of 0.5 hours if the second process is an aerated solids contact basin, or

(B) a minimum hydraulic residence time of 3 hours if the second process is an activated sludge aeration basin.

(7) Nitrification Design. The design for nitrification using dual treatment processes must include:

(A) a sludge reaeration basin if the second process is an aerated solids contact basin; and

(B) an intermediate clarifier if the second process is an activated sludge aeration basin.

§217.184. Rotating Biological Contactors (RBC) - General Requirements.

(a) Pretreatment. A RBC unit must be preceded by pretreatment to remove any grit, debris, and excess oil and grease. A RBC unit must include preaeration if wastes have high hydrogen sulfide concentrations.

(b) Enclosures and Ventilation.

(1) A RBC unit must be covered, but provide appropriate levels of ventilation.

(2) The cover must have working clearance of at least 30 inches above the RBC unit, unless the cover can be removed with on-site equipment.

(3) Enclosures must be constructed of a corrosion resistant material.

(4) The unit must include:

(A) access doors on each end, and

(B) observation ports with covers at 3 foot intervals along the unit.

(c) Media Design.

(1) A RBC unit must provide self-cleaning action for the media. RBC media must be selected which is compatible with the wastewater.

(2) A RBC design using multiple stages in accordance with this subchapter, must use low density media for the first stage.

(d) Design Flexibility. The report must include descriptions of the following when used in a RBC system:

(1) controlled flow to multiple first stages;

(2) alternate flow and staging arrangements;

(3) removable baffles between stages; and

(4) provision for step feed and supplemental aeration.

(e) Tank Configuration. The engineer must design an RBC tank to minimize zones in which solids will settle out and justify the design in the report. A RBC tank must include tank drains to facilitate removal of any accumulated solids.

(f) Control of Unwanted Growth in the Initial Stages. The engineer may use chlorine ahead of the

RBC system to control the growth beggiatoa.

(g) Downtime Maintenance Provisions. A RBC system designed for 1 mgd or greater must have three or more stages in series. A stage must be capable of being taken off-line when maintenance or cleaning is required and must include tank drains.

(h) Bearing Maintenance. A RBC system's bearings must be easily accessible for inspection and lubrication.

(i) Organic Loading Design Requirements. The engineer shall base the organic loading for a RBC system on total BOD_5 in the waste. The maximum loading rate must not exceed 8 pounds of BOD_5 per day per 1,000 square feet of media in any stage. The engineer shall adjust the required RBC media area to compensate for the effects of the ratio of soluble BOD_5 to total BOD_5. Allowable organic loading for the entire RBC system must not exceed:

(1) 3.0 square feet (sf) of media area for facilities required to meet secondary treatment; or

(2) 2.0 pounds of BOD_5/day/1000 sf for facilities required to meet advanced secondary treatment.

(j) Hydraulic Loading Design Requirements. A RBC system must include flow equalization when the peak-to-design flow ratio is higher than 2.5 to prevent loss of fixed growth from the media. The first stage of the RBC system must include a means of spreading the influent flow evenly across the media.

(k) Stages. A RBC system designed for BOD_5 removal units must have at least 3 stages in series, unless the report justifies a lessor number using either full-scale operating facilities or pilot unit operational data with an appropriate scale-up factor.

(l) Drive Systems. The RBC drive system must handle the maximum anticipated media load and may be a variable speed system. The RBC units may be mechanically driven or air driven.

(1) Mechanical Drive.

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

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

(2) Air Drive.

(A) Each RBC unit must have air diffusers mounted below the media and off-center from the vertical axis of the RBC unit and must have air cups mounted on the outside of the media to collect the air.

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

(C) The air diffuser line to each unit must be mounted such that the air diffuser line may be removed without draining the tank or without moving the RBC media and include an air control valve to each RBC unit.

(m) Dissolved Oxygen. The RBC system must maintain a minimum dissolved oxygen concentration of one milligram per liter in all stages during the maximum organic loading rate. The executive director may require supplemental aeration.

§217.185. Nitrifying RBCs - Additional Requirements.

(a) A RBC system designed for BOD_5 removal and nitrification of domestic wastewater in a single system must include four stages and have a maximum overall organic loading rate of 1.6 pounds of BOD_5/day/1,000 square feet of media.

(b) A nitrifying RBC system must include capabilities for chemical addition if the influent pH is below 7.0.

(c) The report must justify the nitrification rate of the system.

(d) A nitrifying RBC system may be subject to the requirements of §217.10(2) of this title (relating to Types of Approvals).

§217.186. Dual Treatment Systems Utilizing RBCs.

(a) A RBC units may be used in conjunction with other systems.

(b) A RBC system may be used as a "roughing" unit in series with activated sludge as described in §217.183 of this title (relating to Dual Treatment Systems Utilizing Trickling Filters).

(c) Regardless of the type of dual system employing RBC units, the engineer shall submit supporting data, calculations, process descriptions, and vendor information in the report to describe how the proposed system will meet the required treatment levels.

(d) These combined systems may be subject to the requirements of §217.10(2) of this title (relating to Types of Approvals).

§217.187. Submerged Biological Contactors (SBC) - General Requirements.

(a) An SBC system must be air driven and does not require a cover.

(b) A SBC systems requires the same pretreatment as a RBC systems and must meet the criteria §217.184 of this chapter (relating to Rotating Biological Contactors (RBC) - General Requirements), except as described in paragraphs (1) and (2) of this subsection.

(1) Number of Headers. Each SBC unit must include two air headers; one for rotation of the unit and one to provide dissolved oxygen for the biological activity.

(2) Bearing Requirements. The submerged bearings must be sealed to prevent intrusion of the wastewater. If lubrication is required, the SBC unit must have lubrication access above the water level.

§217.188. Dual Treatment Systems Using SBCs.

(a) A SBC unit may be used in conjunction with other systems.

(b) A SBC system may be used as a "roughing" unit in series with activated sludge as described in §217.183 of this title (relating to Dual Treatment Systems Utilizing Trickling Filters).

(c) SBC units may be installed in existing activated sludge basins to create a combination fixed and suspended growth process.

(d) Regardless of the proposed dual system employing SBC units, the engineer shall submit supporting data, calculations, process descriptions, and vendor information in the report to describe how the proposed system will provide the required treatment levels.

(e) These designs may be subject to the requirements of §217.10(2) of this title (relating to Types of Approvals).

§217.189. Filtration - General Requirements.

(a) Reasons for Use.

(1) Permit Requirements. A wastewater treatment facility with tertiary effluent limitations must use filtration as a unit operation to supplement suspended solids removal.

(2) Specific Water Quality Requirements. A wastewater treatment facility with secondary or advanced secondary effluent limitations may use filtration as a unit operation to supplement suspended biological floc and may use intermittent filter operation is acceptable where filters are not necessary to meet permitted effluent limitations.

(b) Redundancy. A wastewater treatment facility using filtration to provide tertiary treatment for a permit requirement must have a minimum of two filter units, and the engineer shall calculate the required filter surface area assuming the largest filter unit out of service. If filters are being provided voluntarily to polish wastewater for situations where permit compliance does not in any way depend on the use of the filter, such as some cases of reclaimed water usage, one filter is sufficient.

(c) Source of Backwash Water. A filtration system must use filtered effluent as the source of backwash water.

(d) Disposition of Backwash Water. A filtration system must return backwash water containing material cleaned from the filter to the head of the treatment plant for processing.

(e) Place in Sequence of Treatment Units. Filter units must be preceded by final clarifiers designed in accordance with Subchapter F of this Chapter. A filter system may be used in conjunction with disinfection tanks to provide additional detention time, provided the filters are backwashed to the headworks of the wastewater treatment facility.

(f) Overload Conditions.The engineer shall design a method to prevent the effluent from overflowing from the wastewater treatment system.

(g) Control of Slime Growth. A filtration system must provide periodic disinfectant in the influent stream to the filters to control slime growth in the filter and backwash storage tank.

§217.190. Additional Specific Design Requirements for Deep Bed, Intermittently Backwashed, Granular Media Filters.

This subsection contains design criteria for deep bed, intermittently backwashed, granular media filters that are in addition to the requirements in §217.189 of this title (relating to Filtration - General Requirements).

(1) Application Rates. The peak application rate to any filtration unit must not exceed twice the design application rate with one unit out of service.

(A) Single Media. The design filtration rate for single media (sand) filters must not exceed 3 gallons per minute per square foot of media surface. The maximum filtration run time between backwash periods is 6 hours.

(B) Dual Media. The design filtration rate for dual media (anthracite and sand) filters must not exceed 4 gallons per minute per square foot of media surface.

(C) Mixed Media. The design filtration rate for mixed media (non-stratified anthracite, sand, garnet, or other materials) must not exceed 5 gallons per minute per square foot of media surface.

(2) Media Design.

(A) A filter underdrain system must be caused by a graded gravel layer with a minimum depth of 15 inches, or other filter media support material unless the engineer justifies a filter media other than gravel in the report.

(B) Uniformity coefficients must be 1.7 or less.

(C) The particle size distribution for dual and mixed media filters must cause 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.

(D) Media depths for the various filter types must conform to the values in table G.4, unless the engineer justifies other media depths with an analysis of the backwash rates.

Figure 1: §217.190(2)

Table G.4 - Minimum Filter Depths For Deep Bed, Intermittently Backwashed Filters			
Filter Type	Type of Media	Effective Particle Size (mm)	Minimum Depth (inches)
Single Media	Sand	1.0-4.0	24
Dual Media	Anthracite & Sand	1.0-4.0	16
Dual Media	Anthracite	1.0-2.0	10
Dual Media	Sand	0.5-1.0	6
Mixed Media	Anthracite, Sand & Other	1.0-4.0	16
Mixed Media	Anthracite	1.0-2.0	10
Mixed Media	Sand	0.6-0.8	4
Mixed Media	Garnet or Similar Material	0.3-0.6	2

(3) Backwash Systems

(A) Flowrate and Media Expansion.

(i) The backwash system must provide for a minimum media expansion of 20%.

(ii) A single media filter must provide a minimum backwash flowrate of 6 to 8 gallons per minute per square foot of media area.

(iii) A dual and mixed media must provide a minimum backwash rate of 15 to 20 gallons per minute per square foot of media area.

(iv) Backwash times between 10 to 15 minutes must be provided, unless the engineer justifies a different time in the report.

(B) Surge Control.

(i) A wastewater treatment facility that does have flow equalization or other means of surge control must have a backwash tank.

(ii) The surge control must prevent increases in flow greater than 15% of the design flow of the upstream treatment units.

(iii) The engineer shall provide calculations demonstrating that the design has appropriately accounted for the effects of backwash water and that the treatment capabilities will not diminish with the return of backwash water to the plant's headworks.

(iv) Enclosed backwash tanks must be vented to maintain atmospheric pressure.

(C) Pumps.

(i) Pumps for backwashing filter units must deliver the required rate with the largest pump out of service. A backup pump must be available on-site.

(ii) The valve arrangement for isolating a filter unit for backwashing must be accessible for maintenance.

(iii) A backwash system employing automatic control must include a provision for manual override.

(D) Supplemental Systems.

(i) A single media filter system must include an air scour system or combination air and water scour system in addition to the upflow backwash water system.

(ii) A dual and mixed media filter system must include either a surface air or water scour system.

(iii) Air scour system flowrates must be 3 to 5 standard cubic feet per minute per square foot of media surface area.

(iv) Water scour system flowrates must be 0.5 to 2 gallons per minute per square foot of media area.

(4) Underdrain System. The underdrain system must provide a uniform distribution for filter backwash without excessive head loss and plugging.

(5) Tank Design. The bottom of the wash water collection troughs must be a minimum of 6 inches above the maximum elevation of the expanded media during backwash. The washwater troughs must

have a minimum freeboard of 3 inches during maximum backwash flowrates.

(6) Controls. The filter operation controls may be manual or automatic. Control indicators must be visible to the operator while adjusting the controls. An automatically controlled system must include a manual override system. Each filter unit must have a head loss indicator.

§217.191. Additional Specific Design Requirements for Multi-Compartmented, Low Head, Automatically Backwashed Filters.

This subsection contains design criteria for multi-compartmented, low head, automatic backwash filters that are in addition to the requirements detailed in §217.189 of this title (relating to Filtration - General Requirements).

(1) Application Rates. The peak application rate to any unit must not exceed twice the design application rate with one unit out of service. The report may include manufacturer's recommended filtration rates with test data.

(A) Single Media. A single media filter must have a maximum design filtration rate of 3 gallons per minute per square foot of media surface.

(B) Dual Media. A dual media filter must have a maximum design filtration rate of 4 gallons per minute per square foot of media surface.

(2) Media Design. Media sizes and depths must correspond to the values in table G.5 unless the report justifies different media sizes and/or depths . **Figure 1: §217.191(2)**

Table G.5 - Filter Depths for Multi-Compartmented, Low Head, Automatic Backwash Filters			
Filter Type	Type of Media	Effective Particle Size (mm)	Minimum Depth (inches)
Single Media	Sand	0.55-0.65	11
Dual Media	Anthracite & Sand	0.55-0.65	16
Dual Media	Anthracite	1.0-2.0	10
Dual Media	Sand	0.5-1.0	6

(3) Backwash System.

(A) The backwash system must provide a minimum of 20 gallons per minute per square foot of media being backwashed at a given time. The backwash duration must last at least 20 seconds for each compartment and must expand the media a minimum of 20% unless the report includes the manufacturer's recommended backwash rates with test data.

(B) The surge control and pumping system requirements must be the same as those detailed in §217.190(3)(B) of this title (relating to Additional Specific Design Requirements for Deep Bed, Intermittently Backwashed, Granular Media Filters)

(4) Traveling Bridge. The traveling bridge mechanism must:

(A) provide support and access to the backwash pumps and equipment;

(B) be constructed of corrosion resistant materials;

(C) have provisions for consistent tracking of the bridge and safe support of the power cords; and

(D) initiate the backwash cycle automatically when a preset head loss through the filter media occurs.

(5) Surface Floatables Control. A filter system must provide for automatic and regular removal of any floating material from the surface of the filter. The floating material must be returned to the head of the plant for further processing.

§217.192. Alternative Designs for Effluent Polishing.

The executive director will review other processes for tertiary suspended solids removal, other than filters, as nonconforming technologies subject to the requirements of §217.10(2) of this title (relating to Types of Approvals).

SUBCHAPTER H : NATURAL TREATMENT SYSTEMS
§§217.200-217.210

STATUTORY AUTHORITY

The rules in Subchapter H, Natural Systems, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.200. Applicability.

This subchapter establishes the minimum design requirements for Imhoff tanks, constructed wetlands, facultative ponds, aerated and partially-aerated ponds, stabilization ponds, treated effluent storage ponds, evaporative pond systems, and overland flow processes

§217.201. Primary and Secondary Treatment Units.

(a) Primary treatment units include aerated and partially-aerated ponds, facultative ponds, evaporative ponds, and Imhoff tanks.

(b) Secondary treatment units include stabilization ponds, constructed wetlands, evaporative ponds, and overland flow processes. Evaporative ponds are used as both primary treatment units and secondary treatment units. The secondary treatment units may be used for polishing and tertiary treatment.

(c) Treated effluent storage ponds are any ponds downstream of the permit sampling location and do not provide any treatment or disinfection for the purposes of this chapter.

(d) All secondary treatment units must be preceded by a primary unit.

§217.202. General Design Considerations for Natural Systems.

(a) Flow Distribution. This subsection applies to constructed wetlands, facultative ponds, aerated and partially-aerated ponds, stabilization ponds, and overland flow processes. The engineer shall design the shape and size of these treatment facilities to ensure even distribution of the wastewater flow. The distribution system for overland flow processes must ensure uniform sheet flow distribution of the wastewater onto and across the overland flow terraces.

(b) Windbreaks and Screening. All natural system treatment units must include windbreaks when spray irrigation is used in a location where drift presents a risk of contact with the general public. The engineer may use vegetative screening. The engineer may determine the use, the type, and the extent of windbreaks or vegetative screening subject to approval by the executive director.

(c) Maximum Liner Permeability.

(1) Except as exempted in paragraphs (1) and (2) of this section, all constructed wetlands, facultative ponds, earthen aerated and partially-aerated ponds, stabilization ponds, and treated effluent storage ponds must be constructed with a liner material with a minimum coefficient of permeability of $1x10^{-7}$cm/sec with a thickness of 2 feet at depths less than 8 feet and 3 feet at depths greater than 8 feet.

(2) The liner must extend from the lowest pond elevation or lowest constructed wetland elevation up to an elevation of 2 feet above normal water elevation in the pond or constructed wetland.

(3) The executive director may grant a variance to the liner requirements, in accordance with §217.5.

(4) The pond liner requirements must comply with 30 TAC Chapter 210 of this title (relating to the Uses of Reclaimed Water) if a pond is constructed to store treated wastewater to be used as reclaimed water.

(5) This section does not apply to evaporative pond systems or overland flow systems. Liner and permeability requirements for these systems are established in §§217.207 and 217.209 of this title (relating to Evaporative Ponds and Overland Flow Process).

(d) Compliance with the Liner Permeability Requirements. Subparagraphs (A)-(D) of this paragraph provide the minimum criteria for satisfying that the liner's permeability will not exceed that allowed in paragraph (3) of this section. The report must include the results of any tests required in this subsection.

(1) Using Unmodified In-Situ Soils. In some cases ,the soils which naturally exist at a proposed pond or constructed wetland site may restrict the movement of the wastewater to a degree equivalent to a liner placed as described in paragraph (2) of this section. The engineer or licensed professional geoscientist shall use the requirements in (i) - (v) of this paragraph to certify the permeability of the in-situ soil layer. to ensure that groundwater quality and surface water quality are protected.

(A) The engineer shall take a minimum of one core sample per 0.25 acres of pond bottom area, or constructed wetland bottom area for each pond or constructed wetland.

(B) The engineer shall test each core sample to determine the coefficient of permeability, the percent passing a 200 mesh sieve, the liquid limit value, and the plasticity index value for the soil which is to serve as the liner.

(C) The test results must show a coefficient of permeability of less than or equal to $1x10^{-7}$ cm/sec in compliance with subparagraph (B)(i)-(iii) of this paragraph.

(D) A liner must be constructed in accordance with one of subparagraphs (2), (3), or

(4) of this section if the test results do not show a coefficient of permeability of $1x10^{-7}$ cm/sec, or if any of the soil characteristics in subparagraph (B)(i)-(iii) of this section do not exist in the in-situ soil.

(E) The in-situ soil may be used as the pond liner or constructed wetland liner if the in-situ soil meets all the requirement in §217.202(d)(3)(A) of this section provided that one layer of excavated in-situ material, with the minimum soil characteristic requirements is placed in one 8-inch loose lift compacted to no less than 6 inches at 95% standard proctor density in accordance with ASTM D 698. This placed layer must be keyed into the in-situ soil.

(2) Placed Liners. The soil characteristics of the liner material for a placed liner must comply with clauses (i)-(v) of this subparagraph. The tests to determine the soil characteristics must conform to standard methods such as ASTM.

(A) The liner material must have more than 30% passing a 200 mesh sieve;

(B) The liner material must have a liquid limit greater than 30%;

(C) The liner material must have a plastic index of greater than 15;

(D) The liner material must be placed in four-eight inch maximum loose lifts which must be compacted to 95% standard proctor density in accordance with ASTM D 698. The lifts must be no less than 6 inches thick after compaction for a total liner width of at least 24-inches (2 feet); and,

(E) The lowest level lift must be keyed into the existing soil.

(3) Using Amended In-Situ Soils.

(A) A liner may be constructed from amended soils, or blended with imported soils or soils excavated from the proposed pond site.

(B) An amended soil must sufficiently decrease the coefficient of permeability to $1x10^{-8}$ cm/sec.

(C) The engineer shall take three representative samples from each 6,700 cubic feet of amended soil, running one field permeability test and running one laboratory permeability test for each of the three representative samples.

(D) The tests must verify that the coefficient of permeability is equal to or less than $1x10^{-8}$ cm/sec.

(E) When soil permeabilities are decreased by adding amended soil, the liner thickness throughout the pond may be decreased to 6-inches provided that the liner is placed in one 8-inch loose lift compacted to no less than 6-inches at 95% standard proctor density in accordance with ASTM D 698. This placed layer must be keyed into the in-situ soil.

(F) The amended soil may have a coefficient of permeability of $1x10^{-7}$cm/sec if the modified material is placed in accordance with subparagraph (B)(iv) and (v) of this paragraph.

(4) Using synthetic membrane liners. A synthetic membrane liner must have a minimum thickness of 40 mils. A pond with a membrane liner must include an underdrain with a leachate detection and collection system. The liner material must be capable of receiving constant sunlight without degrading. The use of synthetic membrane liners for constructed wetlands is prohibited.

(e) Embankment Design and Construction. This section applies to constructed wetlands, facultative ponds, aerated and partially-aerated ponds, stabilization ponds, treated effluent storage ponds, and evaporative ponds. The top width of embankments must be a minimum of 10 feet. The report must justify all inner and outer embankment slope steeper than 1 foot vertical to 4 feet horizontal from the top down to the normal operating level. Inner and outer embankment slopes steeper than 1 foot vertical to 3 feet horizontal are prohibited. All embankments must be protected against erosion by planting grass, paving, riprapping, or other approved methods. All embankments must provide a minimum cover of 6-inches of topsoil if vegetated.

(f) Disinfection. Chemical or ultraviolet disinfection is not required if a detention time of at least 21 days is provided in the entire, free-water surface, natural treatment unit.

(g) Sampling Point Significance.

(1) The engineer shall not take credit for detention times and surface areas of any natural treatment units downstream of the sampling point used to monitor for permit compliance, for purposes of sizing treatment units upstream of the permit monitoring sampling point.

(2) All wastewater ponds downstream of a sampling location are considered to be treated effluent storage ponds for the purposes of this rule. Treated effluent storage ponds may be used for municipal permit storage requirements or for reclaimed water projects and must comply with other requirements of Chapter 210 of this title (relating to Use of Reclaimed Water).

(h) Storm Water Drainage. A natural treatment system must prevent storm water drainage into the system.

§217.203. Imhoff Tanks.

This section provides the design criteria for constructing an Imhoff tank.

(1) Settling Compartment.

(A) The minimum length-to-width ratio of the settling compartment is 2:1.

(B) The tank inlet must provide uniform flow distribution across the width of the settling compartment.

(C) The septum walls must slope to the center of the compartment at an angle between 50 to 60 degrees from horizontal. The septum walls must create an overlap with a continuous slot at least 8 inches wide provided between the walls to allow solids to be dispersed into the digestion compartment.

(D) The maximum depth between the normal water level and the plane of the slot is 9 feet.

(E) The minimum freeboard above the normal water level is 18 inches.

(F) One of the septum walls must continue past the slot to create a minimum slot overhang of 8 inches.

(2) Surface Loading. The settling compartment overflow loading rate must not exceed 800 gallons per day per square foot of settling compartment area under design flow conditions. The longitudinal velocity of wastewater through the settling compartment must not exceed 1 foot per second under 2-hour peak flow conditions.

(3) Scum Baffles. The inlet and outlet of the tank must include scum baffles. The engineer shall design baffle height to meet the water levels at minimum and peak flows.

(4) Gas Vents. An Imhoff tank must include gas vents compartment with a total area not less than 20% of the total tank surface area. The width of the vent openings must allow maintenance access into the digestion compartment.

(5) Digestion Compartment - Loading. The digestion compartment minimum volume must be 3.5 cubic feet per capita or 20.5 cubic feet per pound of influent BOD_5 per day, whichever is greater.

(6) Imhoff Tank Dimensions. The total depth of the Imhoff tank must not be less than 15 feet as measured from the water surface elevation to the bottom of the digestion compartment. The engineer shall not include the first 18 inches of tank depth below the plane of the slot for design digestion volume.

(7) Sludge Removal. An Imhoff tank must have the capability to withdraw sludge from the digestion compartment through a sludge withdrawal pipe. The sludge withdrawal pipe must have a minimum diameter of 8 inches and include cleanouts or other provisions for regular cleaning. The digestion compartment must allow for portable pumps to remove accumulated sludge.

(8) Odor Management. The engineer shall design the Imhoff tank to minimize the effects of odors from the gas vents on the neighboring properties. The executive director may require bio-filters, carbon filters, or other odor control devices to minimize odors.

(9) Treatment Efficiency. An Imhoff tank must be followed by subsequent treatment units. The engineer may assume that the Imhoff tanks provide a 35% removal of influent BOD_5 and 60% removal of influent TSS may be assumed for typical municipal raw wastewater for the design of subsequent units.

(10) Material and Construction. An Imhoff tank must be constructed of reinforced concrete with a sealant. All components of an Imhoff Tank must be resistant to the corrosive effects of the wastewater environment.

§217.204. Facultative Ponds.

(a) Configuration/Inlets/Outlets.

(1) The length-to-width ratio of a facultative pond must be 3:1, unless the report justifies other dimensions more suitable to the site.

(2) The flow in a facultative pond must be from the inlets along one end of the pond to the outlets at the opposite end.

(3) The length of the facultative pond must be oriented in the direction of the prevailing winds with the inlet side located such that debris will be blown toward the inlet.

(4) A facultative pond must have inlet baffles to collect floatable material when no pre-screening is provided.

(5) The outlets must allow the water level of the facultative pond to be varied under normal operating conditions.

(b) Depth. The deeper portion of the facultative pond near the inlets must have a minimum depth of 12 feet to provide sludge storage and anaerobic treatment, with the deeper portion at least 25 percent of the area of the pond bottom. The remainder of the facultative pond must have a minimum depth of not less than 8 feet.

(c) Organic loading. The organic loading must not exceed 150 pounds of BOD_5 per acre per day based on the surface area of the facultative pond.

(d) Odor Control. The facultative pond inlets must be submerged at least 24 inches below the water surface to minimize odor. The outlets must be submerged at least 12 inches below water surface, and not disturb the anaerobic zone. A facultative pond must allow for recirculation at 50% to 100% of the design flow. A facultative pond must preclude siphoning of pond contents through submerged inlets.

(e) Removal efficiency. The executive director will give credit for up to 50% removal of the influent BOD_5 in a facultative pond.

§217.205. Aerated Ponds.

A complete mix aerated pond has adequate mixing to maintain all biological solids in suspension and provide uniform oxygen concentrations in the pond. A partially mixed aerated pond allows for settling and anaerobic composition of a portion of the influent suspended solids as well as the biological solids generated in the system. The requirements of this section apply to both completely mixed ponds and partially mixed ponds, unless otherwise specified.

(1) Wastewater Oxygen Requirements. The size of the mechanical or diffused aeration equipment for an aerated pond systems must allow for a minimum of 1.6 pounds of oxygen per pound of influent BOD_5.

(2) Redundancy.

(A) An aerated pond system must maintain a minimum of 1.6 pounds of oxygen per pound of influent BOD_5 with the largest single aeration unit in the overall pond system out of service.

(B) The pond system's pipes and valves must allow the flow to be proportionally rerouted.

(C) The aeration equipment must have alarms which will provide sufficient notification to ensure maintenance can be provided which prevents permit violations. If the facility is not staffed 24-hours per day, the alarm system must be tied into a telemetering system.

(3) Removal Efficiency. The engineer shall use Equation 1.h for calculating the BOD_5 removal in each pond. The value of K for a domestic wastewater and a complete mix pond is 0.50 day^{-1} at 20˚C. The value of K for a partial mix pond is 0.28 day^{-1} at 20˚C. The engineer may adjust the value of K for the minimum monthly water temperature using Equation 2.h. The engineer shall determine the value of K for high-strength or industrial wastewater by either laboratory studies or evaluation of existing facilities treating a similar wastewater. **Figure 1: §217.205(3)**

$$E = 1[1 + K(V/Q)] \qquad \textit{Equation } 1.h$$

where:	E	=	efficiency of a complete mix reactor, in this case an aerated lagoon, without recycle (% BOD_5 removal in aerated lagoon).
	K	=	first order removal rate constant, day$^{-1.}$
	V	=	aeration basin volume, million gallons.
	Q	=	influent wastewater flow rate, million gallons per day.

$$K_T = [K_{20} * 1.06 * (T - 20°C)]/1.06 \qquad \textit{Equation } 2.h$$

where:	K_T	=	K value which corresponds to the lowest average water temperature expected during any 30-day period.
	K_{20}	=	K value at 20°C
	T	=	The average water temperature expected during any 30-day period.

(4) Aeration Equipment. The size of the aeration equipment in an aerated pond must supply the oxygen demand determined in paragraph (1) of this section. For purposes of sizing aeration equipment,

the engineer may assume that the aerated pond is the same as an aeration basin and shall comply with the mechanical and diffused air requirements in §217.156 of this title, (relating to Aeration Equipment Sizing). Where multiple partially mixed aerated ponds are used in series, the power input may be reduced as the influent BOD_5 to each pond decreases.

(5) Aerated Pond Construction and Design Requirements. The engineer shall design and construct an aerated pond system in accordance with all the same requirements for wastewater treatment ponds detailed in §§217.202(e), 217.206(2), (4), and (6) of this title (relating to General Design Consideration for Natural Systems and Wastewater Stabilization Ponds).

(6) Scour Prevention. An earthen-lined aerated pond system must include concrete scour pads in all areas of the earthen liner subject to velocities of 1 foot per second or greater.

§217.206. Wastewater Stabilization Ponds.

This subsection applies to stabilization ponds which are designed as secondary treatment units to treat suspended and dissolved organic matter in wastewater. Primary treatment must remove the settleable and floatable solids in the influent wastewater prior to discharge into the stabilization ponds.

(1) Odor Management.

(A) A wastewater stabilization ponds must be located so that the local prevailing winds will be toward less populated areas.

(B) Where uncontaminated water is available, the ponds must be pre-filled to the two foot level at start-up.

(C) The pond system must include a pipe arrangement which allows the recirculation of effluent from the final pond to the influent side of the initial stabilization pond. A stabilization pond may return recirculation water by surface spray to assist in maintaining aerobic conditions at the pond surface and reduce potential odors.

(2) Minimum Number of Wastewater Stabilization Ponds. The minimum number of stabilization ponds is two to comply with secondary treatment limits. The stabilization ponds must be operated in series with each other following the primary treatment unit.

(3) Pond Dimensions and Water Level Considerations.

(A) The minimum length-to-width ratio of a stabilization pond is 3:1.

(B) Islands, peninsulas, or coves within the pond boundaries are prohibited.

(C) The stabilization ponds must have a normal water depth between 3 and 5 feet.

(D) Inlet and outlet structures must allow for raising and lowering water levels a minimum of 6 inches to assist in controlling weeds and other vegetative growth.

(E) A stabilization pond must have a 2 foot minimum freeboard above the normal pond operating level if the pond's normal water surface area is less than 20 acres. A stabilization pond must have a 3 foot minimum freeboard above the normal pond operating level if the pond's normal water surface area is 20 acres or more.

(4) Hydraulic and Pipe Considerations.

(A) All structures and pipes in stabilization ponds must be sized to transport at least 250% of the facility's design flow.

(B) The inlet and outlet structures must be sized to transport the volume of water found in the top 6 inches of the pond during normal operating depths, per day, at the available head.

(C) The pipe and recirculation system must allow any one pond to be taken out of service while maintaining a level of water quality which complies with the facility's permit requirements.

(5) Maximum Surface Organic Loading Rate on Stabilization Ponds.

(A) The maximum surface organic loading rate on the stabilization ponds is 35 pounds of BOD_5 per acre of total secondary treatment stabilization pond surface area per day.

(B) The maximum surface organic loading rate on the first treatment stabilization pond in the stabilization pond series is 75 pounds of BOD_5 per acre per day.

(C) The surface organic loading rate applied to the stabilization ponds is equal to the total influent organic loading minus any reduction in organic load provided by the primary treatment units.

(6) Inlet/Outlet Structures.

(A) All stabilization pond outlets must include removable baffles to prevent floating material from being discharged, and must be constructed so that the level of the pond surface may vary under normal operating conditions.

(B) Outlets must be submerged to a depth between 18 and 24 inches to control the discharge of algae.

(C) The engineer may use multipurpose control structures to facilitate normal operational functions such as drawdown and flow distribution flow depth, measurement, sampling, pumps for recirculation, chemical additions, and to minimize the number of construction sites within embankments.

(D) All pipe embankment penetrations must have seep water-stop collars.

(E) A stabilization pond must have drain pipes to allow emptying for maintenance and may use pumps as part of the drainage system. If not permanently installed, a temporary pipe suction station must be provided.

§217.207. Evaporative Ponds.

(a) General.

(1) The evaporative pond process must have a minimum of two ponds.

(2) The primary evaporative pond must provide at least 60% of the total surface area.

(3) The engineer shall determine the number and size of evaporative ponds for high and low periods of evaporation.

(b) Odor Management. Evaporative ponds must be located so that the local prevailing winds will be toward less populated areas.

(c) Liners.

(1) Evaporative ponds must be constructed with synthetic membrane liners with a minimum thickness of 40 mil.

(2) The liners must have an underdrain leak detection system consisting of at least a leachate collection and a detection system.

(3) The liner construction specifications may require proper compaction of soils beneath the liner.

(4) The liner material must be capable of receiving constant sunlight without degrading.

(d) Configuration/Depth/Loading.

(1) An evaporative pond may be constructed in round, square or rectangular style shapes. The corners of a square and rectangular shaped evaporative pond must be rounded in order to minimize accumulation of floating materials.

(2) The depth of an evaporative pond is dependant on its location within the pond system process. The maximum operating depth for a primary pond is 5 feet, except that the area around the inlet must be designed for solids deposition according to the same criteria as a facultative pond. The maximum operating depth for a secondary pond is 8 feet.

(3) Evaporation and Organic Loading.

(A) The engineer shall size the evaporation ponds based on the evaporation rate for a given site and a maximum allowable organic loading rate.

(B) The engineer shall determine the evaporation loss by using the Penman-Monteith Method or a comparable established method.

(C) The engineer shall size the evaporative ponds to take into account the influent flows and provide for the effects of the precipitation occurring from a 25-yr. frequency, one-year rainfall amount in accordance with §309.20(b)(3)(B) of this title (relating to Land Disposal of Sewage Effluent), unless the report includes an alternate method used and all supporting calculations.

(D) The engineer shall calculate maximum organic loading rate on an evaporative pond based on the evaporation rate, but the BOD_5 loading on the primary pond must not exceed 150 pounds of BOD_5 per acre of primary pond surface area per day.

(e) Embankment. The embankments for evaporative ponds must be constructed in accordance with §217.202(5) of this title (relating to General Design Considerations for Natural Systems).

(f) Inlet/Outlet Structures.

(1) The evaporative influent line must terminate into a manhole located along the embankment edge.

(2) The inlet manhole invert must be a minimum of 6 inches above the maximum high water level of the primary pond.

(3) Submerged discharge pipes must be located from the manhole along and anchored to the bottom of the pond.

(4) The inlet discharge pipe must discharge into a depression near the center of the primary pond and must discharge to a concrete apron to prevent scour.

(A) The concrete apron must be at least 2 square feet in surface area and at least 8 inches thick.

(B) The concrete must be resistant to the corrosive effects of a wastewater environment.

(5) The report must justify the use of other materials.

(6) Inlet and outlet structures for evaporative ponds must be constructed in a manner which allows the water surface elevation to be varied during normal operating conditions.

§217.208. Constructed Wetlands.

Constructed wetlands are man-made complexes of saturated substrates, emergent and submergent vegetation, animal life, and water designed to simulate natural wetland ecologic conditions. Constructed wetland are designed to be inundated or saturated by wastewater flow at a frequency and duration sufficient to support a prevalence of flora and fauna typically adapted for life in wetlands conditions. Constructed wetlands function exclusively as secondary wastewater treatment units. A constructed wetland may include free water surface systems (FWS) or subsurface flow systems (SFS). The use of natural wetlands for primary or secondary wastewater treatment is prohibited.

(1) General Design Considerations.

(A) Primary Treatment.

(i) All constructed wetlands must be preceded by primary treatment and may be preceded by secondary treatment.

(ii) Primary treatment may include:

(I) septic tanks,

(II) Imhoff tanks

(III) facultative lagoons,

(IV) aerated lagoons,

(V) stabilization ponds, or

(VI) any other primary treatment process to remove settleable and floating solids.

(iii) The engineer shall consider odor and algae control in selecting the primary treatment system.

(iv) The engineer shall design primary treatment units to produce an effluent quality of less than 150 mg/l BOD_5 to help minimize anaerobic conditions and stress of vegetative communities in subsequent wetlands treatment units.

(B) Wastewater treatment systems which use constructed wetlands as the means of complying with a permit effluent limit must be sized and designed in a manner which ensures that the permit limits may be complied with assuming any one constructed wetland cell is out of service.

(C) Typical Vegetation. A constructed wetland must have a diverse vegetative community and is recommended to minimize adverse impacts from potential disease, insect pests, or species specific toxicity. may have the following flora:

(i) Emergent aquatic vegetation including:

(I) Scirpus spp. (bulrush),

(II) Sagittaria spp. (arrowhead),

(III) Phragmites spp. (reeds),

(IV) Juncus spp. (rushes),

(V) Elecharis spp. (spikerush),

(VI) Cyperus spp. (sedges),

(VII) Typha spp. (cattails),

(VIII) caladium spp. (elephant ear),

(IX) various aquatic grass species (e.g. wild rice, etc.).

(ii) Floating aquatic vegetation including:

(I) Lemna spp. (duckweed),

(II) Hydrocotyle umbellata spp. (water pennywort),

(III) Limnobium spongia spp. (frogbit),

(IV) Nymphaea spp. (water lily),

(V) Wolffia spp. (water meal), or

(VI) other appropriate species may be used in conjunction with emergent plant species.

(D) The engineer shall ensure that the type of vegetation used in a constructed wetland are suitable for the local growing conditions. The use of indigenous plants is recommended, provided that these species have been demonstrated as effective for the constructed wetlands wastewater environment. Plans for harvesting aquatic plants from waters of the state must be reviewed with the U.S. Corp of Engineers to determine if regulatory coordination is required. Procurement of seed plants from natural wetlands must assure minimum impact on the harvested plant community.

(E) The Texas Parks and Wildlife Department shall approve use of all harmful or potentially harmful wetlands plants and organisms, as described in 31 TAC §§57.111-57.118 and 31 TAC §§57.251-57.258. The report must identify the wetlands plants and organisms.

(F) Herbicides, insecticides, and fertilizers are prohibited within constructed wetlands.

(G) The engineer shall specify in the operations and maintenance manual the maintenance of emergent and aquatic vegetation in constructed wetlands by periodic removal of dead plant matter and detritus. The removal methods must prevent damage to living plants, liners, and system hydraulics. The methods of constructed wetlands maintenance may include promoting active growth, controlling of mosquitos, and maintaining hydraulic capacity and must not result in a deterioration of water quality.

(H) Floating Material Removal. A constructed wetlands must include provisions for the removal of the primary treated effluent algal mat or other floating materials prior to entering the wetlands. Removal mechanisms may include screens, submerged adjustable inlets, baffles or other methods and must be justified in the report. The removed floating material must be stored and disposed of in such a manner as to minimize nuisance odors. The disposal practices must conform with the requirements in Chapter 330 of this title (related to Municipal Solid Waste).

(I) Constructed wetlands require time for maturity of flow ecosystems before effective wastewater treatment may be anticipated. The engineer shall specify provisions to ensure that a properly functioning wetlands system has matured before wastewater effluent is processed. The report must include a management and oversight program which specifies construction scheduling, plant species selection, planting practices, and start-up procedures.

(J) The engineer shall determine the potential evaporative effects on the ponds. The report must include water balance calculations and the potential effect of evaporation on the predicted effluent concentrations.

(K) Liners. The liners for wetlands systems must comply with the requirements of §§217.202(3) and (4) of this title (relating to General Design Considerations for Natural Systems). A minimum 6-inch layer of productive topsoil must be placed above the liner to encourage subgrade root penetration.

(L) Berms.

(i) The berms of a constructed wetland must not have side slopes steeper than 3:1.

(ii) The interior berm side slopes must be lined.

(iii) The interior berm side slopes above the normal operational water level and the exterior berm side slopes must be finished with a minimum 6-inch productive topsoil layer and vegetated with grass or a comparable natural erosion control system.

(iv) The berms may have an alternate synthetic side slope protection system such as slope paving.

(M) Flood Hazard Analysis. A constructed wetland must be protected from flood hazard in accordance with the requirements of §217.34 of this title (relating to 100-Year Flood Plain

Requirements).

(N) Nitrification. The executive director will review all constructed wetlands intended by the engineer to provide nitrification as an innovative and nonconforming technology, subject to §217.10(2) of the title (relating to Type of Approval).

(O) Allowed Uses. FWS wetlands and SFS wetlands may be used as either secondary treatment units, advanced secondary treatment units, or as a means of polishing wastewater effluent.

(2) Free Water Surface Systems. FWS wetlands are shallow open water bodies, less than 24 inches water depth, populated principally by various emergent plant species. Wastewater flows through the wetland, primarily in the horizontal direction, and is treated by a variety of physical, biological, and chemical treatment processes.

(A) FWS General Design. The engineer shall design FWS wetlands based on a maximum water depth of not greater than 24 inches in emergent vegetated areas at design flow.

(B) FWS Plant Spacing. Plant spacing must assure maturity of the wetlands flora ecosystem under normal growing conditions before the application of wastewater to the wetlands. Plant spacing must be not more than 66 inches on center.

(C) FWS Configuration. A FWS wetland cell must include the following minimum configuration standards:

(i) Multiple Cell. A FSW wetland system must include multiple cells which may be operated independently, allowing individual cells to be removed from service while maintaining system operations. The size of the cell must meet permit effluent water quality limits with any single cell removed from service.

(ii) Minimum slope. A FWS wetland cell must have adequate bottom slope to facilitate drainage for maintenance. The engineer shall design the bottom slope to maintain appropriate wetlands water depth range along the entire wetlands length under all anticipated operational flow conditions.

(iii) Parallel trains. The engineer shall design parallel treatment trains to increase operational flexibility.

(iv) Wind protection. A FWS wetland cell must:

(I) be oriented to avoid cross winds perpendicular to the process flow direction; or

(II) use elevated berms or vegetative windbreaks.

(D) Flow Distribution. A FWS wetland must include the following minimum flow distribution standards for treatment efficiency:

(i) Uniform distribution. The FWS inlets and outlets of a wetland must assure uniform distribution of influent flow and uniform collection of effluent flow across the entire cell cross section. Inlet and outlet devices must minimize erosion of wetlands substrate from locally high velocities. Inlet and outlet devices must allow variations in operational water level.

(ii) Submergence. The inlets must be submerged under normal operational conditions.

(iii) Inspection and Cleaning. Provisions must be made to allow inspection and cleaning of inlet and outlet devices.

(E) FWS Organic Loading/Treatment Efficiency.

(i) Constructed wetlands process design may be based on organic loading design for typical municipal wastewater primary or secondary effluent.

(ii) The engineer shall use the organic removal treatment efficiency for FWS wetlands on the areal loading rate equation, equation 3.h, unless the report justifies an alternate method to determine the organic removal treatment efficiency by identifying the method, the sources of the method and all supporting calculations. **Figure 1: §217.208(2)(E)**(ii)

$$C_0 = C^* + (C_i - C^*)\exp - \frac{Ka}{0.0365Q} \qquad Equation 3.h$$

where:

C_i = influent BOD_5 concentration, mg/l
C_o = target effluent BOD_5 concentration, mg/l
C* = wetland background limit, mg/l
(for TSS, C* = 5.1 = $0.16C_i$)
(for BOD_5, C* = 3.5+ 0.053 C_i)
k = first-order areal rate constant: (34 m/yr @ 20° C for BOD)
A = is required wetland area, hectacre (ha) (1,000 m/yr @ 20° C for TSS)
(active treatment area, not including dike, buffers, etc.)
Q = is design flow in m^3/d

(F) Vector Control.

(i) The engineer shall design mosquito control for a FWS wetland. The engineer may:

(I) use mosquito fish (Gambusia) and other natural predators,

(II) maintain aerobic conditions, or

(III) use other biological controls.

(ii) The engineer shall design controls to minimize the potential damage to wetlands caused by mammals such as nutria and muskrats.

(3) Subsurface Flow Systems. SFS wetlands are water bodies with a water depth less than 24 inches and are populated by various emergent plant species. Wastewater flow in SFS wetlands is maintained below the surface of a porous media, such as gravel, in which the emergent plants are rooted. Wastewater flows through the SFS wetland, primarily in the horizontal direction, and is treated by a variety of physical, biological, and chemical treatment processes.

(A) SFS General Design.

(i) The engineer of a SFS wetland shall specify in the report the wetted subsurface media to allow adequate root penetration.

(ii) The operational water depth of a SFS wetland must not exceed the lessor of:

(I) 18 inches at design flow or

(II) the maximum normally anticipated root penetration for the emergent plant species.

(iii) The engineer shall design provisions for seasonal draw down of the water level to encourage deeper root penetration into the wetted media.

(B) SFS Plant Spacing.

(i) Plant spacing must assure maturity of the wetlands flora ecosystem under normal growing conditions before scheduled wastewater loading.

(ii) The SFS wetland plant spacing must not exceed 36 inches on center.

(C) SFS Configuration. A SFS wetland facilities must include the following minimum configuration standards:

(i) Multiple cells. A SFS wetland system must include multiple cells which may be operated independently, allowing individual cells to be removed from service while maintaining system operations. The size of the cell must meet permit effluent water quality limits with any single cell removed from service.

(ii) Hydraulic profile.

(I) A SFS wetland must maintain minimum 6-inch dry media cover during design flows, at least 2-inches of upstream media cover during 2-hour peak flow conditions, and not more than 12-inches of upstream media cover during diurnal low flow conditions.

(II) The engineer must design a SFS wetland hydraulic profile based on Darcy's Law, equation 4.h, unless the report justifies an alternate design method and includes the sources of the method and all supporting calculations and documentation. **Figure 2: §217.208(3)(C)(ii)(II)**

$$Q = K_s * A * S \qquad \textit{Equation } 4.h$$

where:

Q = Design flow (gal/day)
K_S = Media hydraulic conductivity (gal/sf/day) (see Table H.1
S = Hydraulic gradient (ft/ft)
A = Cross sectional area perpendicular to the flow

Table H.1 - Typical Media Characteristics			
Media	Effective Size (inches)	Porosity (%)	Hydraulic Conductivity (gal/sf/day)
Fine Gravel	5/8"	38	185,000
Medium Gravel	1¼"	40	250,000
Coarse Rock	5"	45	2,500,000

(iii) Maximum depth.

(I) The maximum wetted media depth of a SFS wetland is the lessor of:

(-a-) 24-inches at design flow, or

(-b-) the maximum normally anticipated root penetration for the planned primary population emergent plant species.

(II) A SFS wetland must have a dry media cover depth of 6 to 9 inches above the design flow hydraulic gradient.

(iv) Minimum slope. The engineer shall design the SFS wetland cells with adequate bottom slope to facilitate drainage for maintenance, and maintain media water depth by covering the entire cell length under all anticipated operational flow conditions.

(v) Parallel trains. A SFS wetland must have parallel treatment trains must be provided to increase operational flexibility.

(D) Flow Distribution. Constructed wetlands treatment efficiency depends largely on effective flow distribution and collection. A SFS wetland must include the following minimum flow distribution standards:

(i) Flow distribution.

(I) The inlets and outlets of a SFS wetland must assure uniform distribution of influent flow and uniform collection of effluent flow across the entire cell.

(II) The inlet and outlet devices must minimize transport of wetlands media from locally high velocities.

(III) The inlet and outlet devices must be adjustable to allow variation in operational water level and flooding of cells for weed control.

(ii) Submergence. The inlets and outlets for a SFS wetland must be below the media surface and must be designed to allow variations in operational water level.

(iii) Maintenance. The design of the inlet and outlet devices must allow inspection and cleaning.

(iv) Staged influent feed. The engineer shall include provisions for optional staged influent feed to improve process control where a high influent BOD_5 load is anticipated.

(E) SFS Organic Loading/Treatment Efficiency.

(i) The constructed wetlands process may be based on organic loading design for typical municipal wastewater primary or secondary effluent.

(ii) The engineer shall base the organic removal treatment efficiency for a SFS wetland on the areal loading equation, equation 5.h, unless the report justifies an alternate method to determine the organic removal treatment efficiency and all supporting calculations. **Figure 3: §217.208(3)(E)**

$$C_0 = C^* + (C_i - C^*)\exp - \frac{Ka}{0.0365Q} \qquad Equation 5.h$$

where:

C_i	=	influent BOD_5 concentration, mg/l
C_o	=	target effluent BOD_5 concentration, mg/l
C*	=	wetland background limit, mg/l
		(for TSS, C* = 5.1 = $0.16C_i$)
		(for BOD_5, C* = 3.5+ 0.053 C_i)
k	=	first-order areal rate constant: (180 m/yr @ 20° C for BOD)
A	=	is required wetland area, ha (3,000 m/yr @ 20° C for TSS)
		(active treatment area, not including dike, buffers, etc.)
Q	=	is design flow in m^3/d

(F) Temperature. The engineer shall account for this warmer temperature of the winter design condition water temperature for SFS wetlands are generally warmer than FWS wetlands design due to improved insulation and shorter hydraulic residence time of SFS wetlands, particularly if upstream treatment processes do not provide significant heat loss opportunity. This warmer temperature shall be accounted for in the design as deemed necessary by the engineer a SFS wetland in the design.

(G) Vector Control. The engineer shall design vegetation maintenance practices for removal of excessive plant litter and detritus to prevent mosquito breeding opportunities.

(H) Media Design. The SFS wetland media must meet the following minimum requirements:

(i) The media must be hard rock, slags, or other clean, comparable media material.

(ii) The media must maintain less than 0.1% by weight of clay, sand and other fine materials.

(iii) The media materials must have a Mohs hardness of at least 5.0. All media must be resistant to acidic conditions.

(iv) The executive director considers synthetic medias as nonconforming and/or innovative technologies subject to §217.10(2) of this title (relating to Types of Approvals).

(v) The engineer shall use media gradation and uniformity to determine the wetland's hydraulic conductivity.

(vi) The media must be placed in the SFS wetlands by light equipment to avoid introduction of clay or other undesirable materials, to avoid compaction, and to avoid rutting of the subgrade.

(vii) If a SFS wetland has a gravel media larger than one and one-half inch diameter in the subsurface flow system, the engineer shall design a top layer of small gravel layer to encourage healthy plant rooting. The gravel layer must be above the normally saturated media zone. The engineer shall design transitional (medium grade) layer between small gravel caps and coarse gravel to minimize small gravel migration into lower void spaces.

§217.209. Overland Flow Process.

An overland flow process is the application of wastewater along the upper portion of uniformly sloped and grass covered land, which flow, in a thin sheet over the vegetated surface to runoff collection ditches. The primary objective of this process is treatment of wastewater. An overland flow process results in a discharge and requires a wastewater discharge permit. This process is best used on soils with low permeability.

(1) Nitrification. The executive director considers an overland flow process intended to provide nitrification as innovative and nonconforming technology subject to §217.10(2) of this title (relating to Types of Approvals).

(2) Hydraulic Loading Rate. The engineer may vary the hydraulic loading rate and application rate depending on levels of pretreatment, desired quality of effluent, temperature, and other climatic conditions. The engineer shall use Table H.2 for values for application rates. and the report must identify the design rates. **Figure 1:§217.209(3)**

Table H.2 - Application Rates For Overland Flow Systems - *	
Process Conditions	Application Rate (gallons/minute/foot of slope)
Overland Flow Preceded by Primary Treatment Permit Limits: 20 mg/l BOD_5 20 mg/l TSS Maximum Soil Temperature > 10°C	0.13
Overland Flow Preceded by Primary Treatment Permit Limits: 20 mg/l BOD_5 20 mg/l TSS Maximum Soil Temperature < 10°C	0.12
Overland Flow Preceded by Primary Treatment Permit Limits: 10 mg/l BOD_5 15 mg/l TSS Maximum Soil Temperature > 10°C	0.12
Overland Flow Preceded by Primary Treatment Permit Limits: 10 mg/l BOD_5 15 mg/l TSS Maximum Soil Temperature < 10°C	0.09
Overland Flow Preceded by Secondary Treatment	0.19
* - Numbers are based on the EPA's Process Design Manual EPA/625/1-81/013a titled Supplement on Rapid Infiltration and Overland Flow	

(3) Climate/Wastewater Storage. An overland flow process must include storage for the wastewater for days when temperatures preclude operation. An overland flow process must include storage of influent wastewater during rainfall to sufficiently to ensure compliance with the organic load mass limits in the discharge permit. The engineer shall design the storage size to store at least 2 days of influent wastewater.

(4) Storage Basin Design. A storage basin must be an off-line basinused only as needed and emptied as soon as possible by blending with other pretreated wastewater prior to application.

(5) Storage Basin Construction. A storage basin for an overland flow system must comply with §§217.202(3)-(5) and 217.206(6) of this title (relating to General Design Considerations for Natural Systems and Wastewater Stabilization Ponds).

(6) Nuisance Odor Prevention. If the engineer determines that the overland flow system may cause a nuisance to adjacent landowners, the design must include sufficient measures to prevent the nuisance odors.

(7) Soil/Soil Testing.

(A) Overland flow systems must be located in soil conditions which will not allow effluent percolation to groundwater.

(B) An overland flow system is prohibited in soils with a coefficient of permeability greater than 0.6 inches per hour.

(C) The engineer shall take core samples at sites where overland flow systems are proposed and analyze a minimum of 10 cores for each soil type and at least one core for every two acres of the same soil type.

(D) The soil profile evaluation must extend to a depth of at least 4 feet below the root zone of the vegetation in the overland flow system.

(E) The report must include a soil profile and a permeability test for these cores.

(F) The report must include a geological investigation which determines the depth to groundwater and the depth to bedrock under the overland flow site.

(G) The executive director may require deeper soil profiles and additional hydraulic and geological analyses to ensure that the overland flow system does not constitute a threat to groundwater.

(8) Distribution Systems. The application cycle must maintain uniform coverage of the overland flow area onto and across the terraces. The application cycle must provide a maximum of 12 hours for dosing followed by a minimum period of 12 hours of resting.

(9) Terraces. The sloped areas that receive wastewater must be uniformly graded to eliminate wastewater ponding and short circuiting for the length of the flow. The report must include site grading procedures and tolerances. The minimum slope is 2 percent. The maximum slope is 8 percent. The application site must include flood protection. The minimum slope length for the applied wastewater is 100 feet.

(10) Vegetation Selection. The application site must have a vegetative cover. The plant types must be suitable for overland flow conditions and must provide uniform coverage of soil to prevent short circuiting and channelization of the area.

(11) Buffer Zone. The overland flow process treatment area must include the same buffer zone requirements as aerobic wastewater treatment system units.

(12) Disinfection. Any wastewater quality and disinfection requirements for overland flow process discharges are established by a discharge permit issued by the commission.

(13) Sampling. An effluent sampling station must be provided prior to discharge to surface waters. The sampling and reporting requirements are established by a discharge permit issued by the commission.

§217.210. Integrated Facultative Ponds.

Integrated facultative ponds are nonconforming technology, subject to review in accordance with §217.10(2) of this title (relating to Types of Approvals).

(1) Configuration/Inlets/Outlets.

(A) The length-to-width ratio of the integrated facultative pond must be three to one (3:1), unless the report justifies other dimensions more suitable to the site, the inlet must be located in the pit portion of the pond.

(B) The pit must not be less than 0.40 acres in total surface area.

(C) The outer pond area must not be less than 10 times the surface area of the pit.

(D) The pit must have adequate volume to contain 0.1 cubic feet per capita per year sludge storage minimum 20-year design period, plus a two day hydraulic retention time above the sludge storage area.

(E) The maximum upflow velocity in the pit is two feet per day at design flow.

(F) The engineer may design more than one pit within a single integrated facultative pond if each pit receives an equivalent amount of wastewater influent.

(G) The outlet must be able to maintain the water level within one (1) foot.

(H) The engineer shall locate integrated facultative ponds in a central location with regard to the surrounding secondary ponds to meet the buffer zone requirements specified in Chapter 309 of this title (relating to Domestic Wastewater Effluent Limitations and Plant Siting).

(2) Depth. The depth of the inlet pit must not be less than 15 feet deep from the water surface elevation during normal operating conditions to the influent inlet point within the pit. For an integrated facultative pond must have berms or other deflection devices around the pit. The berm height must be the lessor of 5 feet high or one-half the depth of the outer pond. The minimum depth from the water surface elevation during normal operating conditions, to the top of the berm around the pit is 5 feet.

(3) Organic Loading. The maximum organic loading into the pit is 300 pounds of ultimate BOD per acre of total pond area per day.

(4) Odor Control. The inlet to a pit must be 3 feet above the bottom of the pond with the flow directed downward. The water from the next stage pond following the integrated facultative pond must be recirculated to the surface of the integrated facultative pond. Capabilities for recirculation at 50% to 100% of the design flow must be provided for the facultative pond(s), from the outlet of the downstream pond. An integrated facultative pond must not siphon pond contents through submerged inlets.

(5) Removal Efficiency. The engineer may assume the removal efficiency for an integrated facultative pond to be up to 60% of the influent BOD_5 in the pit. The engineer may assume subsequent

removal efficiency of BOD_5 within the outer portion of the integrated facultative pond to be up to 50% of the remaining 40%. An integrated facultative pond must provide a minimum of 21-days hydraulic retention time.

SUBCHAPTER J : SLUDGE
§§217.240-217.252

STATUTORY AUTHORITY

The rules in Subchapter J, Sludge, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; §5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; §5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health; and Texas Health and Safety Code, §361.022, which provides the state's public policy concerning municipal solid waste and sludge.

§217.240. Applicability.

This subchapter establishes the minimum design requirements for sewage sludge treatment processes and treatment units. For purposes of this rule, the sludge process includes thickening, stabilization, and dewatering. The engineer shall base the selection and operation of the sludge unit processes on the final sludge product. All municipal wastewater treatment facilities that dispose of sludge under Chapter 312 (relating to Sludge Use, Disposal, and Transportation) must use stabilization. All municipal wastewater treatment facilities that dispose of sludge under Chapter 330 (relating to Municipal Solid Waste) must comply with the requirements of that chapter.

§217.241. Control of Sludge and Supernatant Volumes.

(a) All supernatant or centrate resulting from sludge processing activities must be returned to the head of the treatment works and discharged at a point preceding the aeration system or preceding the secondary treatment units if no aeration exists at the plant.

(b) The sludge unit must limit digester supernatant liquor volume to the greatest extent practical.

(c) The engineer shall design the sludge unit to minimize the impact of the returned supernatant on the downstream units.

§217.242. Sludge Pipes.

(a) The pipes of a sludge processing facility must have sufficient gradient to insure the flow of sludge.

(b) The engineer shall design the pipes under a stationary structure to allow blockages to be easily eliminated with rodding or sewer cleaning devices.

(c) The gravity pipes must have uniform grade and alignment.

(d) The slopes on gravity discharge pipes must not be less than three percent.

(e) The diameter of sludge pipes within a digester and any sludge drain pipes must be at least four inches.

(f) The diameter of sludge withdrawal pipes for anaerobic digesters and gravity thickeners must be at least 6 inches for a gravity withdrawal pipes and 4 inches for a pump suction or a discharge pipe.

(g) The available head on a discharge using gravity withdrawal pipe must be at least four (4) feet.

(h) The pipes for the primary sludge clarifier pump using gravity withdrawal must allow for removal of digested sludge.

(i) Each sludge pipe must include a means to observe the quality of the supernatant from each of the withdrawal outlets.

(j) Each sludge processing and treatment unit must be capable of independent drainage.

(k) The engineer shall design pipes located inside the digestion tank for corrosion resistance and the stability of supporting systems.

§217.243. Sludge pumps.

(a) The engineer shall design sludge transfer pumps based on the quantity and character of the anticipated solids load.

(b) The design pumping capacity of mechanical pump systems must allow pumping with the largest sludge pump out of service.

(c) The engineer may design air lift pumps as a mechanism for sludge transfer. Duplicate design pumping capacity is not required with air lift pumps.

(d) Centrifugal sludge pumps must have a positive suction head, unless the pumps include a priming device.

(e) The engineer shall use positive displacement pumps or other types of pumps with demonstrated solids handling capability for handling raw sludge.

(f) The engineer shall design the pump with a minimum positive head necessary for proper operation at the suction side of the centrifugal type pump. A positive head of 24 inches or more may be desirable for all types of sludge pumps.

§217.244. Exclusion of Grit and Grease from Sludge Treatment Units.

(a) The engineer shall design the facility to minimize the discharge of grit, debris, oil, and grease to the sludge treatment unit.

(b) The engineer shall design the sludge treatment unit for the ultimate use and disposal of the various solids generated during the treatment of domestic sewage.

(c) The sludge treatment unit must remove all screening, grit, and grease if the sludge is to be land applied.

§217.245. Ventilation.

(a) The engineer shall design sufficient ventilation to eliminate the presence of fumes or gases. of a level sufficient to constitute a public health hazard or a threat to air quality, must provide sufficient ventilation to eliminate these dangers.

(b) An enclosed area must have automatic, continuous or intermittent mechanical ventilation. A continuous ventilation system must provide at least 30 complete air exchanges per hour. An intermittent ventilation system must provide at least six complete air exchanges per hour.

(c) An open area must include a means of ventilation that protects public health and air quality.

§217.246. Odor Control.

The design of all sewage sludge process units must prevent nuisance odors.

§217.247. Chemical Pretreatment of Sludge.

This section contains the minimum criteria for the use and handling of chemicals and equipment for chemical addition to enhance solids removal.

(1) Chemical Selection. The chemicals must be compatible with the unit operation and must have no detrimental effect upon receiving waters. The report must include a pilot plant study or data from unit operations treating design flows of sewage or domestic wastewater of similar characteristics (organic levels, metal concentrations, etc., within 25% of proposed design) to justify appropriate chemicals and feed ranges.

(2) Safety Provisions for Storage of Chemicals.

(A) A liquid chemical storage tank must include a liquid level indicator and an overflow receiving basin or drain capable of complete retention of any spills.

(B) Powdered activated carbon must be stored in an isolated fireproof area.

(C) All storage and handling areas where potentially volatile chemicals or conditions exist must have explosion proof electrical outlets, lights, and motors. The chemicals must remain contained during transport, storage, and use to preclude any discharges to the atmosphere.

(D) An operator who will handle dry chemicals that are known to pose potential health problems must have protective equipment for eyes, face, head, and extremities.

(E) A facility using chemicals must provide eye washing and showering systems.

(F) All protective equipment and neutralizers must be stored in the operating area.

(3) Minimum Chemical Supply. A facility must have at least thirty (30) days of chemical supply in dry storage conditions, unless the report justifies a reduced amount. The solution storage tanks or direct feed day tanks must have sufficient capacity for daily operation at the design flow of the facility.

(4) Chemical Handling.

(A) The engineer shall design procedures for measuring quantities of chemicals used to prepare feed solutions and shall design storage tanks, pipes, and other equipment for the specific chemical.

(B) Intermixing of chemicals is prohibited.

(C) Concentrated liquid acids must not be handled in open vessels, but must be pumped in undiluted form from the original containers to the point of treatment to a covered day tank or to a storage tank.

(D) Concentrated acid solutions or dry powder must be kept in closed, acid-resistant shipping containers or storage units.

(E) The transfer of toxic materials must be controlled by positive actuating devices.

(F) The operator shall use one or more of the following control methods to ensure that the transfer of dry chemicals will minimize the quantity of dust entering the equipment room:

(i) Vacuum pneumatic equipment of closed conveyor systems;

(ii) Facilities for emptying shipping containers in special enclosures; or

(iii) Exhaust fans and dust filters which put the hoppers or bins under negative pressure sufficient to eliminate chemical particles that escape into the air.

(G) The engineer shall design procedures for disposing of empty containers in a manner that minimizes potential for harmful exposure to chemicals.

(5) Housing of Chemicals. The areas that include chemical feed equipment must provide access for servicing, repair, and observation of operations. The floor surfaces must be smooth, slip resistant, impervious, and must have a minimum slope of 1/8 inch per foot. All open basins, tanks, and conduits must be protected from chemical spills or accidental drainage.

(6) Feed Equipment.

(A) Redundancy. The engineer shall design sufficient equipment redundancy to ensure operation during the shutdown of the largest operational unit. The feed system must have at least two feeders and must be able to supply the amounts of chemicals needed for process reliability throughout the range of feed.

(B) Design and Capacity.

(i) The feed system must be able to deliver a proportional amount of chemical feed based on the rate of flow.

(ii) The feed system must not use positive displacement type solution feed pumps to feed chemical slurries, unless the engineer justifies such use in the report.

(iii) If using potable water, the water must be protected by at least two backflow preventers, including at least one air gap between the supply line and the solution tank.

(iv) The feed system materials and surfaces must be resistant to the chemical solutions.

(v) A dry chemical feed system must:

(I) measure chemicals volumetrically or gravimetrically;

(II) provide effective mixing and solution of the chemical in the solution pot;

(III) provide gravity feed from solution pots;

(IV) completely enclose chemicals; and

(V) prevent emission of dust to the operation room.

(C) Spill Containment. The feed equipment must have protective curbing to contain chemical spills.

(D) Control.

(i) All feed systems must have automatic controls capable of reverting to manual control.

(ii) All feed systems must have manual starting equipment.

(iii) The engineer may design a feed system with automatic chemical dose or residual analyzers.

(iv) If automatic chemical dosing or residual analyzers are used, the engineer shall determine the need for alarms for critical values and recording charts.

(E) Weighing Scales. A volumetric dry chemical feeder or a non-volumetrically calibrated carboy must have weighing scales that measure in increments of no greater than 0.5 percent of the load.

(F) Feed System Protection. The feed system must have freeze protection and must be accessible for cleaning.

(G) Service Water Supply. The feed system must protect the service water from contamination. The service water supply must have sufficient pressure to ensure dependable operations. The water supply must include a means for measurement of solution concentrations. The engineer must design sufficient duplicate equipment to ensure process reliability and may use booster pumps to maintain pressure.

(7) Solution Tanks.

(A) The solution tanks must be able to maintain uniform strength of solution consistent with the nature of the chemical solution and must provide continuous agitation.

(B) The feed system must have two solution tanks.

(C) The total solution tank capacity must provide storage for at least one full day of operation at design flow.

(D) A solution tank must have a drain and a solution level indicator.

(E) The intake point for make-up potable water must have an air gap.

(F) The chemical solutions must be covered with access openings curbed and fitted with tight covers.

(G) The subsurface locations for each solution tank must be impermeable, protected against buoyancy forces, include provisions to drain groundwater or other accumulated water away from the tank, include design provisions which will detect leaks, and allow for containment and remediation of any chemical spills.

(H) The overflow pipes must be turned downward, have an unobstructed discharge, and be placed in an open location. The overflow pipes must drain to a containment area and must not contaminate the wastewater or receiving stream.

(8) Requirements for Chemical Application. The chemical application system must provide maximum efficiency of treatment and provide safety to the operators. The chemicals application system must

prevent backflow or back-siphonage between multiple points of feed through common manifolds. The application of pH affecting chemicals to the wastewater must be done before the addition of coagulants.

§217.248. Sludge Thickening.

Sludge thickening is used for volume reduction and conditioning of sludge, prior to sludge treatment, as an aid to processing and managing the sludge waste stream. Sludge thickening is optional. If sludge thickeners are used, the engineer must use the following criteria.

(1) General Requirements for Thickeners.

(A) Capacity. The thickeners must be capable of operating during the two-hour peak flow.

(B) Flexibility. The sludge thickening system must have a bypass. All treatment works with a design flow greater than 1.0 mgd must have dual units, alternate means of thickening and alternate disposal methods.

(2) Specific Requirements for Mechanical (Gravity) Thickeners.

(A) Equipment Features.

(i) A mechanical thickener must have low-speed stirring mechanisms for continuous mixing and flocculation within the zone of sludge concentration.

(ii) A mechanical thickener must have sludge storage, if sufficient storage is unavailable within other external tankage.

(iii) A mechanical thickener must have means of controlling the rate of sludge withdrawal.

(iv) A mechanical thickener may use chemical additions and dilution water feed systems.

(v) The scraper mechanical train must be capable of withstanding all expected torque loads. The normal working torque load must not exceed ten (10%) of the rated torque load.

(B) Design Basis.

(i) The report must justify the mechanical thickener design.

(ii) The executive director may require data from a pilot study.

(iii) Thickener overflow rates must be between 400 and 800 gpd/sf.

(iv) The minimum side water depth is 10 ft.

(v) A circular thickener must have a minimum bottom slope of 1.5 in/ft.
(vi) The peripheral velocity of the scraper must be between 15 and 20 ft/min.

(vii) A mechanical thickener must minimize the potential short circuiting.

(3) Specific Requirements for Dissolved Air Flotation Thickeners.

(A) Equipment Features.

(i) A dissolved air flotation (DAF) basins must have bottom scrapers that must function independently of the surface skimmer mechanism.

(ii) The recycle pressurization system for the DAF basin must use effluent or secondary effluent instead of potable water.

(iii) The DAF basin must have a polymer feed system. The feed system must meet the requirements of §217.247(6) of this title (relating to Chemical Pretreatment of Residuals).

(iv) The DAF basin must be located in a covered building and have a positive air ventilation system.

(B) Design Basis.

(i) The report must justify the DAF basin design.

(ii) The executive director may require data from a pilot study.

(iii) The hydraulic loading rates must not exceed 2.0 gal/min/sq.ft.

(iv) The solids loading rate must be between 1.0 and 4.0 lb/hr/sq.ft.

(v) The air to solids weight ratio must be between 0.02 and 0.04.

(vi) The retention tank system must have a minimum pressure of 40 pounds per square inch gauge (psig).

(vii) The skimmer must have multiple or variable speeds that allow an operational range from one (1) fpm up to 25 fpm.

(4) Specific Requirements for Centrifugal Thickeners.

(A) The report must justify the centrifugal thickener design.

(B) The executive director may require data from a pilot study.

(C) The centrifuge must be preceded by pretreatment to prevent plugging of the nozzle and/or excessive wear in the bowl.

(D) The centrate is subject to §217.241 of this title (relating to Control of Sludge and Supernatant Volumes).

§217.249. Sludge Stabilization.

The design requirements for the stabilization processes listed below are based on the assumption that the process is the sole stabilization process employed at the treatment works. The report must justify a variance for reducing these requirements for treatment works employing series operation of two or more stabilization processes or methods.

(1) Anaerobic Digestion.

(A) Multiple Design. A facility with a design flow exceeding 0.4 mgd must have a minimum of two anaerobic digesters, so each digester may be used as a first stage or primary reactor for treating primary and secondary sludge flows. Each digester must have the means for transferring a portion of its contents to other digesters. A facility without multiple digesters must have an emergency storage basin, so the digester may be taken out of service.

(B) Depth. The anaerobic digester must provide a minimum of six feet of storage depth for supernatant liquor.

(C) Maintenance Provisions. The design must allow access to all units that require maintenance.

(D) Slope. A digester bottom must slope towards the withdrawal drain pipe. A flat-bottomed digestion chamber is prohibited.

(E) Access Manholes. The top of the digester must have at least two access manholes and a gas dome. One manhole must have sufficient diameter to permit the use of mechanical equipment to remove grit and sand. An digester system must have a separate side wall manhole at ground level.

(F) Safety. The operation and maintenance manual must require the use of non-sparking tools, rubber soled shoes, safety harness, gas detectors for flammable and toxic gases, and at least one self contained breathing apparatus.

(G) Sludge Inlets and Outlets. A digester must have multiple sludge inlets, draw-offs, and at least three recirculation sections and discharge points to facilitate effective mixing of the digester contents. One inlet must discharge above the liquid level and be located at the center of the digester. Raw sludge inlet discharge points must be located to minimize short circuiting to the supernatant draw-off.

(H) Digester Capacity.

(i) The engineer shall calculate the digester capacity from the volume and character of the sludge. The report must include the calculations to justify the basis of design.

(ii) The engineer shall calculate the total digestion volume based upon:

(I) the volume of sludge added;

(II) the percent solids and character of the sludge;

(III) the temperature to be maintained in the digesters;

(IV) the degree or extent of mixing to be obtained; and

(V) the size of the installation with appropriate allowance for sludge and supernatant storage.

(iii) The digester must maintain a daily minimum average sludge digestion temperature of thirty-five degrees Celsius (95^{o} F) and maintain temperature control within a 4^{o}(+/-) C range.

(iv) The minimum detention time for sludge undergoing digestion for stabilization is 15 days within the primary digester, unless longer periods are required to achieve the necessary level of pathogen control and vector attraction reduction for the method used for sludge management (relating to 30 TAC Chapter 312).

(v) An unheated digester must have the capacity to provide a minimum detention time of 60 days and maintain a temperature of at least 20^{o} C (68^{o} F) (relating to 30 TAC Chapter 312).

(vi) Completely Mixed Systems.

(I) A digester must have an average feed loading rate of less than 200 pounds of volatile solids per 1,000 cubic feet of volume per day in the active digestion volume.

(II) Complete mixing in 30 minutes is required for:

(-a-) confined mixing systems where gas or sludge flows are directed through vertical channels;

(-b-) mechanical stirring or pumping systems; and

(-c-) unconfined continuously discharging gas mixing systems.

(III) A tank over 60 feet in diameter must have multiple mixing devices.

(IV) The minimum gas flow supplied for complete mixing must be 15 cubic feet per minute per 1,000 cubic feet of digestion volume.

(V) The complete mix system must have flow measuring devices and throttling valves.

(VI) The minimum power supply for mechanical stirring or pumping type complete mixing systems is 0.5 horsepower per 1000 cubic feet of digestion volume.

(vii) Moderately Mixed Systems. A digestion system where mixing is accomplished only by circulating sludge through an external heat exchanger must be loaded at less than 40 pounds of volatile solids per 1,000 cubic feet of volume per day in the active digestion volume. The engineer shall design the volatile solids loading in accordance with the degree of mixing. The report must justify the loading rates if mixing is accomplished by other methods.

(I) Gas Collection, Pipes, Storage and Appurtenances.

(i) General Requirements. The engineer shall design all portions of the gas system to maintain positive gas pressure under all normal operating conditions including sludge withdrawal.

(ii) Safety Equipment. The system must include pressure and vacuum relief valves, flame traps, and automatic safety shut-off valves. The installation of water seal equipment on gas pipes is prohibited.

(iii) Gas Pipes and Condensate.

(I) The gas pipes must be adequate for the volume of gas and must be pressure tested for leakage at 1.5 times the design pressure before the digester is placed into service.

(II) The gas pipes must slope at least 1/8 inch per foot to provide drainage of condensation.

(III) The main gas pipe from the digester must have a sediment trap and a drip trap.

(IV) The use of float controlled condensate traps is prohibited.

(V) The condensation traps must be accessible for daily servicing and draining.

(VI) A drip trap must be located at all other low points in the pipes.

(VII) The gas pipes to every gas outlet, must have flame checks or flame traps.

(VIII) The burner pilot must be a natural or bottled gas source.

(IX) All main gas pipes must have flame traps with fusible shut-offs.

(X) The gas pipe to the waste gas burner must include a pressure valve, vacuum valve, and relief valve.

(iv) Electrical Fixtures and Equipment. The engineer shall design the electrical equipment in the sludge digester pipe area containing gas to prevent potential explosive conditions.

(v) Waste gas. The waste gas burners must be accessible and must be located at least 50 feet away from any structure if placed at ground level. The waste gas burners may be located on the roof of the control building. The waste gas burners must not be located on top of the digester. The discharge of less than 100 cubic feet per hour (CFH) of digester gas through a return bend screened vent with a flame trap terminating at least 10 feet above the walking surface is allowed.

(vi) Ventilation. All underground enclosures connected to anaerobic digesters tanks, gas pipes, or sludge equipment must have forced ventilation in accordance §217.245 of this title (relating to Ventilation). All underground enclosures must include tightly-fitting, self-closing doors.

(vii) Meter. The system must have a gas meter with bypass to measure total gas production.

(viii) Manometers. The gas manometers must have tight shut-off vents and vent cocks. The vent pipes must be extended outside the buildings. The vent pipe openings must have screens and be arranged to prevent the entrance of rainwater. The engineer shall determine what safety devices and/or appurtenances are needed for the manometer pipe system and must list the required safety items in the report. The gas pipes for anaerobic digesters must be equipped with closed-type indicating gauges that measure in inches the following:

(I) the main line pressure,

(II) the pressure to gas-utilization equipment, and

(III) pressure to waste burners.

(J) Digestion Temperature Control.

(i) Insulation. The digester must be constructed above the water table and must be insulated to minimize heat loss.

(ii) Heating Facilities. The sludge must be heated by circulating the sludge through external heaters. The pipes must provide for the preheating of feed sludge before introduction to the digesters, unless effective mixing is provided within the digester. The engineer shall design the layout of the pipes and valves to facilitate cleaning. The engineer shall design the size of the heat exchanger sludge pipes based on the heat transfer requirements.

(iii) Heating Capacity. The digester system must have the heating capacity to consistently maintain the design temperature required for sludge stabilization. The digester system must have an alternate source of fuel for emergency use. The boiler or other heat source must be capable of using the alternate fuel.

(iv) Mixing. The digester system must have facilities for mixing the sludge.

(v) Sludge Heating Device Location. The sludge heating devices with open flames must be located above grade in areas separate from the gas production or storage location.

(K) Supernatant Withdrawal.

(i) Pipe Size. The minimum diameter for supernatant pipes is 6 inches.

(ii) Withdrawal Arrangements.

(I) The supernatant pipes must be arranged to allow withdrawal from three or more levels in the tank. A supernatant selector must have at least two other draw-off levels located in the digester's supernatant zone in addition to the un-valved emergency supernatant draw-off pipe.

(II) The system must have a positive, un-valved, vented overflow.

(III) The engineer shall design the supernatant withdrawal level on fixed cover digesters by means of interchangeable extensions at the discharge end of the pipe.

(IV) The supernatant pipe system must have high pressure backwash facilities.

(iii) Sampling. The supernatant pipes must have sampling points at each supernatant draw-off level. The minimum diameter for the sampling pipes is 1.5 inches.

(iv) Supernatant Handling.

(I) The report must address shock organic loads associated with digester supernatant.

(II) Supernatant liquor from anaerobic digesters may be treated by chemical means or other methods approved by the executive director before being returned to the plant.

(III) The treatment of the supernatant liquor with lime must meet the following requirements:

(-a-) The lime must be applied to obtain a pH of 11.5;

(-b-) the lime feeder must be capable of feeding 2,000 mg/l of hydrated lime or its equivalent;

(-c-) the lime must be mixed with the supernatant liquor by a rapid mixer or by agitation with air in a mixing chamber; and,

(-d-) after adequate mixing, the solids must be allowed to settle.

(IV) The supernatant liquor treatment system may be a batch or continuous process. The batch process may have the mixing and settling processes in the same tank. The sedimentation tank for the batch process must have a capacity to hold 36 hours of supernatant liquor, but not less than 1.5 gallons per capita. The sedimentation tank for a continuous process must have a detention time of not less than eight hours.

(V) The solids from the supernatant liquor treatment must be returned to the digester or conveyed to the sludge handling facilities.

(VI) The clarified supernatant liquor must be returned to the head of the treatment works in accordance with §217.241 of this title (relating to Control of Sludge and Supernatant Volumes).

(L) Digester Covers.

(i) Uncovered anaerobic digesters are prohibited.

(ii) The sludge and supernatant withdrawal pipes for a single-stage and first-stage digesters with fixed covers must be arranged to minimize the possibility of air being drawn into the gas chamber above the liquid in the digester.

(iii) A digester cover must include a gas chamber.

(iv) A digester cover must be gas tight.

(v) The specifications must include a test of every digester cover for gas leakage.

(vi) A digester cover must be equipped with an air vent with a flame trap, a vacuum breaker, and a pressure relief valve.

(2) Aerobic Sludge Digestion. This subsection applies to the stabilization of waste sludge to a Class B Biosolid by aerobic digestion. Class B biosolid is defined in Chapter 312 of this title (relatig to Sludge).

(A) Solids Management. The report must include a solids management plan which demonstrates a method of managing the waste solids to provide adequate stabilization and adequate volume to maintain the design sludge age for the biological process.

(B) Detention Time and Mass Balance Requirements. The engineer shall calculate the lowest one week average of the water temperature to determine the design temperature of the aerobic digester system. The lowest one week average is the lowest daily average of seven consecutive days. In addition to designing for the total detention time, the engineer shall perform mass balance calculations. The mass balance calculations must take into account process design sludge age, waste stream concentration, operational hours, operational volume in tanks, decant or dewatering volumes and characteristics, time frames needed for decanting or dewatering, and the volume needed for storage and sampling.

(i) Single Stage.

(I) Single stage aerobic digestion consists of utilizing one tank operating in continuous-mode-no -supernatant removal, continuous-mode-feeding-batch removal, or other mode detailed in the solids management plan.

(II) The engineer shall design the size of the aerobic digesters based on the minimum total detention times for the water temperature in Table J.1.

(III) The digester size must be of sufficient volume to provide both the detention time in table J.1 and to provide for the mass load to be received by the unit.

Figure 1: §217.249(2)(B)(i)

Table J.1 - Minimum Detention Times For Aerobic Digesters	
Temperature (Degrees Celsius)	Total Detention Time
15	60 days
20	40 days

(ii) Multiple Stage. Multiple stage aerobic digestion consists of two or more completely mixed reactors of the same volume operating in series.

(iii) Field Data.

(I) If an existing facility can demonstrate satisfactory compliance with the fecal Coliform levels for Class B sludge, that facility may continue to operate at the test time–temperature conditions.

(II) Any increases in flow, organic loading, or process modifications require new testing and verification of the time-temperature operating parameters.

(III) Expansion of existing facilities may be designed and operated according to previously established time-temperature conditions.

(IV) Facilities may be re-rated under Subchapter B of this chapter after sufficient supporting data is collected and evaluated.

(C) Design Requirements.

(i) The engineer may design an additional tank to accommodate testing of the sludge prior to disposal.

(ii) The engineer shall use a maximum design concentration of two percent solids concentration to calculate the total detention time for aerobic digesters that concentrate the waste sludge only in the digester tank.

(iii) The engineer may use a design concentration of up to three percent solids upon collection of supporting data.

(iv) A diffuser must be of the type which minimizes clogging.

(v) The engineer shall design diffusers to permit removal for inspection, maintenance, and replacement without dewatering the tanks.

(vi) The volatile solids loading must range between one tenth and two tenths (0.1 and 0.2) pounds of volatile solids per cubic foot per day, unless otherwise justified in the report.

(vii) The dissolved oxygen concentration maintained in the liquid must be at least 0.5 milligrams per liter.

(viii) The energy input requirements for mixing must range between 0.5 to 1.5 horsepower per 1,000 cubic feet where mechanical aerators are used and 20 to 30 standard cubic feet per minute per 1,000 cubic feet of aeration tank where diffused air mixing is used.

(ix) The engineer shall design facilities for effective separation and withdrawal, or decanting of the supernatant.

(3) Heat Stabilization.

(A) Capacity. The engineer shall design the heat treatment system based on the anticipated sludge flow rate (gpm) with the required heat input dependent on sludge characteristics and concentration. The system must have continuous operation to minimize additional heat input to start up the system.

(B) Redundancy.

(i) The heat treatment system must have multiple units, unless nuisance-free storage or alternate stabilization methods are available to avoid disruption to treatment works operation when units are not in service.

(ii) A single system must have standby grinders, fuel pumps, air compressor (if applicable), and dual sludge pumps.

(iii) The report must identify a reasonable downtime for maintenance and repair based on data from comparable facilities.

(vi) The report must justify adequate storage for process feed and downtime.

(C) Equipment Features.

(i) The heat treatment system must provide heat stabilization in a reaction vessel within a range from 175°C or 350 degrees Fahrenheit (350°F) for 40 minutes to 205°C or 400°F for 20 minutes at pressure ranges of 250 to 400 pounds per square inch gauge (psig), or provide for pasteurization at temperatures of 30°C or 85°F or more and gage pressures of more than one standard atmosphere (14.7 psi) for periods exceeding twenty five (25) days.

(ii) The heat treatment system must have sludge grinders to protect the heat exchangers from rag fouling.

(iii) The heat treatment system must include an acid wash or high pressure water wash system to remove scale from heat exchangers and reactors.

(iv) The decant tank must have a sludge scraper mechanism and must be covered.

(v) The engineer must select corrosion resistant materials for construction of the heat exchangers.

(vi) The engineer may design separate, additional grit removal to prevent abrasion of the pipes.

(vii) The heat treatment system must have continuous temperature recorders.

(D) Recycle Loads. The report must identify the method of treatment for recycle streams from heat treatment. The recycle streams must not impact water quality or the facilities treatment processes.

(4) Alkaline Stabilization.

(A) Design Basis.

(i) Alkaline Dosage. The engineer shall calculate the alkaline additive dosage required to stabilize sludge based on the type of sludge, chemical composition of sludge, and the solids concentration. The engineer shall use performance data taken from pilot plant test programs or from comparable facilities to determine the proper dosage.

(ii) pH and Contact Time. The engineer shall design alkaline stabilization system to furnish uniform mixing in order to maintain the pH and contact time as specified in §§312.82-312.83 of this title (relating to Pathogen Reduction and Vector Attraction Reduction) for alkaline addition in the alkaline additive-sludge mixture.

(iii) Temperature and Contact Time. The alkaline stabilization system must meet the temperature and contact time objectives described in §§312.82-312.83(b) of this title (relating to alkaline-sludge mixture).

(iv) Reliability. The alkaline stabilization system must have multiple units, unless nuisance free storage or alternate stabilization methods are available to avoid disruption to treatment works operations when units are not in service. A single system must have standby conveyance and mixers, backup heat sources, and dual blowers. The design must include a reasonable downtime for maintenance and repair based on data from comparable facilities and adequate storage for process, feed, and downtime.

(B) Housing Facilities. The engineer shall design the housing facilities in accordance with §217.247(5) of this title (relating to Chemical Pretreatment of Residuals). The housing facilities must have mechanical or aeration agitation to ensure uniform discharge from the storage bins.

(C) Feeding Equipment. The alkaline additive feeding equipment must meet the requirements of §217.247(6) of this title. Hydrated lime must be fed as a 6 to 18 percent $Ca(OH_2)$ slurry by weight, unless otherwise justified in the report. The report must identify any other means for controlling the feed rate for dry additives.

(D) Mixing Equipment. The additive/sludge blending or mixing vessel must be large enough to hold the mixture for 30 minutes at maximum feed rate. A batch process must maintain a pH greater than 12 in the mixing tank during this period. A continuous flow process must maintain a pH greater than 12 in the exit line and designed with the nominal detention time (defined as tank volume divided by volumetric input flow rate). Slurry mixtures may be mixed with either diffused air or mechanical mixers. The mixing equipment must maintain the alkaline slurry mixture in complete suspension.

(i) Air Mixing. An air mixing using coarse bubble diffuser must have a minimum air supply of 20 standard cubic feet per minute (scfm) per 1000 cubic feet of tank volume for adequate mixing. The mixing tank must be ventilated and include odor control equipment.

(ii) Mechanical Mixing. A mechanical mixer must provide between 5 to 10 HP per 1,000 ft^3 of tank volume. The impellers must minimize debris fouling in the sludge.

(E) Detention Time. A pasteurization vessel must provide a minimum retention period of thirty (30) minutes. The report must specify the provisions for external heat.

§217.250. Sludge Dewatering.

This section contains the minimum design criteria for comprehensive consideration of wastewater sludge dewatering unit processes. The report must include the reasons for the proposed units, design calculations, results from any pilot studies, all assumptions, and appropriate references. The engineer shall design the dewatering units using mass balance principles.

(1) General Requirements.

(A) Centrate or Filtrate Recycle. The drainage from beds and centrate or filtrate from dewatering units must be returned to the head of the wastewater facility. The engineer shall include these organic loads in the design of any downstream units.

(B) Sludge with Industrial Waste Contributions. The dewatering system must not allow the release of constituents such as free metals, organic toxins, or strong reducing/oxidizing compounds in a manner that threatens water quality or discharge permit compliance.

(C) Redundancy.

(i) A mechanical dewatering system must have at least two units, unless the report justifies adequate storage or an alternative means of sludge handling.

(ii) When performance reliability and sludge management options are dependent on production of dewatered sludge, each of the mechanical dewatering units must:

(I) operate for less than sixty (60) hours during any six day period; and

(II) be able to dewater in excess of 50% of the average daily sludge flow with the largest unit out of service.

(iii) The requirements for excess capacity must be based on the type of equipment provided, peak sludge factor, and storage capability.

(D) Storage Requirements.

(i) A mechanical dewatering system must have separate storage if the equipment will not operate on a continuous basis and the treatment system has no digesters with built-in short-term storage.

(ii) In-line storage of stabilized or un-stabilized sludge must not interfere with any of the treatment units.

(iii) The separate sludge storage from primary digesters must be aerated and mixed to prevent nuisance odor conditions.

(E) Sampling Points. The dewatering system must have sampling stations before and after each dewatering unit or any other segment of the unit identified in the report and must allow periodic evaluation of the dewatering process.

(F) Bypass Requirements. All dewatering system units must have bypass capabilities to allow maintenance.

(2) Sludge Conditioning.

(A) The dewatering system must provide adequate mixing time for the reaction between the chemical or other additive and the sludge. Any subsequent handling must eliminate floc shearing.

(B) The engineer shall design the addition point location in relation to downstream equipment and in relation to the combined effect of other additives.

(C) The report must include pilot plant testing or full size performance data used by the engineer to determine the characteristics and design dosage of the additives.

(D) The report must justify in-stream flocculation/coagulation system designs by comparable performance data or pilot plant testing. The engineer shall determine whether the mixers require conditioning tanks. The report must include calculations for the capability for variable detention times.

(E) Solution storage or day tanks may be smaller than the design volume required for daily dosages if the equipment design does not require continuous operation.

(F) A minimum of eight (8) hours storage must be provided, unless the specific chemical or additive selected is adversely affected by storage.

(G) The storage for batch operations must be adequate for one batch at maximum chemical demand.

(H) The report must justify any storage volume reductions and any other methods to ensure a continuous supply of chemicals through the operating day or batch.

(3) Sludge Drying Beds. The engineer may design the sludge drying beds size based on data from similar facilities in the same geographical area with the same influent sludge characteristics. If such data is unavailable, or if the executive director determines that the data is not appropriate for the proposed facility, the engineer shall design sludge drying beds according to the following:

(A) Open Beds.

(i) A sludge drying bed system must have at least two beds.

(ii) The engineer shall calculate the minimum surface area for sludge drying beds using the values in Table J.2 for areas of the state with less than 45 inches annual average rainfall and annual average relative humidity of less than 50%, as determined by National Weather Service data.

(iii) The engineer shall design other methods of sludge dewatering in lieu of sludge drying beds in areas of the state that experience both high rainfall (greater than 45 inches average annual rainfall) and high relative humidity (annual average of 50% or greater), as determined by National Weather Service data.

(iv) The design must:

(I) provide methods of effectively dewatering sludge;

(II) provide a means for accelerated dewatering;

(III) increase the size of the sludge drying beds sufficiently to store accumulated sludge during periods of extended high humidity and rainfall; and

(IV) provide an alternative dewatering method to effectively dewater the sludge during periods of extended high humidity and rainfall.

(v) The report must provide justification for use of modified sludge drying beds in high rainfall, high relative humidity areas of the state. **Figure 1: §217.250(3)(A((i)**

Table J.2 - Surface Area Requirements For Sludge Drying Beds	
Stabilization Process	Pounds Digested Dry Solids Per Square Foot Per Year
Anaerobic Digestion	20.0
Aerobic Digestion	15.0

(B) Gravel Media Beds. A gravel media bed must be laid in two or more layers. The gravel around the underdrains must be properly graded and must be at least 12 inches in depth, extending at least six inches above the top of the underdrains. The top layer of the gravel media bed must be at least three inches thick and must consist of gravel 1/8 inch to 1/4 inch in size.

(C) Sand Media Beds. A sand media bed must consist of at least 12 inches of sand with a uniformity coefficient of less than 4.0 and an effective grain size between 0.3 and 0.75 millimeters above the top of the underdrain.

(D) Underdrains. The underdrains must be at least four inches in diameter and sloped not less than one percent to drain. The underdrains must be spaced not more than 20 feet apart.

(E) Decanting. A sludge drying bed may have a method of decanting supernatant installed on the perimeter of the bed.

(F) Walls. The interior walls of a sludge drying bed must be watertight and extend 12 to 24 inches above and at least 6 inches below the bed surface. The exterior walls of a sludge drying bed must be watertight and extend 12 to 24 inches above the bed surface or ground elevation, whichever is higher.

(G) Sludge Removal. The sludge drying bed system must be arranged to facilitate sludge removal. The sludge drying beds must have concrete pads for vehicle support tracks on 20-foot centers for all percolation type sludge beds.

(H) Sludge Influent. The sludge pipe to the beds must terminate at least 12 inches above the surface of the media and be arranged so that the pipe drains to a sump to be pumped to the headworks. The sludge discharge points must have concrete splash plates.

(I) Drying Bed Bottom. The bottom of a sludge drying bed must consist of a minimum of one-foot layer of clayey subsoil having a permeability of less than 10^{-7} cm/sec. An impermeable concrete pad must be installed over the liner in locations where the ground water table is within four (4) feet of the bottom.

(4) Modified Drying Beds. The executive director will review any vacuum assisted or other variations to the gravity drying bed concept as innovative and/or nonconforming technologies subject to §217.10(2) (relating to Types of Approvals).

(5) Rotary Vacuum Filtration.

(A) Filtration Rate. The engineer may calculate the rates of filtering for various types of sludge with proper conditioning, using Table J.3,. The report must justify the actual value.

Figure 2: §217.250(5)(A)

Table J.3 - Filtration Rates	
Type of Treatment	Pounds of Dry Solids Per Square Foot Per Hour (Minimum - Maximum)
Primary	4-6
Primary and Trickling Filter	3-5
Primary and Activated Sludge	3-4

(B) Duplicate Equipment. Unless dual trains are provided, the following equipment must be provided in duplicate to allow equipment alternation: feed pump, vacuum pump and filtrate pump. Spare filter fabric must be provided except when metal coils are used.

(C) Filter Equipment. Wetted parts must be constructed of corrosion-resistant material. Drum and agitator assemblies must be equipped with variable-speed drives, and provisions must be made for altering the liquid level.

(D) Filter Speed Requirements. The filter must have variable speed.

(E) Pumps.

(i) A vacuum pump with a capacity of at least 1.5 cfm per square foot must be provided for metal-covered drums. A dry-type vacuum pump must have a vacuum receiver.

(ii) A filtrate pump must have adequate capacity to pump the maximum amount of liquid to be removed from the sludge.

(iii) Each filter must be fed by a separate feed pump to ensure a proper feed rate.

(6) Centrifugal Dewatering.

(i) The report must justify the sizing and design of the centrifugation system. The engineer shall use performance data developed from similar operational characteristics when designing the size of a centrifugation system when available. If no performance data is available, the engineer shall use the results of a pilot scale tests or full scale tests. The engineer shall account for the abrasiveness of each sludge supply in scroll selection.

(ii) The engineer shall design adequate sludge storage.

(iii) Unless dual trains are provided, the centrifugation system must have the following spare appurtenant equipment with necessary connecting pipes and electrical controls:

(I) drive motor;

(II) gear assembly; and

(III) feed pump.

(iv) Each feed pump must have variable speed.

(v) Each centrifuge must have a separate feed system.

(vi) Each centrifuge must be equipped for variable scroll speed and pool depth.

(vii) Each centrifugation system must have a crane or monorail for equipment removal or maintenance.

(viii) The engineer must design provisions for adequate and efficient wash down of the interior of the machine.

(7) Plate and Frame Presses.

(A) Sizing.

(i) The engineer shall use performance data developed from similar operational characteristics when designing the size of a plate and frame press when available. If no performance data is available, the engineer must use the results of a pilot scale tests or full scale tests.

(ii) The engineer may use appropriate scale-up factors for full size designs if pilot scale testing is done in lieu of full-scale testing.

(iii) The report must justify the size the plate and frame press.

(B) Duplicate Equipment and Spare Parts. Unless multiple units are provided, a plate and frame press system must include the following spare appurtenances:

(i) a duplicate feed pump;

(ii) at least one extra plate for every ten required for startup, but not less than two;

(iii) one complete filter fabric set;

(iv) one closure drive system;

(v) air compressor; and

(vi) one washwater booster pump.

(C) Operational Requirements.

(i) The filter feed pumps must be capable of a combination of initial high flow, low pressure filling, followed by sustained periods of operating at 100 to 225 psi.

(ii) The engineer may use an integral pressure vessel to produce this initial high volume flow.

(iii) The plate and frame system may use operating pressures less than 225 psi if the report includes actual performance data using similar sludge justifying such a use.

(iv) The engineer may design provisions for cake breaking to protect or enhance down line processes where necessary.

(D) Maintenance.

(i) The plate and frame system must have crane or monorail services capable of removing the plates.

(ii) The plate and frame system must have a high pressure water or acid wash system to clean the filter.

(8) Belt Presses.

(A) Sizing.

(i) The engineer must use actual performance data developed from similar operational characteristics to size a belt press system or appropriate scale-up factors for full size designs if pilot plant testing is performed in lieu of full-scale testing.

(ii) A belt press system must have a second belt filter press or a backup method of sludge disposal approved by the executive director if a single belt press will be operated sixty (60) hours or more within any consecutive five (5) day period, or whenever the average daily flow received at the treatment works equals or exceeds four (4) mgd.

(iii) The report must include all data used to size the belt press system.

(B) Duplicate Equipment and Spare Parts. Unless multiple units are provided, a belt press system must have the following spare appurtenances:

(i) a duplicate feed pump;

(ii) washwater booster pumps;

(iii) one complete set of belts;

(iv) one set of bearings for each type of press bearing;

(v) duplicate tensioning;

(vi) tracking sensors;

(vii) one set of wash nozzles;

(viii) one doctor blade; and,

(ix) duplicate conditioning or flocculation drive equipment.

(C) Conditioning. The report must include the engineer's polymer selection methodology, accounting for sludge variability and anticipated sludge loading to the press.

(D) Sludge Feed.

(i) The sludge feed must be relatively constant to eliminate difficulties in polymer addition and press operation.

(ii) The report must include the range in feed variability.

(iii) The sludge feed may include equalization.

(iv) The belt press system may include grinders ahead of the flocculation system.

(v) The sludge feed must provide a method for uniform sludge dispersion on the belt.

(vi) The belt press system must use thickening of the feed sludge unless the report justifies separate thickening or dual purpose thickening.

(E) Filter Press Belts.

(i) The belt must have variable speed.

(ii) The belt press system must have belt tracking and tensioning equipment.

(iii) The report must justify the weave, material, width, and thickness of the belts.

(F) Filter Press Rollers.

(i) The rollers must have a protective finish.

(ii) The engineer shall calculate the maximum roller deflection and operating tension of the belt to justify equipment selection.

(iii) The roller bearings must be watertight and rated for a B-10 life of 100,000 hours.

(G) Spray Wash System.

(i) The belt press system must use high pressure wash water for each belt.

(ii) The engineer shall determine the specified operating pressure at the point of washwater discharge.

(iii) The spray wash system may include booster pumps.

(iv) The spray wash system must allow cleaning without interfering with the system operation.

(v) The engineer shall justify the nozzle selection and optional nozzle cleaning systems when recycled wastewater is used for belt washing.

(vi) The belt press system must have replaceable spray nozzles and spray curtains.

(H) Maintenance Requirements.

(i) The belt press system must have drip trays under the press and under the thickener when gravity belt thickening is employed.

(ii) The side and floor of the belt press must have adequate clearance for maintenance and removal of the dewatered sludge.

(iii) All electrical panels or other materials subject to corrosion must be located outside of the press area.

(iv) The doctor blade clearance must be adjustable.

§217.251. Sludge Storage.

This section applies to the storage of residuals after processing but before final disposal or removal from the site. The site may store solids in either liquid, dewatered, or dry form if the solids have been stabilized in the treatment process.

(1) General.

(A) The engineer shall design the storage facility to abate nuisance and odor conditions and vector attraction.

(B) A storage facility must provide storage of waste sludge outside of the biological treatment process.

(C) When designing a storage facility, the engineer shall consider process design, sludge age, waste stream concentration, operational hours, operational volume in tanks, decant or dewatering volumes and characteristics, time frames needed for decanting or dewatering, and volume needed for storage and sampling.

(D) The report must include a solids management plan that demonstrates a method of managing the waste solids that will maintain the design sludge age for the biological process.

(2) Solids Storage (Not Dewatered).

(A) Aerobically Digested Solids.

(i) The storage facility may store aerobically digested solids.

(ii) The basin must have diffused air or mechanical mixing.

(iii) A diffused air mixing unit must have minimum air requirement of 30 standard cubic feet per minute per 1000 cubic feet of volume.

(iv) A mechanical surface aerators must have a minimum horsepower requirement of 1.0 horsepower per 1000 cubic feet of volume.

(v) An earthen basin must be lined in accordance with §217.202(3) and (4) of this title (relating to General Design Considerations for Natural Systems).

(B) Anaerobically Digested Solids. A storage facility may store anaerobically digested solids in covered basins. The storage facility must abate nuisance odor conditions.

(3) Dewatered Solids Storage.

(A) A storage facility may store dewatered solids with a solids content of less than 35 percent for no more than 7 days .

(B) The storage facility must store dewatered solids in steel or concrete containers that preclude re-wetting by rainfall.

(C) A storage facility may store dewatered solids with a solids content of less than 50 percent and greater than or equal to 35 percent for no more than 90 days.

(D) The storage facility must store the dewatered solids in containers or in stockpiles that preclude re-wetting by rainfall.

(4) Open Stockpiles

(A) A stockpile must have an impervious pad underneath the solids to preclude groundwater contamination.

(B) A stockpile must have provisions for collecting rainfall runoff and returning the runoff to the head of the treatment facility.

(5) Dried Solids Storage.

(A) A storage facility may store dewatered solids with a solids content of greater than or equal to 50 percent in bins or covered facilities.

(B) The enclosed storage structure must be mechanically ventilated between 20 to 30 air changes per hour and must have an odor control system for the exhaust air.

§217.252. Final Use or Disposal of Sludge.

The report must identify the final use or disposal of the sludge. The use, disposal, and transportation of sludge must be conducted in accordance with the requirements contained in Chapter 312 of this title (relating to Sludge Use, Disposal and Transportation).

(1) Quantities. The engineer shall estimate the quantity of solids generated by the treatment process from similar full scale facilities or pilot facilities. The engineer shall use a mass balance approach to determine the quantity of sludge produced at the facility.

(2) Pollutants. The engineer shall determine the pollutants in sludge using Standard Method's laboratory test procedures. The engineer shall design the use or disposal option based on the character of the sludge. The pollutant levels must be less than the levels specified in Chapter 312 of this title.

(3) Pathogens. The engineer shall design the wastewater treatment facility to reduce pathogens to levels specified in Chapter 312 of this title with regards to the ultimate use or disposal method.

(4) Vector Attraction. The engineer shall design the wastewater treatment facility to reduce vector attraction of the sewage sludge to levels specified in Chapter 312 of this title with regards to the ultimate use or disposal method.

(5) Emergency Provisions. The report must include a backup plan in the event of equipment failure or conditions which prevent the facility's primary use or disposal method.

(6) Weather Factors. The engineer shall account for weather factors such as rainfall, wind conditions, and humidity in the selection of the use or disposal of sewage sludge.

SUBCHAPTER K : DISINFECTION
§§217.270-217.278

STATUTORY AUTHORITY
The rules in Subchapter K, Disinfection, are proposed under the authority of Texas Water Code, § 5.013, which provides the commission's general jurisdiction; § 5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; § 5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; § 5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.270. Applicability.

This subchapter details the requirements for disinfection, dechlorination, post aeration, and sampling point locations.

§217.271. Chlorine and Sulfur Dioxide Disinfection and Dechlorination Systems.

(a) Redundancy.

(1) All chlorine, sulfur dioxide disinfection, and dechlorination systems must include at least two banks of cylinders.

(2) A bank of cylinders must meet the requirements of cylinder bank sizing requirements in subsection (b)(2) of this section.

(3) A bank of cylinders must include a device that automatically switches operations from an empty bank of cylinders to a full bank of cylinders in a manner that ensures continuous disinfection. The facility must have sufficient space to store a bank of empty cylinders.

(4) A facility must include a minimum of two chlorinators, sulfonators, or evaporators.

(5) The engineer shall design the chemical delivery systems so that the pound per day requirements in subsection (b)(1) of this section are satisfied with the largest chlorinator, sulfonator, or evaporator out of service.

(6) A chemical delivery system must include backup pumps for any injector water supply systems requiring booster pumps.

(b) Capacity and Sizing.

(1) Pounds per Day Requirements.

(A) The engineer shall design the capacity of the chlorine and sulfur dioxide gas withdrawal systems by using the 2-hour peak flow in accordance with §217.32(2) of this title (relating to Design of New Systems Organic - Loadings and Flows) or §217.33(1) of this title (relating to Design Existing Systems - Organic Loadings and Flow) and Equation 1.k. Table K.1 establishes the minimum acceptable design chlorine dosage for disinfection.

Figure 1: §217.271(b)(1)

$$PPD = Q * D * 8.34 \qquad \textit{Equation 1.k}$$

PPD = pounds per day of chlorine or sulfur dioxide required for treatment
Q = peak 2 hour flow (millions of gallons per day)
D = chlorine concentration from Table 1, or sulfur dioxide dosage needed to dechlorinate the expected chlorine residual
8.34 = conversion factor

Table K.1 - Minimum Design Chlorine Concentration Needed for Disinfection	
Type of Effluent	Chlorine Concentration (mg/l), (D)
Primary	15
Fixed Film	10
Activated Sludge	8
Tertiary Filtration Plant Effluent	6
Nitrified Effluent	6

(B) The engineer shall design the dechlorination system using at least one unit of sulfur dioxide gas to dechlorinate at least one unit of chlorine gas.

(2) Cylinder Bank Sizing. The engineer shall calculate the number of chlorine or sulfur dioxide cylinders required per bank of cylinders as follows:

(A) Cylinder Withdrawal Rates.

(i) Gas Withdrawal. The engineer shall calculate the gas withdrawal rate per cylinder using Equation 2.k and the variables from Table K.2.

(I) If the cylinders are not stored in a temperature-controlled area, the engineer shall calculate the ambient temperature based on the lowest 7-day average of the average daily local temperatures over the last 10 years, as measured at the nearest National Oceanic and Atmospheric Administration's (NOAA) National Weather Service weather station.

(II) Heating blankets on chlorine gas cylinders are prohibited.

Figure 2: §217.271(b)(2)(A)(i)

$$W_g=(T_A-T_{th})*F \qquad \textit{Equation 2.k}$$

T_A = Low Ambient Temperature, °F
T_{th} = Threshold Temperature, °F
F = Withdrawal Factor, lb/°F/day
W_g = Maximum Gas Withdrawal Rate per Cylinder, lb/day

Table K.2 - Threshold Temperatures And Withdrawal Rates For Chlorine And Sulfur Dioxide - *			
Gas and Cylinder Size	Withdrawal Factor, (F) lb/°F/day	Threshold Temperature, (T_{th}) for Cylinder Mounted Vacuum Regulator, °F	Threshold Temperature, (T_{th}) for Manifold Systems at 10-15 psig Pressure, °F
150 pound Chlorine Cylinder	1.0	0	10
1 ton Chlorine Cylinder	8.0	0	10
150 pound Sulfur Dioxide Cylinder	0.75	30	40
1 ton Sulfur Dioxide Cylinder	6.0	30	40
* - Values found in the Handbook of Chlorination, Second Edition, Geo. Clifford White, Van Nostrand Reinhold			

(ii) Liquid Withdrawal. If liquid withdrawal from one ton cylinders is proposed, the engineer must use the following maximum withdrawal rates: **Figure 3: §217.271(b)(2)(A)(ii)**

W_l(Chlorine) = 9,600 pounds per day
W_l(Sulfur dioxide) = 7,200 pounds per day

(B) Cylinders per Bank. The engineer shall calculate the number of cylinders per cylinder bank with Equation 3.k: **Figure 4: §217.271(b)(2)(B)**

$$Cyl=PPD/W_{g,l} \qquad \textit{Equation 3.k}$$

Cyl = minimum number of cylinders required per bank (round up to the nearest whole number)
PPD = pounds per day of chemical required as determined in equation 1.K

$W_{g,l}$ = pounds per day of chemical which may be withdrawn per cylinder as determined in §§217.271(b)(2)(A)(I) or (ii) of this title (relating to Gas Withdrawal and Liquid Withdrawal).

(c) Dosage Control.

(1) A new or modified chlorine and sulfur dioxide system must include automatic dosage control.

(2) The engineer shall design the dosage control to automatically adjust the dosage of chlorine or sulfur dioxide relative to the flow of the effluent stream.

(d) Handling of Chemicals. This subsection details requirements related to handling of sulfur dioxide and chlorine system equipment and cylinders.

(1) Systems Utilizing 150 Pound Cylinders.

(A) Heated Rooms.

(i) The chlorine and sulfur dioxide systems that use 150 pound cylinders must be located indoors at a minimum temperature of 65°F. This provision applies to all chemical feed equipment beginning at banks of cylinders and ending at the chlorinators or sulfonators, including the cylinders, chlorinators, and/or sulfonators.

(ii) Any unconnected cylinders may be stored outdoors, but the cylinders must reach at least 65°F before being connected to the system.

(B) Heating Blankets for 150 Pound Cylinders.

(i) Heating blankets on chlorine gas cylinders are prohibited.

(ii) Sulfur dioxide cylinders may have heating blankets in temperature controlled rooms to increase the temperature inside the cylinders above the ambient room temperature. The engineer shall determine what temperature the heating blankets may maintain inside the cylinders when stored at a 65°F or greater room temperature. The heating blanket must include a mechanism which ensures that the blankets do not heat the cylinders above 100°F. An operating cylinder must have a downstream pressure reducing valve. The sulfur dioxide system must be capable of deactivating the blanket if high pressure is detected downstream.

(C) Separation. A disinfection system using 150 pound cylinders must store all chlorine equipment and sulfur dioxide equipment in separate and completely isolated rooms and prevent any contact between the equipment. The design of these systems must ensure that chlorine and sulfur dioxide will never come into contact with each other.

(2) Systems Using One Ton Cylinders - Gas Withdrawal.

(A) Heated Rooms. The facility must locate the chlorinators and sulfonators for systems using one ton cylinders indoors at a minimum temperature of 65°F.

(B) Outdoor Storage of One Ton Cylinders.

(i) If one ton cylinders are stored outdoors, the engineer must determine the temperature used for system sizing in accordance with subsection (b)(2)(A) of this section.

(ii) If one ton cylinders are stored outdoors, the storage structures must protect the cylinders from direct sunlight and allow safe removal and replacement of the cylinders.

(iii) The operational cylinders stored outdoors may have heated pipes to prevent gas reliquification from occurring when the chemical enters the heated building or when gas cools down in pressure pipe.

(C) Heating Blankets for One Ton Cylinders.

(i) Heating blankets on chlorine gas cylinders are prohibited.

(ii) One ton sulfur dioxide cylinders may have heating blankets to increase the operating temperature of the sulfur dioxide system. The engineer shall determine what temperature the heating blankets may maintain inside the cylinders based on the lowest 7-day moving average of the daily local temperatures over the last ten years.

(iii) The engineer shall use the temperature as the ambient temperature when calculating the cylinder withdrawal rate in subsection (b)(2)(A) of this section.

(iv) The heating blankets must include a mechanism to prevent heating the cylinders above 100°F.

(v) The dechlorination system must have a pressure reducing valve downstream from the operating cylinders and a high pressure interlock to deactivate the blankets.

(D) Separation.

(i) The housing of the sulfur dioxide feed equipment for one ton cylinders must be separate from the chlorination feed equipment and cylinders.

(ii) A system with one ton cylinders must separate the chlorination and sulfonation feed equipment from the one ton chlorine and sulfur dioxide cylinders with a gas tight wall, except for the following exceptions:

(I) Sulfur dioxide cylinders and chlorine cylinders may be stored in the same area if:

(-a-) the cylinders are stored outdoors;

(-b-) the outlet valves of any one sulfur dioxide cylinder and the outlet valves of any one chlorine cylinder have a minimum distance of 10 feet; and

(-c-) the chlorine equipment and chlorine storage containers are marked separately from sulfur dioxide equipment and sulfur dioxide storage containers.

(II) Sulfur dioxide and chlorine chemical feed equipment may be stored in the same room if:

(-a-) both systems are a remote vacuum type;

(-b-) no pressure gas pipes exist in the room;

(-c-) no cylinders are stored in the room; and

(-d-) the design ensures that chlorine and sulfur dioxide cannot be mixed.

(3) Systems Utilizing One Ton Cylinders - Liquid Withdrawal.

(A) Heated Rooms. The chlorinators and sulfonators must be located indoors at a minimum temperature of 65°F.

(B) Outdoor Storage of One Ton Cylinders. The chlorine and sulfur dioxide cylinders for systems using liquid withdrawal may be stored outdoors without reducing the withdrawal rates assumed in subsection (b)(2)(A)(II) of this section.

(C) Separation. The separation requirements for one ton cylinder liquid withdrawal systems are the same as those for one ton cylinder gas withdrawal systems under subsection (d)(2)(D) of this section.

(e) Housing Requirements for Chlorine and Sulfur Dioxide Disinfection and Dechlorination Systems. This subsection establishes the requirements for the chemical storage building.

(1) Floor Drains. The floor drains from the chlorine or sulfur dioxide feed and storage rooms must not drain to any pipe system common with other rooms of the wastewater treatment system. The floor drains for the chlorine rooms must not drain to a pipe system common with floor drains for sulfur dioxide rooms.

(2) Doors and Windows.

(A) All doors must open to the outside of the building and include panic hardware.

(B) All enclosed rooms must include at least one clear, gas-tight window installed in the exterior door.

(C) The engineer may design additional windows to ensure adequate view of the disinfection and dechlorination systems may be viewed without entering the enclosed rooms.

(3) Ventilation.

(A) All enclosed storage and feed rooms must have forced mechanical ventilation with at least one air change every three minutes.

(B) The exhaust equipment must have external controls and leak detection equipment.

(C) The fan must be located at the top of the room to push air across the room and through an exhaust vent located at the bottom of the room on the opposite side.

(D) The location of the exhaust vent must not allow contamination of air inlets into other buildings.

(E) The exhaust system may use negative pressure ventilation instead of the forced mechanical ventilation if the facility has gas containment and treatment as prescribed by the current Uniform Fire Code (UFC).

(F) The vents from the sulfur dioxide or chlorine gas feed systems must exhaust to a point which is not frequented by personnel and not near a fresh air intake and must be clearly identified.

(4) Gas Detectors and Protection.

(A) An area containing chlorine or sulfur dioxide under pressure must have gas detectors and alarms.

(B) An area for handling pressurized gases must have respiratory air-pac protection equipment meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH).

(C) The respiratory equipment must be immediately accessible.

(D) The storage of respiratory equipment inside any rooms where gases are stored or used under pressure is prohibited.

(E) The respiratory equipment storage area must include instructions for using the equipment.must be kept with, or posted next to, the equipment.

(F) The respiratory units must use compressed air and must have at least a 30-minute capacity.

(f) Equipment and Materials. All equipment and materials used in the disinfection and dechlorination systems must be the type that the manufacturer recommends for the pertinent chemical.

(1) Storage Orientation. The one ton cylinders must be stored horizontally on trunnions. The 150 pound cylinders must be stored vertically and be secured by a clamp or chain.

(2) Measurements. All chlorine and sulfur dioxide systems must have a scale for determining the amount of chemical used daily and the amount of chemical remaining in the container.

(3) Pressure Pipe Systems- Gas Transport.

(A) Gas transport pressure pipes must be constructed of schedule 80 black seamless steel pipe with 2,000 pound forged steel fittings.

(B) The use of PVC at any points in a pressure pipe system is prohibited.

(C) A one ton cylinder system must use gas filters upstream of any pressure reducing valves.

(D) A pressure pipe system must have pressure reducing valves in the following situations:

(i) systems with long lengths of supply pipes;

(ii) sulfur dioxide systems with heating blankets; and,

(iii) in the pressure pipes on the discharge side of evaporators.

(E) The pressure pipes at the gas discharge side of an evaporators must have rupture disks and high pressure switches that warn of disk rupture.

(F) The gas pipe entering a chlorinator or sulfonator must have a heated leg drop sediment trap.

(G) Sulfur dioxide systems must have 316 stainless steel seat and stem in lieu of the monel seat and stem used in chlorine systems.

(4) Pressure Pipe Systems - Liquid Transport.

(A) The use of PVC in a pressure pipe system is prohibited.

(B) The manifolding of one ton containers for simultaneous liquid chemical withdrawal is prohibited.

(C) A liquid pipe system must include a rupture disk, a pressure switch to warn of disk rupture and an expansion chamber.

(5) Vacuum pipes. The vacuum pipes and fittings may be PVC or 316 stainless steel downstream of the vacuum regulator. The vacuum pipes must have socket joints.

(6) Diffusers. The report must include calculations that verify a minimum velocity of 10 feet per second through any chlorine or sulfur dioxide system diffuser, unless the diffuser has a mechanical mixer.

§217.272. Design of Sodium Hypochlorite and Sodium Bisulfite Systems.

(a) Redundancy. A sodium hypochlorite and sodium bisulfite system must include at least two chemical solution pumps and must ensure that the capacity requirements of §217.271(b)(1) of this title (relating to Chlorine and Sulfur Dioxide Disinfection and Dechlorination Systems) are met with the largest pump out of service.

(b) Capacity and Sizing. The engineer shall design the size of the chemical liquid solution pumps and pipe system as follows:

(1) Sodium Hypochlorite (NaOCl).

(A) Determine Pounds Per Day of Chlorine Required. The engineer shall use Table 1 and equation 1 in §217.271(b)(1) of this title (relating to Chlorine and Sulfur Dioxide Disinfection and Dechlorination Systems) to determine the pounds per day of chlorine required.

(B) Cl_2 Determination. The engineer shall determine pounds of available Cl_2 per gallon of NaOCl solution using values supplied by chemical manufacturer and appropriate references.

(C) Gallons per Hour Determination. The engineer shall calculate the gallons per hour using the values found in §217.271(b)(1) of this title in Equation 4.k in order to size the chemical metering equipment. **Figure 1: §217.272(b)(1)(C)**

*R=PPD/(24*C)* *Equation 4.k*

R	=	minimum size of chemical metering equipment, (gal/hr)
PPD	=	pound per day of Cl_2 which must be delivered to the wastewater, (ln/day)
C	=	Pounds of available Cl_2 in one gallon of NaOCl, (lb Cl_2/gal)

(2) Sodium Bisulfite ($NaHSO_3$).

(A) Determine Assumed Pounds Per Day Of Chlorine Residual Which Must Be Dechlorinated. The engineer shall use Equation 1 in §217.271(b)(1) of this title (relating to Pounds Per Day

Requirements) to determine the pounds per day of chemical required.

(B) Calculate Pounds of $NaHSO_3$ Needed. The minimum amount of $NaHSO_3$ needed to dechlorinate one pound of chlorine is 1.465 pounds. The engineer shall multiply the pounds per day of chlorine which must be dechlorinated, as determined in subparagraph (A) of this paragraph, by 1.465 pounds of $NaHSO_3$ per pound of Cl_2, to determine the pounds of $NaHSO_3$ needed.

(C) Gallons Per Hour Of $NaHSO_{3.}$ The engineer shall calculate the gallons per hour (R) of $NaHSO_3$ solution needed from the chemical metering equipment with equation 5.k. **Figure 1: §217.272(b)(2)(C)** *Equation 5.k*

$$R=(\text{lbs } NaHSO_3)/[(10.9 \text{ lbs } NaHSO_3/\text{gallon } NaHSO_3)*(1/\text{solution strength in percent})*24]$$

(c) Dosage Control.

(1) The engineer shall design the dosage control systems to automatically adjust sodium hypochlorite or sodium bisulfite feed rate to correspond to at least the flow of the effluent stream.

(2) The following systems must have automatic dosage control:

(A) all upgrades to existing sodium hypochlorite and sodium bisulfite systems; and

(B) all new sodium hypochlorite and sodium bisulfite systems.

(d) Handling of Chemicals.

(1) Storage Tank Sizing.

(A) The bulk storage facilities for solution strengths greater than or equal to 10% must not be sized to store more than a 15-day supply of sodium hypochlorite, unless a residual analyzer or oxidation-reduction potential (ORP) monitoring provides automatic feed control to compensate for solution degradation.

(B) For solution strengths are less than 10%, and where residual analyzers or ORP instruments are provided for sodium hypochlorite solutions, the bulk storage facilities must not be sized to store more than a 30-day supply of sodium hypochlorite.

(C) A facility with design flows above 1 mgd must have at least two tanks.

(2) Temperature considerations.

(A) If sodium hypochlorite tanks are not stored indoors, the tanks must be opaque or otherwise block sunlight penetration.

(B) A sodium bisulfite storage facility and pipes stored outdoors must be insulated and heat traced in locations where the ambient temperature, based on the lowest 7-day average of the average daily local temperatures over the last 10-years as measured at the nearest National Oceanic and Atmospheric Administration's (NOAA) National Weather Service weather station, is below 40°F.

(e) Equipment and Materials.

(1) The materials used for storage, pumping, and transport of sodium hypochlorite must be per manufacturer's recommendation and suitable for use with a corrosive chemical environment.

(2) The materials used for storage, pumping and transport of sodium bisulfite must be per manufacturer's recommendations and suitable for use with an acidic chemical environment.

(f) Safety.

(1) Ventilation. A chemical storage area must be ventilated to prevent buildup of fumes.

(2) Liquid-depth indicators. A storage tank must have external-tank liquid-depth indicators.

(3) Spill containment.

(A) A chemical storage area must have secondary containment equal to 125 percent of the volume of the full content of the largest storage tank.

(B) A manifolded tank must have secondary containment adequate to contain 125 percent of the cumulative manifolded tank volume, unless the pipe system precludes a combined release.

(C) The tanks must be placed on equipment pads:

(i) elevated above the secondary containment maximum liquid level, or

(ii) provided with positive drainage from below the tank.

(D) The containment system for sodium hypochlorite must be separate from the containment system for sodium bisulfite.

(4) Emergency and Protective Equipment. A chemical storage area must have at least one emergency eye wash station and adequate personal protective equipment for all personnel working in the area.

§217.273. Application of Disinfection and Dechlorination Chemicals.

(a) Mixing Requirements.

(1) New Facility. A new facility must be constructed so that the applied chlorine is thoroughly mixed with the wastewater prior to entry into the chlorine contact chamber.

(2) Mixing Zones. The engineer must not count any mixing zones within the chlorine contact basins of existing facilities as part of the volume needed for disinfection.

(3) Chlorine and Sodium Hypochlorite. The disinfection system must apply the chlorine gas or solution in a highly turbulent flow regime created by in-line diffusers, mechanical mixers, or jet mixers. Effective initial mixing for the mean velocity gradient in the area of turbulent flow, (G value), must exceed 500/sec.

(4) Sulfur Dioxide and Sodium Bisulfite. The engineer shall determine the appropriate degree of mixing for a sulfur dioxide and sodium bisulfite system to ensure compliance with all relevant discharge permit requirements. The disinfection system must provide a mean velocity gradient, or G value, of $250/sec^{-1}$ or greater.

(b) Disinfection Contact Basins.

(1) The engineer shall design the chlorine contact basin to provide a minimum hydraulic residence time at 2-hour peak flow of 20 minutes.

(2) The engineer shall design the contact chambers to prevent short circuiting and that at least 70 percent of the wastewater is retained in the basin for 20 minutes.

(3) The report must include supporting data from contact basin design models, performance data of similar designs, or field tracer studies.

(c) Dechlorination Contact Time. The disinfection system must have sufficient mixing and contact time between the disinfected wastewater and the dechlorinating agent to ensure continuous compliance with the permitted chlorine limits. The minimum contact time at peak flow is 20 seconds.

§217.274. Other Chemical Disinfection and Dechlorination Systems.

All chemical disinfection or dechlorination systems not discussed in this subchapter, are subject to the requirements of §217.10(2) of this title (relating to Types of Approvals).

§217.275. Ultraviolet Light Disinfection Systems.

The engineer shall use §309.3 of this title (relating to Application of Effluent Sets) for the permit requirements when designing ultraviolet (UV) light disinfection systems.

(1) Definitions.

(A) Modules. A module is defined as a grouping of UV lamps, electrically and physically connected together to form an independent subcomponent of a bank and is not capable of treating the full channel design width and depth.

(B) Banks. A bank is defined as a grouping of individual UV lamps or modules, electrically connected together and physically connected together or physically adjacent to each other that forms a complete unit capable of treating the full channel design width and depth. A bank may include several individual lamps or several modules. A complete UV system may include multiple channels with several banks in each channel.

(2) Redundancy.

(A) Ultraviolet (UV) disinfection systems must include a minimum of two banks of UV bulbs.

(B) The engineer shall design UV light disinfection systems so that the dosage requirements determined from paragraph (4) of this section is met when the largest bank of UV bulbs in each channel is out of service at 2-hour peak flow as defined in §217.32(1) or §217.33(1) of this title (relating to Design of New Systems - Organic Loadings and Flows and Design of Existing Systems - Organic Loadings and Flows).

(3) Monitoring and Alarms.

(A) The operator shall continuously monitor the following:

(i) the UV flow rate in each disinfection channel;

(ii) the UV transmittance;

(iii) the UV liquid level in each disinfection channel;

(iv) the status of each UV bank (On/Off);

(v) the status of each UV lamp (On/Off);

(vi) the UV intensity measured by the greater of one probe per bank or one probe per 40 lamps; and

(vii) the lamp age in hours of each UV lamp.

(B) The operator shall not rely on flowrate as a means of automatic flow pacing.

(C) An automatic system must account for:

(i) flowrate;

(ii) intensity of the lamps; and

(iii) the age of the lamps continually.

(D) The banks of an UV lamp must indicate elapsed operating time.

(E) A UV system must include an alarm system.

(F) A facility that is not supervised 24-hours per day must include telemetry as part of the alarm system. The telemetry system must notify the licensed operator of a facility in the event of all UV alarms.

(G) An UV system must include the following minimum alarm conditions:

(i) Minor alarms must be included for low UV intensity (45% after 100 hours burn in), high temperature and individual lamp failure.

(ii) Major alarms must be included for low UV intensity (25% after 100 hour burn in), adjacent lamp failure, multiple lamp failures (more than 5% of lamps in one bank), communication failure and module failure.

(4) Hydraulics. The engineer shall use the manufacturer's tracer studies for each lamp/ballast configuration of the UV systems. The tracer studies must determine the residence time distribution (RTD) for each configuration of lamps/ballasts. The engineer shall use the RTDs in conjunction with a bioassay in subsection (d) of this section as the basis of design.

(5) Dosage and System Sizing.

(A) The engineer may size the low pressure systems based on the latest version of the EPA's UV disinfection model titled Ultraviolet Light Disinfection System Evaluation (UVDIS).

(B) The executive director may require a bioassay to be performed on low pressure systems sized using the UVDIS model.

(C) The engineer shall size all other UV disinfection systems on the results of a bioassay which was performed on a system developed by the same manufacturer.

(D) The engineer shall use the results of the bioassay to determine the minimum dose of the UV system and the minimum number of lamps/ballasts per unit of flow rate.

(E) The engineer shall submit the proposed design to accommodate different lamp/ballast configurations and comparable bioassays under the same testing protocol.

(F) The bioassay procedure must conform to the publication, USEPA (1986) "Design Manual: Municipal Wastewater Disinfection," EPA/625/1-86/021.

(G) The engineer shall design the UV system to deliver a minimum specified dose based on the following:

(i) UV lamp output at 65% of nominal,

(ii) UV transmittance based on treatment process,

(iii) RTDs, and

(iv) the results of a bioassay.

(H) The engineer may size the UV system based on full-scale pilot test data if the report details the testing results and protocol.

(I) A system sized on full scale pilot test data will be considered nonconforming technology for the purposes of this rule and must be subject to the requirements of §217.10(2) of this title (relating to Types of Approvals).

(6) Reactor Design.

(A) The approach channel must be unobstructed and have a minimum length before the first UV bank of 4 feet, or 2 times the channel water depth, whichever is larger.

(B) The downstream channel length must be unobstructed for a minimum length of 4 feet or 2 times the channel water depth, whichever is larger, following the last bank of UV lamps before the fluid level control device.

(C) The engineer shall design all inlets to the UV reactors to hydraulically distribute the reactor influent in plug flow with radial dispersion.

(D) The engineer shall design the inlet channels to provide equal flow distribution across all UV channels.

(E) The downstream discharge point of the reactor must include level controls that ensure that the UV bulbs remain submerged at a near constant depth regardless of flow.

(F) The maximum water surface elevation variation in each UV channel is 3 inches between periods of no flow (zero flow) and the maximum design peak flow.

(G) The upstream and downstream portions of the UV reactor channel between UV banks must be covered to shut out all natural light.

(7) Cleaning and Maintenance.

(A) The engineer shall design provisions for routine cleaning of the UV bulbs and modules and draining each UV disinfection channel.

(B) The UV system must have spare parts to meet the greater of:

(i) one complete uninstalled module; or

(ii) as a percentage of the total system equaling at least:

(I) 5% of the lamps;

(II) 2% of the ballasts;

(III) 5% of the enclosure tubes; and

(IV) 2% of the modules or a minimum of one.

(8) Safety. All personnel must wear appropriate clothing, UV rated face shields, and safety glasses or goggles in the reactor area.

§217.276. Power Reliability.

(a) A disinfection system must include a backup power system capable of providing sufficient power to operate during any power outage.

(b) The backup power system must automatically restart the disinfection system during a power outage.

(c) The backup power system must meet the requirements of §217.35 of this title (relating to Backup Power Requirements).

§217.277. Post Aeration.

(a) The disinfection system must include post aeration to ensure compliance with dissolved oxygen (DO) requirements in the facility's wastewater discharge permit.

(b) If the wastewater discharge permit requires a minimum DO of 5 mg/l or greater, the report must include the calculations that show how the disinfection system will maintain the minimum DO level.

§217.278. Sampling Points.

The engineer shall incorporate accessible sampling points into the design of the wastewater treatment system to allow the operator to monitor the system and identify the location of the sampling points in the report.

SUBCHAPTER L : SAFETY
§§217.290-217.307

STATUTORY AUTHORITY
The rules in Subchapter L, Safety, are proposed under the authority of Texas Water Code, §5.013, which provides the commission's general jurisdiction; §5.103, which provides the commission's authority to adopt any rules necessary to carry out its powers and duties under the laws of Texas; § 5.105, which provides the commission's authority to, by rule, establish and approve general policy of the commission; § 5.120, which provides the commission's authority to administer the law to promote conservation and protection of the quality of the environment; §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and §26.041, which provides the commission's authority to set standards to prevent the discharge of waste that is injurious to the public health.

§217.290. Applicability.

This subchapter establishes the general safety requirements for the design, construction, and installation of wastewater treatment facilities.

§217.291. General Policy.

(a) The engineer shall address occupational safety, health hazards and risks to the workers, other persons, and the public as part of treatment process, disinfection, and chemical selection in preliminary and final designs.

(b) The engineer shall select and specify processes that require or use non-hazardous, non-toxic, less hazardous or less toxic chemicals, diluted forms of chemicals, and a minimum inventory of chemicals.

(c) The engineer shall use guidelines established under 29 CFR Parts 1901.1 Occupational Safety and Health Administration (OSHA).

(d) The engineer's design and the report must address the following safety issues:

(1) walking and working surfaces;

(2) means of access and egress;

(3) occupational health and environmental controls;

(4) hazardous materials and toxic and hazardous substances;

(5) general environmental controls;

(6) fire and explosion hazard protection;

(7) compressed gas and equipment;

(8) material handling and storage;

(9) machinery and machine guarding;

(10) hand and power tools and other hand held equipment;

(11) electrical systems;

(12) confined space entry;

(13) lockout/taggout of energy sources;

(14) site fence and other fencing;

(15) portable equipment such as lighting, blowers, and ventilators;

(16) warning signs for slippery areas;

(17) non-potable water;

(18) low head clearance;

(19) open service manholes, vaults, and tanks;

(20) railways and walkways;

(21) hazardous/toxic chemical storage areas;

(22) ventilation; and

(23) eyewash fountains and safety showers.

(e) The engineer shall demonstrate compliance with subsection (d) of this section by implementing §§217.292 and 217.293 of this title (relating to Safety Audit and Job Hazard Analysis and Protective Equipment Lists).

§217.292. Safety Audit and Plant Security.

(a) Safety Audit.

(1) The owner or designated representative for an existing facility being modified or expanded must conduct a safety audit of the facility for the prior three-year period in order to determine the locations, causes, types of injuries, and jobs being performed when the injuries occurred.

(2) The safety audit must:

(A) evaluate the locations and jobs associated with high injury or incident rates,

(B) identify corrective action, and

(C) implement corrective measures that will eliminate the cause or reduce the frequency, magnitude, and duration of exposure to the cause of the injury.

(3) The engineer shall address the corrective actions identified in the safety audit as part of the modification or expansion project.

(b) Plant/Systems Security. The owner or designated representative of an existing facility shall conduct a security audit.

(1) The owner or designated representative shall use the "Asset Based Vulnerability Checklist for Wastewater Utilities" by the Association of Metropolitan Sewerage Agencies (AMSA) or

(2) other alternative checklist with the approval of the executive director.

(c) Emergency Response. The owner or designated representative of an wastewater facility and/or wastewater collection system shall develop an emergency response management plan.

§217.293. Job Hazard Analysis and Protective Equipment Lists.

(a) The owner or designated representative shall perform an analysis of hazardous operation and maintenance for new, expanded, or modified facilities.

(b) In conjunction with the owner or designated representative, the engineer must develop a list of the following based on the hazardous jobs workers must perform:

(1) tools, equipment, and supplies;

(2) fixed and portable lifting equipment;

(3) fixed and portable monitoring equipment;

(4) personal protective equipment and clothes;

(5) warning signs and guards; and

(6) first-aid supplies.

(c) The tools must be sufficient to:

(1) allow workers to safely and properly operate equipment;

(2) perform required preventive maintenance, as per manufacturers' minimum requirements;

(3) make repairs; and

(4) maintain processes, pumps, motors, blowers, compressors, laboratory, instrumentation, and other equipment.

§217.294. Railings, Ladders, Walkways, and Stairways.

(a) The openings in railings must have removable chains.

(b) The open valve boxes, pits, tanks, and basins extending less than four feet above ground must have railings.

(c) Steep and vertical ladders are acceptable for infrequent access to equipment.

(d) Walkways, steps, landings, and ladder rungs must have a non-slip finish.

(e) Walkways above open tanks must have kick plates.

(f) Ladders must have flat safety tread rungs and extensions at least one (1) foot out of a vault.

(g) Overhead pipes must have seven feet of clearance unless the pipes are padded to prevent head injury and have warning signs.

§217.295. Electrical Code.

The electrical design must conform to local electrical codes. The electrical design must conform to the National Electrical Code if the facility's locations does not have a local electrical code.

§217.296. Unsafe Water.

(a) All yard hydrants and outlets for non-potable water must be properly marked "Unsafe Water."

(b) All pipes must be identified as specified in §217.298 of this title (relating to Color Coding of Pipes).

§217.297. Facility Protection.

(a) The facility area must be completely fenced and have lockable gates at all access points.

(b) A facility containing open clarifiers, aeration basins, and other open tanks must be surrounded by an eight-foot fence with a minimum single apron barbed wire outrigger, or a six-foot high fence with three strands of barbed wire to a height of 78 inches. A five strand barbed wire fence may be used in lieu of these chain link or board fences in rural areas for stabilization ponds, lagoons and overland flow plots. The fencing must have hazard signs stating "Danger - Open Tanks - No Trespassing" within visible sighting of each other and on all gates and levees.

(d) The facility must have at least one all-weather access road with the driving surface situated above the 100-yr. flood plain.

(e) The report must identify an alternate means of access during 100-year flood conditions.

§217.298. Color Coding of Pipes.

(a) A new facility must have color-coded pipes.

(b) All non-metallic underground pipes at new facilities must have tracer tape.

(c) An existing facility must color-code all pipes and install tracer tape when performing upgrades or modifications.

(d) The non-potable water pipes must be painted white and be stenciled "NON-POTABLE WATER" or "UNSAFE WATER." The pipes of a reclaimed water system must be marked and installed in accordance with Chapter 210 of this title (relating to the Use of Reclaimed Water).

(e) The engineer shall use the following coding:

(1) Sludge Line - Brown;

(2) Gas Line - Red;

(3) Potable Water Line - Light Blue;

(4) Chlorine Line - Yellow;

(5) Sulfur Dioxide - Lime Green with Yellow Bands;

(6) Sewage Line - Grey;

(7) Compressed Air Line - Light Green;

(8) Heating Water Line - Blue with 6" red bands spaced 30" apart;

(9) Power Conduit - Orange;

(10) Reclaimed Water Lines - Purple;

(11) Instrument Air - Light Green with Dark Green Bands

(12) Liquid Alum - Yellow with Orange Bands;

(13) Alum (solution) - Yellow with Green Bands;

(14) Ferric Chloride - Brown with Red Bands;

(15) Ferric Sulfate - Brown with Yellow Bands;

(16) Polymers - White with Green Bands;

(17) Ozone - Stainless Steel with White Bands; and

(18) Raw Water - Tan.

§217.299. Portable Ventilators and Gas Detection Equipment.

(a) A ventilating manhole must have portable, gasoline operated ventilators.

(b) A person whose job requires entering enclosed spaces capable of having accumulations of hydrogen sulfide or other harmful gases must wear a personal gas protector.

(c) An OSHA-approved personnel-retrieval system must be provided for confined space entry.

§217.300. Potable Water.

(a) The facility must have potable water with double check backflow preventers at the water main.

(b) All potable water wash down hoses must have atmospheric vacuum breakers

§217.301. Freeze Protection.

All surfaces subject to freezing must be sloped to prevent standing water.

§217.302. Noise Levels.

The noise levels in all working areas must remain below standards established by the Occupational Safety and Health Act. Removable noise attenuations are prohibited.

§217.303. Safety Training.

The facility must conduct safety training annually for all employees.

§217.304. Confined Space.

The engineer shall not design confined spaces as described in 29 CFR 1910.146.

§217.305. Plans and Specification Safety Review.

(a) The design plans and specifications must include reasonable and adequate safeguards to minimize worker exposure to workplace hazards.

(b) The engineer shall consider hazards associated with:

(1) abnormal atmospheres;

(2) airborne hazards;

(3) burns;

(4) harmful chemicals;

(5) confined spaces;

(6) drowning;

(7) earthquakes;

(8) electrical shock;

(9) elevated areas;

(10) explosive gases, liquids, and dusts;

(11) falls;

(12) fires;

(13) flooding;

(14) food contamination;

(15) housekeeping;

(16) impact;

(17) infections and diseases;

(18) ingress and egress;

(19) laboratory;

(20) ladders, stairs, and ramps;

(21) lifting;

(22) materials handling;

(23) moving machinery;

(24) natural hazards;

(25) night operations and maintenance;

(26) noise;

(27) noxious gases and vapors;

(28) openings;

(29) open tanks;

(30) overhead fixtures, pipes, and conduits;

(31) pinning and crushing;

(32) radioactive material;

(33) slips and falls;

(34) spillage and sprays;

(35) storms;

(36) vapors and dust;

(37) vehicles;

(38) ventilation;

(39) vibration;

(40) walkways;

(41) weather, and

(42) yard work.

(c) The engineer shall consider the following environmental conditions:

(1) noise,

(2) humidity,

(3) odor,

(4) temperature,

(5) illumination,

(6) vibration, and

(7) chemical exposure.

§217.307. Other Safety Design Guidelines.

The engineer must use the latest edition of Design of Municipal Treatment Plants, WEF Manual of Practice No.8, published by the Water Environment Federation or other authoritative documents for other safety design guidelines.