TITLE 252. DEPARTMENT OF ENVIRONMENTAL QUALITY
CHAPTER 626. PUBLIC WATER SUPPLY CONSTRUCTION STANDARDS

SUBCHAPTER 1. INTRODUCTION

252:626-1-2. Definitions

Terms have the meaning assigned in the Environmental Quality Code. The following words or terms, when used in this Chapter, have the following meaning unless the context clearly indicates otherwise:

"25-year flood" means a flood event that has a 4 percent chance of being equaled or exceeded in magnitude in any given year.

"100-year flood" means a flood event that has a 1 percent chance of being equaled or exceeded in magnitude in any given year.

"ANSI" means the American National Standards institute.

"APHA" means the American Public Health Association.

"API" means the American Petroleum Institute.

"Approvable", "Approve", "Approved" mean a submission to the DEQ that shall be considered a final submission, all preliminary discussions between the DEQ and the permittee regarding the requirements of a submission shall be concluded prior to the submission, so that the submission shall be deemed complete as submitted.

"ASTM" means the American Society for Testing Materials.

"AWWA" means the American Water Works Association.

"Board" means the Environmental Quality Board.

"Calculated dose" means the RED calculated using the dose-monitoring equation that was developed through validation testing.

"Cartridge filter" means a filter that is manufactured by placing a flat sheet membrane media between a feed and filtrate support layer and plating the assembly to increase the membrane surface area within the cartridge. The pleat pack assembly is then placed around a center core with a corresponding outer case and subsequently sealed, via adhesive or thermal means, into its cartridge configuration.

"Certified waterworks operator" means an operator licensed by the State of Oklahoma, pursuant to OAC 252:710.

"CFR" means Code of Federal Regulation.

"Challenge test" means a study conducted to determine the removal efficiency (i.e. log removal value [LRV]) of a membrane material for a particular organism, particulate or surrogate.

"Clean-in place (CIP)" means the periodic application of a chemical solution or series of solutions to a membrane unit for the intended purpose of removing accumulated foulants and restoring permeability and resistance to baseline levels, commonly used for in-situ chemical cleaning.

"Combined distribution system" means the interconnected distribution system consisting of the distribution systems of wholesale systems and of the consecutive systems that receive finished water.

"Consecutive system" means a public water supply system that receives some or all of its finished water from one or more wholesale systems. Delivery may be through a direct connection or through the distribution system of one or more consecutive systems.

"Council" means the Water Quality Management Advisory Council.

"CT" means ~~contact time~~the product of "residual disinfectant concentration" (C) in mg/l, and the corresponding "disinfectant contact time" (T) in minutes, i.e., "C" x "T". CT requirements for a variety of disinfectants and conditions appear in the EPA Guidance Manual to the Surface Water Treatment Rule.

"CT Value" means the product of disinfectant residual and disinfectant CT. The required amount of CT needed is contained in the EPA Guidance Manual to the Surface Water Treatment Rule.

"DEQ" means the Oklahoma Department of Environmental Quality.

"Differential pressure" means a pressure drop across a membrane module or unit from the feed inlet to concentrate outlet, as distinguished from transmembrane pressure (TMP), which represents the pressure from across the membrane barrier.

"Direct integrity testing" means a physical test applied to a membrane unit in order to identify and/or isolate an integrity breach.

"Director" or "Executive Director" means the Executive Director of the Oklahoma Department of Environmental Quality.

"Effective size" means from a particle-size distribution curve, it is the diameter where 10% of the material is finer.

"Element" means a term used to describe an encased spiral-wound membrane module and is synonymous with the terms module and cartridge.

"Engineer" means a professional engineer licensed to practice engineering in Oklahoma.

"ETV" means the EPA's Environmental Technical Verification Program.

"EPA" means the United States Environmental Protection Agency.

"FDA" means the United States Food and Drug Administration.

"Flood Plain" means the flood way and a zone of floodwater storage where water moves slowly or is ponded, thus attenuating the flood peak as the flood waters move downstream.

"Flood way" means the part of the flood plain considered to be the zone of highest hazard and the zone to be reserved for the passage of larger floods.

"Flux" means the throughput of a pressure-driven membrane filtration system expressed in terms of flow per unit of membrane area.

"GWUDI" means groundwater under the direct influence of surface water.

"Hydraulic analysis" means the study of the water system network, evaluating water flows within the distribution system under prescribed conditions, such as peak hourly flow plus fire flow when required. Hydraulic analysis includes consideration of all factors affecting system energy losses.

"Indirect integrity monitoring" means the monitoring of an aspect of filtered water quality, such as turbidity, that is indicative of the removal of particulate matter at a frequency of no less than once every fifteen (15) minutes.

"Individual water system" means a water system serving only one single-family residence.

"Iron and manganese control" means the treatment process designed specifically for the treatment or removal of iron and manganese.

"Membrane unit" means a group of membrane modules that share common valving which allows the unit to be isolated from the rest of the system for the purpose of integrity testing or other maintenance, synonymous with the terms rack, skid and train.

"Minor public water supply system" means a water system not included in the public water supply system definition. Minor public water supply systems are regulated by OAC 252:624.

"Multi-family dwelling" means a single structure designed and suitable for use of several or

many families.

"Municipal system" means public water supply distribution systems constructed, operated, and maintained by a municipality or trust for the benefit of such municipality.

"mm" means millimeter.

"nm" means nanometer.

"NSF" means the National Sanitation Foundation.

"OAC" means the Oklahoma Administrative Code.

"O.S." means the Oklahoma Statutes.

"OWRB" means the Oklahoma Water Resources Board.

"Package treatment plant" means plants that are pre-manufactured used to treat water that do not meet conventional standards for flocculation and sedimentation.

"Plan documents" means reports, proposals, preliminary plans, survey and basis of design data, general and detail construction plans, profiles, specifications, and all other information pertaining to water supply planning.

"Pitless unit" means an assembly which extends the upper end of the well casing to above grade to prevent the entrance of contaminants into the well or potable water supply, to conduct water from the well, to protect the water from freezing or extremes of temperature and to provide fill access to the well and to parts within the well.

"psi" means pounds per square inch.

"Public water supply (PWS) system" means ~~a~~any system ~~whether publicly or privately owned which supplies water under pressure~~ providing water for human consumption through pipes or other constructed conveyances, ~~to the public through pipes or other constructed conveyances,~~ if such system has at least 15 service connections or regularly serves an average of at least 25 individuals at least 60 days per year, whether receiving payment or not. Multi-family dwellings, which are constructed, inspected, and maintained under a State or locally approved plumbing code and purchase water from a permitted water system, are not classified as a Public Water Supply system. The following are the categories of Public Water Supply systems:

(A) **"Community water system"** means any PWS system, which serves at least 15 service connections, used by year-round residents or regularly serves at least 25 year-round residents.

(B) **"Non-community water system"** means any PWS system, which serves an average of at least 25 individuals at least 60 days per year but is neither a community water system nor a non-transient non-community water system.

(C) **"Non-transient non-community (NTNC) water system"** means any PWS system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year.

~~(D) **"Minor water system"** means any other PWS system not included in (A), (B), or (C) of this definition. These water systems may be state-licensed facilities or non-licensed facilities and are regulated in OAC 252:624.~~

"Purchase water system" means any system, which purchases all of its water through a master meter and provides that water to the public.

"Reduced pressure zone, backflow preventer" means a device designed to prevent backflow consisting of two spring loaded check valves with an intermediate reduced pressure zone that drains to the atmosphere by a relief valve, with a reduced pressure maintained in the intermediate zone by means of a pressure differential valve.

"Reduction Equivalent Dose (RED)" means the UV dose derived by entering the log

inactivation measured during full-scale reactor testing into the UV dose-response curve that was derived through collimated beam testing. RED values are always specific to the challenge microorganism used during experimental testing and the validation test conditions for full-scale reactor testing.

"Required Dose" means the UV dose in units of mJ/cm^2 needed to achieve the target log inactivation for the target pathogen.

"Residuals" means the sludge generated by a drinking water treatment facility.

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

"Rural water system" means a water system designed to provide domestic water service to an area having its major part outside of an incorporated community. This system may be organized as a trust authority, a rural water district, or non-profit water corporation.

"Silt density index (SDI)" means the ASTM, standard D 4189-95, *Standard Test Method for Silt Density Index of Water*. Measurements are taken by filtering a water sample through a 0.45mm flat sheet filter with a 47mm diameter at a pressure of 30 psi. The time required to collect two samples at 500 ml each is measured and the resulting data is imputed into a formula.

"Solids contact unit" means a combination rapid mix, floc-aggregation, and upflow sedimentation basin constructed in either a round or square configuration.

"**Standard methods for the examination of water and wastewater"** means the approval methods developed by the APHA, the AWWA and the Water Environmental Federation. The current standard methods are contained in the 20^{th} Edition, published by the AWWA.

"Sufficiency certification" means to provide assurance that the integrity and capacity of an existing system will not or have not been compromised.

"Transmembrane pressure (TMP)" means the pressure drop across the membrane barrier.

"UL" means the Underwriters Laboratory.

"Uniformity coefficient" means from a particle-size distribution curve it is, the ratio of the 60 percent grain size to the 10 percent grain size.

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

"UV" means ultra violet.

"UV absorbance" means a measure of the amount of UV light that is absorbed by a substance at a specific wavelength, across a specified pathlength of substance. This measurement accounts for absorption and scattering in the medium. Standard Method 5910B details this measurement method, however, for drinking water applications, samples need not be filtered or adjusted for pH or longer pathlength cuvettes, 4 cm to 5 cm should be used instead of 1 cm cuvette.

"UV dose" means the UV energy per unit area incident on a surface, typically reported in units of mJ/cm^2 or J/m^2. The UV dose received by a waterborne microorganism in a reactor vessel accounts for the effects on UV intensity of the absorbance of the water, absorbance of the quartz sleeves, reflection and refraction of light from the water surface and reactor walls, and the germicidal effectiveness of the UV wavelengths transmitted.

"UV dose distribution" means the probability distribution of UV doses that microorganisms receive in a flow-through UV reactor, typically shown in a histogram.

"UV inactivation" means a process by which a microorganism is rendered unable to reproduce, thereby unable to infect a host.

"UV intensity" means the power passing through a unit area perpendicular to the direction of propagation. UV intensity is used in the UV Disinfection Guidance Manual (UVDGM) to

describe the magnitude of UV light measured by UV sensors in a reactor and with a radiometer in bench-scale UV experiments.

"UV lamp sleeve" means the quartz tube that houses the UV lamp. The exterior of the lamp sleeve is in direct contact with the water being treated. There is typically an air gap (approx. 1 cm) between the lamp envelope and quartz sleeve.

"UV low-pressure lamp" means a mercury-vapor lamp that operated at an internal pressure of 0.13 to 1.3 Pa (2X10 to $2X10^{-4}$ psi) and electrical input 0.5 watts per centimeter (W/cm). This results in essentially monochromatic light output at 254 nm.

"UV low-pressure high-output lamp" means a low-pressure mercury-vapor lamp that operates under increased electrical input (1.5 to 10 W/cm), resulting in a higher UV intensity than low-pressure lamps. This results in essentially monochromatic light output at 254 nm.

"UV medium-pressure lamp" means a mercury-vapor lamp that operates at an internal pressure of 1.3 to 13,000 Pa (2 to 200 psi) and electrical input of 50 to 150 W/cm. This results in a polychromatic (or broad spectrum) output of UV and visible light at multiple wavelengths, including wavelengths in the germicidal range.

"UV off-line chemical clean" means a process to clean lamp sleeves where the UV reactor is taken off-line and a cleaning solution (typically weak acid) is sprayed into the reactor through a service port.

"UV off specification" means a UV facility that is operating outside of the validated operating conditions (e.g. at a flow rate higher than the validated range or UVT below the validated range).

"UV on-line mechanical clean" means a process to clean lamp sleeves where an automatic mechanical wiper (e.g. o-ring) wipes the surface of the lamp sleeve at a prescribed frequency.

"UV on-line mechanical-chemical clean" means a process to clean lamp sleeves where an automatic mechanical wiper (e.g. o-ring) with a chemical solution located within the cleaning mechanism wipes the surface of the lamp sleeve at a prescribed frequency.

"UV sensor" means a photosensitive detector used to measure the UV intensity at a point within the UV reactor that converts the signal to units of milliamps (mA).

"UV transmittance (UVT)" means a measure of the fraction of incident light transmitted through a material. The UV transmittance is usually reported for a wavelength of 254 nm and a pathlength of 1 cm. If an alternate pathlength is used, it shall be specified or converted to units of cm^{-1}. UV transmittance is often represented as a percentage and is related to the UV absorbance (A254) by the following equation (for a 1 cm path length): % UV transmittance=$100X10^{-A}$ where A is UV absorbance.

"Validated dose" means means the UV dose in units of mJ/cm^2 delivered by the UV reactor is determined through validation testing. The validated dose is compared to the required dose to determine log inactivation credit.

"Water line extension" means an extension of an existing permitted water distribution line.

"WEF" means the Water Environmental Federation, formerly known as the WPCF.

"Wholesale system" means a public water supply system that treats source water as necessary to produce finished water and then delivers finished water to another public water supply system. Delivery may be through a direct connection or through the distribution system of one or more consecutive systems.

"WQA" means the Water Quality Association.

"WTP" means Water Treatment Plant.

SUBCHAPTER 3. PERMIT PROCEDURES

252:626-3-6. Engineering report

(a) **Copies and timing.** Submit 3 copies of an approvable engineering report as required in OAC 252:626-3-2 for proposed new construction or modifications to PWS systems, at least 30 days prior to the submission of the application for a permit to construct.

(b) **Purpose.** The purpose of the report is to present the Engineer's findings with enough attention given to detail(s) to allow adequate review of the project by the owner and applicable regulatory agencies.

(c) **Requirements.** The report must include all information necessary for a comprehensive evaluation of the proposed construction. The report must present, at a minimum, the following:

(1) **General information.** Include the following:

(A) a description of existing water works and wastewater facilities,

(B) identification of the municipality or area served,

(C) name and mailing addresses of the owner and official custodian,

(D) a statement as to whether the project will be constructed in phases. If the project is to be constructed in phases, the statement will include the number of phases necessary to complete the project and which portions of the project will be completed in each phase,

(E) a demonstration that adequate capacity, treatment and compliance with the primary drinking water standards are maintained during construction, ~~and~~

(F) a letter from the permittee approving the contents contained in the engineering report as submitted~~.~~,

(G) a map showing legal and natural boundaries of entire service area, and

(H) a map showing new service areas or annexed areas.

(2) **Extent of water works system.** Include the following:

(A) a description of the area to be served,

(B) provisions for extending the waterworks system,

(C) establish the anticipated design average and peak flows for existing and potential industrial, commercial, institutional and other water supply needs for both the current service area and potential future service areas, ~~and~~

(D) a hydraulic analysis that demonstrates that a minimum of 25 psi shall be met at all times throughout the distribution system~~.~~, and

(E) a site plan and schematic layout of treatment facilities.

(3) **Alternate plan.** Where feasible and practical, provide a minimum of 3 alternative solutions and discuss the alternatives, including cost estimates and reasons for selecting the one recommended.

(4) **Soil, ground water conditions, and foundation problems.** The report must include a description of the following:

(A) the character of the soil where water mains are to be laid,

(B) soil conditions, which might affect foundations of proposed structures, and

(C) the approximate elevation of ground water in relation to subsurface structures.

(5) **Water use data.** Provide the following water use data:

(A) a description of the population trends as indicated by available records, and the estimated population which will be served by the proposed water supply system or expanded system,

(B) present water consumption of existing systems and the projected average and maximum daily demands that were used as the basis of the design, and

(C) present or estimated yield of supply source(s) along with a copy of the water rights verification form and/or the purchase water contract.

(6) **Fire flow requirements.** Demonstrate that the plans meet the requirements regarding fire flows pursuant to the *International Fire Code,* published by the International Code Council, Inc., 2003 Edition, *Distribution System Requirements for Fire Protection, M 31,* published by the AWWA, 3rd Edition or other recommendations of similar organizations for the fire service area

(7) **Sewer system available.** Describe the methods of disposal for sanitary and all other wastewater from the treatment plant.

(8) **Sources of water supply.** For the alternative chosen, the report must describe the proposed source or sources of water supply to be developed, the reasons for their selection, and provide information required by OAC 252:626-7 and the following:

(A) surface water sources, including:

(i) hydrological data, stream flow and weather records,

(ii) safe yield, including all factors that may affect it,

(iii) maximum flood or pool elevation,

(iv) description of watershed, noting any existing or potential sources of contamination which may affect water quality, and

(v) quality of the raw water with special reference to fluctuations.

(B) ground water sources, including:

(i) sites considered,

(ii) advantages of the site selected,

(iii) elevations with respect to surroundings,

(iv) character of formations through which the source is to be developed,

(v) geologic conditions affecting the site,

(vi) summary of exploration; test well depth and method of construction; placement of liners or screen; test pumping rates and duration; water levels and specific capacity; chemical and radiological quality of the water,

(vii) sources of possible contamination including but not limited to wastewater collection and treatment facilities, landfills, outcroppings of consolidated water-bearing formations, waste disposal wells, slush pits, irrigation wells and abandoned wells, and

(viii) industrial and other private water supply. Where pertinent, use significant ground water developments within a 1 mile radius of the proposed ground water source, giving depths, size, protective casing depth, capacity, location, type and any available information pertaining thereto.

(9) **Proposed treatment processes.** Summarize and determine the adequacy of proposed processes and unit parameters for the treatment of the water under consideration. Pilot studies may be required for innovative design. Post treatment for membrane systems shall be in accordance with OAC 252:626-9-9 (f)(6).

(10) **Residuals management.** Submit a Residuals Management Plan that discusses the wastes and volume generated by existing and proposed water treatment processes, their volume, proposed treatment of waste products, points of discharge or method of disposal or land application.

(11) **Project sites.** Address the following in the report:
(A) discussion of various sites considered and advantages of those recommended,
(B) the proximity of residences, industries, and other establishments, and
(C) any potential sources of pollution that may influence the quality of the supply or interfere with effective operation of the water works system, including but not limited to, absorption systems, septic tanks, privies, sink holes, sanitary landfills, refuse and garbage dumps.

(12) **Cost estimates.** Address the following in the report:
(A) estimated cost of integral parts of the system,
(B) detailed estimated annual cost of operation, and
(C) proposed methods to finance both capital charges and operating expenses.

(13) **Future extensions.** Summarize future needs and services.

SUBCHAPTER 5. GENERAL DESIGN

252:626-5-5. Standby power and elevated storage

If 24 hours of elevated distribution storage based on average daily demand is not available, provide all plants with portable or in-place internal combustion engine equipment which will generate electric power to allow continued operations, at peak hourly demand, during a power failure.

SUBCHAPTER 7. SOURCE DEVELOPMENT

252:626-7-4. Ground water

(a) A ground water source includes all water obtained from drilled, bored or driven wells. A test well is required where sufficient information is not available to assure adequate quality and quantity of water.

(1) **Quantity.**
(A) Provide a minimum of 2 wells for community water systems unless a standby source with adequate capacity is available.
(B) Where ground water is the sole supply source for a community water system, the total developed ground water capacity must equal or exceed:
(i) the design maximum day demand, and
(ii) the design average day demand, with the largest producing well out of service.

(2) **Quality.**
(A) **Bacteriological quality.**
(i) Underground waters subject to a low degree of contamination shall require chlorination if:
(I) the coliform count averages not more than 50 per 100 ml in any 1 month, and
(II) the turbidity does not exceed 5 NTU.
(ii) Disinfect every new, modified or reconditioned ground water source according to AWWA standard specifications after the completion of work and placement of permanent pumping equipment.
(iii) Upon completion of the well, collect at least 2 bacteriologically safe samples on consecutive days. Collect samples after chlorine used in disinfecting the well has been completely dissipated. Submit the records to the DEQ.

(iv) If any samples show the presence of coliform bacteria, take additional samples to determine the degree of contamination and treatment required.

(B) **Physical, chemical, and radiological quality**.

(i) Test every new, modified, or reconditioned ground water source for applicable physical, chemical, and radiological characteristics contained at OAC 252:631-3-1 by submitting a representative sample to a certified laboratory or the State Environmental Laboratory and report results to the DEQ.

(ii) Collect samples at the conclusion of test pumping.

(iii) Additional field determinations or special sampling procedures may be required by the DEQ.

(C) **Test results.** The results of the required testing shall be used to determine the extent of water treatment required. If all parameters are in compliance with the standards set forth in the Safe Drinking Water Act and OAC 252:631, no treatment will be required.

(3) **Location.** In the selection of a site:

(A) evaluate the following:

(i) type of well construction to be utilized,

(ii) depth to water bearing zones,

(iii) type of formations to be penetrated, and

(iv) proximity of existing or possible future sources of pollution such as sewers, seepage pits, soil absorption fields, privies, sink holes, dumping areas, caves, test holes, abandoned wells, borings, industrial lagoons, private water supply developments, fuel storage tanks, and other underground construction,

(B) locate wells at the highest point of the premises consistent with other facilities and surroundings but always protected against surface drainage,

(C) do not locate wells:

(i) in a ravine where the well site may be flooded or within 300 feet horizontally from any existing or potential source of pollution including water bodies. If a wellhead delineation model has been performed for the site, the separation distance must conform to the model prediction for potential contamination,

(ii) within three hundred feet (300') of a proposed or existing sewer line,

(iii) within one hundred feet (100') of a private property line, or

(iv) within fifty feet of a publicly owned property line, and

(D) locate pump room floor at least 2 feet above the 100-year flood plain

(b) **Testing and records.** The permittee shall:

(1) provide yield and drawdown testing procedures for the well(s) in the plans and specifications, approved by the DEQ, and make the results for completed wells available for final inspection. Yield and drawdown tests must:

(A) be performed on every production well after construction or improvements, which affect the well capacity, and prior to placement of the permanent pump,

(B) have test methods clearly indicated in specifications,

(C) determine well capacity with the pumping rate at maximum anticipated drawdown, pumping rate must be at least 1.5 times the quantity anticipated,

(D) test pump the well at 1.5 times the design pumping rate for at least 24 hours or until the drawdown has stabilized for a minimum of 6 hours, and

(E) provide the following test data to the DEQ prior to completion of the well:

(i) test pump capacity-head characteristics, and overall efficiency,

(ii) static water level and water level at design pumping rate,
(iii) depth of test pump setting,
(iv) time of starting and ending each test cycle, and
(v) zone of influence for the well(s).

(2) test the well for plumb and alignment in accordance with AWWA standard specifications. The specifications must cite the AWWA standard and describe the method to be used.

(3) submit well logs that shall contain:

(A) samples collected at maximum 20-foot intervals and at each pronounced change in formation,

(B) a record of drill hole diameters and depths, assembled order of size and length of casings and liners, length of the perforated section and type of perforations, or type and length of screen used, grouting depths, formations penetrated, water levels, and location of any blast charges. Where multiple water bearing formations are developed, give the elevation and length of each perforated or screened section.

(c) **General well construction.**

(1) **Minimum depths of wells.** Construct wells to a depth sufficient to ensure that safe water can be obtained. Water taken from depths of 20 feet or less shall require additional testing to determine the necessary level of treatment.

(2) **Minimum protected depths.** Protect wells by watertight construction to a depth necessary to:

(A) exclude surface contamination, and

(B) seal off formations that are contaminated or yield undesirable water.

(3) **Well surface casing.** Every well shall have a watertight surface casing extending at least 20 feet below the surface. A greater depth will be required in unconsolidated soils, karst formations or when necessary to eliminate contamination from the surface or upper formations.

(A) **Surface casing material.** Surface casing shall only be made from ferrous material and must:

(i) be new pipe meeting ASTM, AWWA, NSF or API specifications for water well construction,
(ii) have minimum weights and thickness indicated in Appendix C,
(iii) be capable of withstanding forces to which it is subjected,
(iv) be equipped with a drive shoe when driven, and
(v) have full circumferential welds or threaded coupling joints.

(B) **Internal casing materials.** Internal casing material shall:

(i) meet AWWA standards,
(ii) meet NSF standards for contact with potable water,
(iii) be resistant to the corrosiveness of the water,
(iv) be able to withstand the stresses to which the well will be subjected during installation, grouting and operation, and
(v) be equipped with a drive shoe when driven.

(4) **Packers.** Packers must be made from an NSF approved material

(5) **Screens.** Screens must:

(A) be constructed of materials resistant to damage by chemical action of ground water or cleaning operations,

(B) have sizes of openings based on sieve analysis of formation and gravel pack materials

to permit maximum transmitting ability without clogging or jamming,

(C) have sufficient diameter to provide adequate specific capacity and low aperture entrance velocity. The entrance velocity must not exceed 0.1 ft/s,

(D) be installed so that the pumping water level remains above the screen under all operating conditions, unless measures are provided to protect the screen from being corroded, and

(E) be provided with a bottom plate or washdown bottom fitting of the same material as the screen, where applicable.

(6) **Grouting requirements.** Surround surface casing with a minimum of 1-½ inches of grout to the depth of the surface casing.

(A) **Cement grout.**

(i) Cement conforming to ASTM Standard C150, with not more than 6 gallons of water per 94 pound sack of cement, must be used for 1-½ inch annular openings.

(ii) Additives used to increase fluidity are subject to approval by the DEQ.

(B) **Concrete grout.**

(i) Equal parts of cement conforming to ASTM Standard C150, and sand, with not more than 6 gallons of water per 90-lb. sack of cement may be used for annular openings larger than 1-½ inches.

(ii) Where an annular opening larger than 4 inches is available, gravel not larger than ½ inch in size may be added.

(C) **Application.**

(i) Provide sufficient annular opening to permit a minimum of 1-½ inches of grout around permanent casings, including couplings.

(ii) When completing a gun perforated well with an annular opening less than 4 inches, install grout under pressure by means of a grout pump from the bottom of the annular opening upward in one continuous operation until the annular opening is filled.

(iii) Concrete grout used in an annular opening of 4 or more inches and less than 100 feet in depth, may be placed by gravity through a pipe installed to the bottom of the opening in one continuous operation until filled.

(iv) Clay seals with at least ten percent (10%) swelling bentonite may be placed by gravity when the annular opening exceeds 6 inches and the depth is less than 100 feet.

(v) Provide the casing with sufficient guides welded to the casing to permit unobstructed flow and uniform thickness of grout.

(7) **Well floor.**

(A) Construct the well floor with reinforced, watertight concrete not less than 6 inches thick with a footing of at least 12 inches.

(B) Provide a watertight joint between the concrete motor base and floor.

(C) Extend the floor or concrete apron at least 2 feet from the well excavation line in all directions. Where necessary, extend it an additional distance to support the pump or casing.

(D) Construct the top of the floor slab or apron at least 6 inches above the surrounding ground.

(E) Thoroughly compact the area below the floor or apron prior to pouring the concrete.

(F) Slope the floor or apron at least 1/8 inch per foot away from the well casing and allow for drainage.

(8) **Upper terminal well construction.**

(A) Extend the casing at least 12 inches above a well house floor or concrete apron.

(B) Terminate the top of the well casing at least 5 feet above the 100-year flood plain, or the highest known flood elevation, whichever is greater.

(C) Seal the top of the casings with a sanitary well seal to properly protect against entrance of contamination into the well.

(D) The discharge piping must:

(i) have control valves and appurtenances located above the well floor,

(ii) be equipped with a check valve, a shutoff valve, a pressure gauge, a flow meter, and a smooth nosed sampling tap located upstream of the shutoff valve and at a point where positive pressure is maintained,

(iii) be equipped with an air relief valve located upstream from the check valve. The exhaust/relief piping must terminate in a down-turned position at least 18 inches above the floor and covered with a 24 mesh corrosion resistant screen,

(iv) be valved to permit test pumping, pumping to waste and control of each well,

(v) enclose all exposed piping, valves and appurtenances in the well house to protect against physical damage, tampering and freezing. The well house design shall be sufficient to accommodate the disinfection equipment,

(vi) be properly anchored to prevent movement,

(vii) be protected against surge or water hammer, ~~and~~

(viii) must not be directly connected to a sewer~~.~~, and

(ix) provide a concrete splash pad outside the wellhouse where the blow-off valve discharges to protect the well house foundation from erosion.

(E) Access to disinfect the well is required.

(F) Design the well vent to:

(i) vent the casing to atmosphere, unless the design is for vacuum operation,

(ii) construct the vent of 1 ½ inch minimum diameter metal pipe and be fitted into the well cap or pump base so as to form a water-tight connection,

(iii) terminate the vent in a full 180-degree bend not less than 24 inches above the well floor slab or apron, and

(iv) screen the opening in the vent with a corrosion resistant screen. The openings in the screen must not be larger than 24-mesh.

(G) Provisions for measurement of water levels in the completed well are required to:

(i) Provide an accurate draw-down gauge, air pipe, direct measurement tube, or other access for measuring the water level in the well.

(ii) Make the connection between the air tube and the pump base watertight when an air pipe passes through the pump base.

(iii) Extend tubes for direct measurement of water levels 24 inches above the well floor slab, and tightly cap with a bolted flange or a screwed cap.

(iv) Provide corrosion resistant water level measurement equipment.

(9) **Pumps.**

(A) **Line shaft pumps.** Wells equipped with line shaft pumps must:

(i) have the casing firmly connected to the pump structure or have the casing inserted into a recess extending at least 1 inch into the pump base,

(ii) have the pump foundation and base designed to prevent water from coming into contact with the joint, and

(iii) have a heavy gasket installed between the pump base and the pump pedestal.

(B) **Submersible pumps.** Where a submersible pump is used:

(i) effectively seal the top of the casing against the entrance of water under all conditions of vibration or movement of conductors or cables,

(ii) firmly attach the electrical cable to the riser pipe at 20 foot intervals or less, and

(iii) pumps with mercury seal are not permitted.

(10) **Aquifer types and construction methods - special conditions.**

(A) **Gravel pack wells.**

(i) Use gravel pack that is well rounded, 95% siliceous material, smooth and uniform, free of foreign material, properly sized, washed and disinfected immediately prior to or during placement.

(ii) Install gravel pack in one uniform continuous operation throughout each screened interval.

(iii) Use Schedule 40 pipe, steel pipe or equivalent incorporated within the pump foundation and terminated with screwed caps at least 12 inches above the pump house floor or concrete apron when using gravel refill pipes.

(iv) Surround gravel refill pipes located in the grouted annular opening by a minimum of 1-½ inches of grout.

(v) Provide protection from leakage of grout into the gravel pack or screen.

(B) **Radial water collector as a raw water source.**

(i) Indicate the locations of all caisson construction joints and porthole assemblies,

(ii) Reinforced the caisson wall to withstand the forces to which it will be subjected,

(iii) Locate radial collectors in areas and at depths approved by the DEQ,

(iv) Assure that radial collectors are essentially horizontal,

(v) Cover the top of the caisson with a watertight floor,

(vi) Protect all openings in the floor from the entrance of foreign material, and

(vii) Do not place the pump discharge piping through the caisson walls.

(C) **Limestone wells.** Where wells are in limestone areas, the DEQ will determine surface casing and grouting requirements. The surface casing must extend at least 20 feet into the formation.

(D) **Naturally flowing wells.**

(i) Provide provisions to control flow.

(ii) DEQ may require special protective construction, if erosion of the confining bed appears likely.

(11) **Pitless well units.**

(A) Pitless well adapters are not allowed.

(B) Pitless units shall meet the standards of PAS-97-CC (04) as developed by the Water Systems Council, as listed in the PAS-97, Appendix C, and shall:

(i) be shop-fabricated from the point of connection with the well casing to the unit cap or cover,

(ii) be threaded or welded to the well casing,

(iii) be of watertight construction throughout,

(iv) be of materials and weight equivalent and compatible to the casing,

(v) have field connection to the lateral discharge from the pitless unit of threaded, flanged or mechanical joint connection,

(vi) terminate at least 12 inches (30 centimeters) above the well slab, and

(vii) terminate 5 feet (1.5 meters) above the 100-year flood plain or the highest known

flood elevation whichever is higher.

(C) Design the pitless unit to provide:

(i) access to disinfect the well,

(ii) a properly constructed casing vent meeting the requirements of OAC 252:626-7-4(c)(8)(F),

(iii) a cover at the upper terminal of the well that will prevent the entrance of contamination,

(iv) a contamination-proof entrance connection for electrical cable,

(v) an inside diameter as great as that of the well casing, up to and including casing diameters of 12 inches, to facilitate work and repair on the well, pump, or well screen, and

(vi) a well floor constructed in accordance with OAC 252:626-7-4(c)(7).

(D) If the connection to the casing is by field weld, the shop-assembled unit must be designed specifically for field welding to the casing. The only field welding permitted will be to connect a pitless unit to the casing.

(d) **Disinfection of wells.** Disinfect all wells and gravel for gravel-pack wells according to current AWWA standard specifications.

(e) **Disinfection of ground water.** Provide chlorination facilities for all ground water systems. If bacteriological tests indicate the water is safe, the facilities may be maintained as standby; otherwise, full time chlorination will be required.

(1) Provide a welded metal plate or a threaded cap for capping a well.

(2) The contractor must provide protection to prevent tampering with the well or entrance of foreign materials while work is in progress.

(f) **Well abandonment.** Seal test wells, abandoned wells and other existing wells not protected and maintained for future use, by methods necessary to restore the controlling geological conditions which existed prior to construction as directed by the OWRB.

(g) **Test and observation wells.**

(1) Test and observation wells must be:

(A) constructed in accordance with the requirements for permanent wells, including surface casing, if they are to remain in service after completion as a water supply well, and

(B) sealed, if not in use, according to OAC 252:626-7-4(f).

(2) A construction permit is required before a test or observation well is converted into a permanent well.

(h) **Capping requirements.**

(1) Provide a welded metal plate or a threaded cap for the capping of a well.

(2) The contractor shall provide protection to prevent the tampering with the well or entrance of foreign materials while work is in progress.

SUBCHAPTER 9. TREATMENT

252:626-9-9. Filtration

(a) **Filtration processes.** When filtration is required, utilize one of the following:

(1) Gravity sand filtration

(A) Slow sand filtration

(B) Rapid sand filtration

(2) Pressure sand filtration

(3) Membrane processes

(b) **Appurtenances.**

(1) Design filters with filter rate controllers that ensure the rated capacity of the filter will not be exceeded.

(2) Head loss through the filter media is monitored by differential pressure-cell devices that measure the water pressure above and below the filter media. The head loss sensor connection to the filter box should be located approximately four inches (4") above the top of the washwater collection trough to prevent the wash water from entering the sensor. A sediment trap with a drain shall be installed on the sensor line to capture any sediment that may enter the line. The end of the sensor shall be turned up, keeping a full column of water in the line at all times to minimize air entrainment. A fine mesh stainless steel screen shall be installed on the end of the sensor to prevent clogging of the filter media.

(3) Include provisions for draining the filters to waste with appropriate measures for backflow prevention.

(4) Provide a means to sample from the combined filter effluent line.

(5) Provide continuous online turbidimeters with a recording device on the effluent line of each filter.

(c) **Slow sand filter design.**

(1) Slow sand filters are allowed for water supplies where raw water turbidity is less than 10 NTU or where this turbidity value can be obtained by pretreatment. Slow sand filters consist of 24 to 48 inches of sand, which has an effective size of 0.15 to 0.30 mm and a uniformity coefficient equal to or less than 2.5 supported by torpedo sand and graded gravel.

(2) A minimum of two filters shall be provided. Design capacity shall be achievable with the largest filter out of service.

(3) Provide for piping for ripening of the filter media.

(4) Water depth above the filter sand surface must be 3 to 5 feet with 6 inches of freeboard.

(5) Provide an underdrain system consisting of a manifold and collector laterals. Construct laterals of open joint, porous or perforated pipe or conduits with even spacing between laterals.

(6) Support media must conform to OAC 252:626-9-9(d)(6).

(7) Provide an orifice on the outlet line from each filter, limiting the flow of water through the system to 50 gal/day/ft^2 of surface area. Size orifices in accordance with Appendix E, Table II. Locate the orifice at least 1 inch above the initial height of the filter sand surface. Alternatively, the outlet line equipped with an orifice may terminate in a weir box with the weir elevation at least 1 inch above the initial height of the filter sand surface.

(8) Equip each filter effluent line with a rate of flow indicator.

(9) Each filter shall be equipped with an indicating loss of head gauge or other means to measure head loss.

(d) **Rapid rate gravity filters.**

(1) **Pretreatment.** Pretreat water to be processed in rapid rate gravity filters prior to filtration by flocculation, coagulation and sedimentation.

(2) **Rate of filtration.**

(A) The maximum filtration rates:

(i) single media filter is 2 gal/min/ft^2 surface area,

(ii) dual media filter is 3 gal/min/ft^2 surface area, and

(iii) multi-media filter is 4 gal/min/ft^2 surface area.

(B) Higher filtration rates will be considered only after pilot studies show that a higher rate

is suitable for the raw water source. Approval of higher rates will require continuous monitoring of raw, settled and finished water for turbidity.

(3) **Structural details and hydraulics.**

(A) Define the hydraulic gradient across the rate-of-flow controller on the plans and specifications. Provide for a positive head at the throat of the controller when operating at the design flow rate. Show the entire hydraulic gradient from top of filter to clear well on the plans.

(B) Provide for the following:

(i) vertical walls within the filter,

(ii) no protrusion of filter walls into filter media,

(iii) head room to permit normal inspection and operation,

(iv) minimum depth of filter box of 8.5 feet,

(v) minimum water depth of 3 feet above the surface of filter media,

(vi) trapped effluent to prevent backflow of air to the bottom of the filters,

(vii) a minimum curb height of 4 inches must surround the filters to prevent the entrance of floor drainage,

(viii) overflow with discharge to backwash wastewater facilities,

(ix) maximum water velocity of 2 ft/s in pipes and conduits to filters,

(x) cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy, or following lime-soda softening,

(xi) washwater drain capacity sufficient to carry maximum flow and equipped with an air gap a minimum of 2 times the diameter of the drain line,

(xii) walkways around filters to be a minimum of 24 inches wide, ~~and~~

(xiii) safety handrails or walls around filter areas adjacent to walkways~~.~~, and

(xiv) for each filter unit, a meter indicating the instantaneous rate of flow.

(4) **Washwater troughs.** Design washwater troughs as follows:

(A) bottom elevation above the maximum level of expanded media during washing,

(B) a 2-inch freeboard at the maximum rate of wash,

(C) the top edges to be level,

(D) spacing so that each trough serves an equal number of square feet of filter area, and

(E) do not exceed a 3 foot maximum horizontal travel of suspended particles to trough.

(5) **Filter material.** The media must be clean silica sand or other natural or synthetic material meeting AWWA standard specifications.

(A) Silica sand (single media) must be a total depth of not less than 24 inches and generally not more than 30 inches, an effective size of 0.45 - 0.55 mm and a uniformity coefficient not greater than 1.65.

(B) Anthracite coal (single media) must be a total depth of 30 to 36 inches of clean crushed anthracite coal, an effective size of 0.45 - 1.2 mm and a uniformity coefficient not greater than 1.65.

(C) Silica sand and anthracite coal (dual media) must be a total depth of 24 to 30 inches with at least 12 inches of sand.

(i) Sand must have an effective size of 0.45 - 0.55 mm and a uniformity coefficient not greater than 1.65.

(ii) Anthracite must have an effective size of 0.45 - 1.2 mm and a uniformity coefficient not greater than 1.85.

(D) Garnet, silica sand, and anthracite (multi-media) must have a total depth of media of at

least 30 inches with a minimum of 4.5 inches of garnet, 9 inches of silica sand, and 16.5 inches of anthracite.

(i) Garnet must have an effective size of 0.15 – 0.35 mm.

(ii) Silica sand must have an effective size of 0.45 - 0.55 mm and a uniformity coefficient not greater than 1.65.

(iii) Anthracite must have an effective size of 0.45 - 1.2 mm and a uniformity coefficient not greater than 1.85.

(E) Granular activated carbon as a single media may be considered for filtration only after pilot or full scale testing and with prior approval of the DEQ. Granular activated carbon use is covered in 252:626-9-5.

(6) **Supporting media.**

(A) **Torpedo sand.** Provide a 3-inch layer of torpedo sand, with an effective size of 0.8 - 2.0 mm, and a uniformity coefficient not greater than 1.7, as a supporting media for filter sand.

(B) **Gravel.** Gravel, when used as supporting media, must consist of hard, rounded particles and not include flat or elongated particles. The coarsest gravel must be 2-½ inches in size when the gravel rests directly on the strainer system, and extends above the top of the perforated laterals.

(i) Provide at least 4 layers of gravel in accordance with Appendix E.

(ii) Reduction of gravel depths may be considered upon justification to the DEQ when proprietary filter bottoms are specified.

(7) **Underdrainage system.**

(A) Design all filter piping based on a minimum flow rate of 5 gal/min/ft^2 of surface area.

(B) Design underdrainage system to collect water with minimum uniform loss-of-head over the filter bed during filtration and for uniform upward velocities throughout the entire filter bed during the backwash process.

(C) Do not use porous types of underdrainage systems where the water has appreciable iron or manganese content, or where softening by lime is considered.

(D) For underdrainage systems using strainers, the maximum ratio of area of strainer openings to area of filter is 0.003.

(E) Direct laterals perforations without strainers downward.

(F) Total cross-sectional area of laterals on underdrain systems must be twice the cross-sectional area of the final openings.

(G) Design the cross-sectional area of the manifold to be twice the cross-sectional area of the laterals in order to minimize friction loss.

(H) Design the manifold so that air cannot accumulate as the result of slope or connection to effluent piping.

(8) **Rate of flow controllers.** Equip each filter with a rate of flow controller to ensure that the rated capacity of each filter is not exceeded during operation of other filters.

(9) **Surface wash or subsurface wash.** Surface or subsurface wash facilities are required except for filters used exclusively for iron or manganese removal, and may be accomplished by a system of fixed nozzles or a revolving-type apparatus.

(A) Install a reduced pressure zone (RPZ) back-flow preventer on surface wash units and the potable water supply.

(B) Minimum water pressure is 45 psi on the high side of the pressure-reducing valve.

(C) Install a pressure regulator on the surface wash supply line.

(D) The minimum design flow rate is 2.0 gal/min/ft^2 of filter area for fixed nozzle designs and 0.5 gal/min/ft^2 for revolving arm designs.

(E) Air-operated surface wash systems are allowed.

(10) **Air scouring.**

(A) Design underdrain to accommodate air scour piping, when piping is installed in the underdrain.

(B) Air flow for scouring the filter must be 3-5 standard ft^3/min/ft^2 of filter area when introduced in the underdrain.

(C) Make provisions to avoid excessive loss of filter media during backwashing.

(D) Air must be free from contamination.

(E) Place the air scour distribution systems below the filter media and supporting bed interface.

(F) Do not use flexible hose piping that is capable of collapsing when not under pressure, or of materials easily eroded at the orifice by high velocity air.

(G) To prevent short-circuiting, do not place air delivery piping in the filter media.

(H) Design for ease of maintenance and replacement of air delivery piping.

(I) Design the backwash water delivery system for 15 gal/min/ft^2 of filter surface area. Where design includes air scour, backwash water rate must be variable with a normal operating range up to 8 gal/min/ft^2 unless experience shows that a higher rate is necessary to remove scoured particles from filter media surfaces.

(11) **Backwash.** Make provisions for backwashing filters as follows:

(A) a minimum backwash rate of 15 gal/min/ft^2, or at a rate necessary for 50 percent expansion of the filter bed. A reduced rate of 10 gal/min/ft^2 may be acceptable for full depth anthracite or granular activated carbon filter,

(B) filtered water must come from washwater tanks, washwater pump(s), high service main, or a combination of these,

(C) duplicate washwater pumps unless an alternate means of obtaining washwater is available,

(D) sufficient water to backwash 1 filter for at least 15 minutes at design backwash rate,

(E) regulator or control valve for each filter to obtain desired rate of filter wash,

(F) rate-of-flow indicator on main washwater line, located so that it can be easily read by the operator during the back-washing process, and

(G) design to prevent rapid changes in backwash water flow.

(e) **Rapid rate pressure filters.**

(1) **General.** Rapid rate pressure filters are only allowed for iron and manganese removal for ground water systems.

(2) **Details of design.** Provide the following:

(A) pressure gauges on inlet and outlet pipes of each filter,

(B) filtration and backwashing of each filter individually,

(C) minimum side wall shell height of 5 feet. A corresponding reduction in side wall height is acceptable where proprietary bottoms permit reduction of the gravel depth,

(D) top of washwater collectors to be at least 18 inches above surface of media,

(E) underdrain system to efficiently collect the filtered water and to uniformly distribute the backwash water at a rate no less than 15 gal/min/ft^2 of filter area,

(F) an air release valve on the highest point of each filter,

(G) an accessible manhole to facilitate inspections and repairs,

(H) means to observe wastewater during backwashing,
(I) construction to prevent cross-connection,
(J) rate of filtration must not exceed 3gal/ft^2 of filter area, and
(K) sufficient information on the filter media to allow review and approval on a case-by-case basis.

(f) **Membrane filtration.** There are four categories of membrane filtration: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO). For the purposes of this design standard, membranes shall be defined strictly by pore size as follows: MF, 0.1 - 0.2 µm; UF, 0.01 - 0.1 µm; NF, 0.001 - 0.01 µm; and RO 0.0001 - 0.001 µm. Using these membrane sizes, MF and UF are used for particle and microbial removal, while NF and RO reject most dissolved contaminants.

(1) **Source water testing.** Source water shall be tested for all parameters that may affect membrane filtration and finished water quality. Historic information shall be reviewed to determine water quality extremes that may be expected. Tabulated results of tests done, summaries and conclusions shall be submitted as part of the engineering report proposing membrane filtration.

(2) **Pilot plant verification study.** Prior to initiating the design of a membrane treatment facility, the DEQ must be contacted to determine if a pilot plant study is required to determine the best membrane to use, type of pretreatment, type of post treatment, the blending ratio (blending is not allowed if the source water is surface water or GWUDI), the amount of reject water produced, process efficiency, process control monitoring, cold and warm water flux, fouling potential, operating and TMP, differential pressure and other design criteria. The DEQ must be contacted prior to iniating any pilot study to establish a protocol. The use of membrane processes for treatment of surface water shall require a pilot study for a minimum duration of three (3) months during the time period identified as having the historically poorest water quality for contaminants tested.

(3) **Log inactivation.** Challenge testing removal efficiency for *Giardia* and *Cryptosporidium* shall be accepted by the DEQ if the system or modules meet the following:

(A) Challenge testing shall be conducted according to the criteria established by 40 CFR § 141.179 (b)(2) and show at a minimum 2.5 log removal of *Giardia* and 2.0 log removal for *Cryptosporidium*.

(B) At least 0.5 log removal credit shall be from approved disinfection process using chlorine, chlorine dioxide, ozone or UV.

(4) **Membrane materials.** Provide for compatibility of membrane material and the use of oxidants in the engineering report.

(5) **Pretreatment.** Membrane processes treating surface water shall require pretreatment in accordance with OAC 252:626-9-2. NF or RO processes treating surface water shall require pre-sedimentation in accordance with OAC 252:626-9-2 (d).

(6) **Post treatment.** Post treatment shall be addressed in the engineering report, which shall demonstrate the degasification of carbon dioxide, hydrogen sulfide removal, organic removal, pH, hardness adjustment for corrosion control, and disinfection as a secondary pathogen control for the distribution system.

(7) **Cross-connections.** Membrane systems piping for feed water, filtrate, backwash water, waste and chemical cleaning shall be designed to prevent any cross connection with any potable water supply, in accordance with OAC 252:626-5-15.

(8) **Flow meters.** Flow meters shall be provided on the source water influent piping, the plant

finish water piping and on membrane backwash piping.
(9) **Pressure gauges.** Pressure gauges shall be provided on the influent and effluent piping to each membrane unit.
(10) **Turbidity monitoring.** Turbidity monitoring equipment shall be required on all membrane processes treating surface water and GWUDI. Turbidity monitoring equipment shall be installed on all influent and effluent piping of membrane units. Continuous turbidity recording equipment shall be provided on the effluent piping and connected to an alarm system to warn operators of an excessive turbidity breakthrough.
(11) **Membrane cleaning.** A schedule and procedure for proper membrane cleaning shall be developed based on manufacturer's recommendations to prevent contamination of both raw and finished water. The Clean-In-Place procedures shall be approved by the DEQ. Chemicals shall meet AWWA, ANSI and/or NSF requirements, where applicable. Only treatment devices approved by ANSI or NSF shall be used.
(12) **Direct testing equipment.** Equipment for direct testing shall be provided to monitor membrane integrity and to detect and locate defects or breaches that could allow raw water to be diverted around the membrane process.
(13) **Indirect testing.** The membrane system shall be designed to conduct and record indirect integrity continuously on each membrane unit.
(14) **Redundancy.** Redundancy of control components, including, but not limited to, valves, air supply and computers shall be required. Provide membrane units to meet the design capacity with the largest unit out of service.
(15) **Flux rates.** The design engineer shall address the following factors in the engineering report and/or pilot study:
(A) Flux rate shall be based upon the coldest average monthly temperature anticipated and the reference temperature (20° Celsius for MF/UF and 25° Celsius for RO/NF).
(B) Chemical cleaning strategy shall be determined to restore membrane permeability and acceptable flux without damaging the membrane integrity.
(C) Backwash strategies shall be implemented for MF/UF membranes to enhance membrane flux and to extend intervals between chemical cleanings.
(D) Flux rate shall be guaranteed by the manufacturer for a minimum of one (1) year.
(16) **Backwashing.** Provisions for backwashing shall be included in the design according to the manufacturer's recommendations.
(17) **Disinfection.** The system shall be properly disinfected and water shall be run to waste each time the membrane units are opened for maintenance. Certain disinfectants shall not be used through the membranes, if prohibited by the manufacturer.
(18) **Reject water and solids.** Waste from membrane filtration shall be handled in accordance with the requirements in OAC 252:626-13.
(19) **Operation and maintenance requirements.** Operation and maintenance manuals for membrane filtration systems shall be in accordance with OAC 252:626-3-7 (c)(6).

252:626-9-14. Anion exchange ~~for nitrate removal~~
(a) **Pilot study.** A pilot study protocol shall be approved prior to conducting the pilot study. A pilot study is required prior to submission of an engineering report and must be conducted for a minimum duration of time sufficient to process water through at least one full bed volume and resin regeneration cycle, or 3 days, whichever is longer. The results of the pilot study shall be included in the engineering report.

(b) **Pretreatment.** Pretreatment shall be required if the total concentration of iron, manganese, and heavy metals exceeds 0.1 mg/L.

(c) **Process Design.**

(1) **Redundancy.** Redundancy of control components, including, but not limited to, valves, air supply and computers, shall be provided. Anion exchange units shall be provided that meet the design capacity at a level below the nitrate/nitrite MCL with the largest unit out of service.

(2) **Automatic controls.** Automatic regeneration based on volume of water treated shall be provided unless manual regeneration can be justified and is approved by DEQ. A manual override shall be provided for all automatic controls.

(3) **Exchange capacity.** The design capacity of the anion exchange system shall not exceed the manufacturer's recommended design capacity of the resin ~~for nitrate removal~~ and regeneration.

(4) **Flow rates.** The design shall not exceed 7 gallons/min/ft^2 of bed area for the treatment flow rate. The backwash flow rate should be 2-3 gallons/min/ft^2 of bed area with a fast rinse approximately equal to the service flow rate.

(5) **Flow meters.** Flow meters shall be provided on the source water influent piping and the plant finished water piping.

(6) **Blending.** If a portion of the water is bypassed around the treatment unit and blended with the treated water, the maximum blend ratio allowable must be determined based on the highest anticipated raw water nitrate level. If a bypass line is provided, a totalizing meter and a proportioning or regulating device or flow regulating valves must be provided on the bypass line.

(7) **Stabilization.** Stabilization for corrosion control shall be provided.

(8) **Appurtenances.** An adequate underdrain and supporting gravel system, brine distribution equipment, and cross connection control shall be provided.

(9) **Construction material.** Pipes and contact materials must be resistant to the aggressiveness of salt.

(10) **Cross connections.** Anion exchange system piping shall be designed to prevent any cross connection with any potable water supply, in accordance with OAC 252:626-5-15.

(d) **Sampling and monitoring.**

(1) **Sampling taps.** Smooth-nose sampling taps for the collection of representative samples shall be provided. The taps shall be located to provide sampling of the anion exchange unit influent, effluent, and blended water. Sampling taps for the blended water shall be located at least 20 feet downstream from the point of blending.

(2) **Water quality test equipment.** Test equipment for pH, alkalinity, stability, total hardness, and nitrate shall be provided to determine treatment effectiveness.

(3) **Monitoring.** The treated water nitrate/nitrite level shall be monitored using continuous monitoring and recording equipment with a high nitrate level alarm. In addition to continuous monitoring and recording equipment, the finished water nitrate/nitrite levels shall be determined (using a test kit) no less than once per day, preferably just prior to regeneration of the unit.

(e) **Brine System.**

(1) **Brine and salt storage tanks.** Cover brine measuring or salt dissolving tanks and wet salt storage facilities and construct them of corrosion-resistant material. The make-up water inlet shall have a free fall discharge of two pipe diameters above the maximum liquid level of

the unit or obtain DEQ approval of other methods of protection from back-siphonage. Support the salt on graduated layers of gravel with a suitable means of collecting the brine. Equip wet salt storage basins with manhole or hatchway openings having raised curbs and watertight covers with overhanging edges similar to those required for finished water storage. Overflow, where provided, must have a free fall discharge and terminate at an approved brine waste disposal facility.

(2) **Salt storage capacity.** Design salt storage large enough to accommodate a 30-day supply.

(3) **Housing.** Enclose and separate salt storage from other operating areas.

(f) **Waste disposal.** A DEQ approved disposal plan is required for brine waste. If brine waste is disposed of in a lagoon, then the lagoon must be permitted and constructed in accordance with OAC 252:656 and lined with a synthetic liner in accordance with the requirement contained in OAC:626-13-4.

SUBCHAPTER 13. RESIDUALS AND DECANT WATER MANAGEMENT

252:626-13-2. Residuals management plan

(a) An approved Residuals Management Plan is required for storage, disposal or reuse of WTP residuals, including residuals from iron and manganese removal plants. When a permit is required, a residuals management plan shall be filed with the DEQ and shall include the following:

(1) estimate the volume of residuals produced using Appendix F,

(2) method of residuals management and storage,

(3) method for drying residuals,

(4) characterization of residuals, and

(5) method of ultimate disposal or reuse.

(b) WTP residuals may be discharged to a sanitary sewer, provided the discharge will not cause pass-through or interference to the publicly-owned treatment works and the owner of the treatment works agrees to accept the discharge. A pre-treatment permit may be required if the discharge to the publicly-owned treatment works meets the requirements of 40 CFR, Part 403. When discharging to a sanitary sewer, a flow-equalization system may be required to prevent the overloading of the sewer and interference with the waste treatment processes.

(c) Mechanical dewatering of residuals is acceptable and shall be constructed in accordance with OAC 252:656-19-5(3),(4) and (5). Mechanical dewatering equipment will be approved on a case-by-case basis.

(d) Storage facilities shall be provided for concentrated residuals.

(e) An approved sludge management plan is required for the land application of WTP residuals. If the residuals are being applied as a fertilizer or soil-amendment, the Oklahoma Department of Agriculture, Food and Forestry regulations apply.

(f) The requirements of OAC 252:515 apply to WTP residuals disposal in landfills.

252:626-13-4. Lagoons

(a) **General.** Lagoons used for the treatment of WTP waste shall be designed, permitted and constructed in accordance with OAC 252:656-11. In addition, lagoon designs shall include the following:

(1) two or more lagoon cells that provide for a minimum residual storage time of six (6) months per lagoon cell,

(2) design lagoons for the periodic removal of residuals as required in OAC 252:631-3-19,
(3) a minimum of 3 feet of freeboard,
~~(3)~~(4) adjustable decanting device,
~~(4)~~(5) effluent sampling point (if lagoon is permitted to discharge),
~~(5)~~(6) a pond gauge, to measure the level of residuals in the lagoon.

(b) Surface evaporation lagoons (total retention).
(1) Size lagoons to store both the expected wastewater and residuals produced.
(2) Provide sufficient surface area to evaporate the wastewater generated.
(3) Base evaporation rates on the annual average pan evaporation minus the 90th percentile annual rainfall.

~~(b)~~(c) **Surface water treatment wastewater handling.**
Design for:
(1) at least 4-hours settling time prior to recycling,
(2) wastewater to be returned to a point prior to the point of primary coagulant addition, ~~and~~
(3) wastewater to be returned at an instantaneous rate of 10 percent or less of the raw water entering the plant. Total flow shall not exceed the WTP maximum design flow rate~~.~~, and
(4) when wastewater is to be discharged, a plant outfall must be provided that is designed and constructed in accordance with OAC 252:656-9-3.

~~(c)~~(d) **Sealing of lagoons**. Water treatment plants utilizing conventional, microfiltration or softening treatment may seal the lagoons with any approvable material listed in OAC 252:656. For all other types of treatment, the lagoons shall have a synthetic liner that meets the requirements of OAC 252:656.

~~(d)~~(e) **Evaporation ponds.** The waste from ion exchange plants, demineralization plants, etc., that cannot flow to a sanitary sewer or meet discharge permit requirements without cost prohibitive treatment may flow to evaporation ponds meeting the requirements of OAC 252:619, 252:621 and 252:656.

SUBCHAPTER 19. DISTRIBUTION SYSTEM

252:626-19-2. Installation of piping

(a) **Standards.** The standards in this Section apply to the installation of piping in public water supply distribution systems. Specifications must incorporate the provisions of the AWWA standards.

(b) **Bedding.** Provide continuous and uniform bedding in the trench for all buried pipe. Tamp backfill material in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe. Remove all stones found in the trench to a depth of at least 6 inches below the bottom of the pipe.

(c) **Cover.** Provide all water mains with at least 30 inches of cover or with sufficient insulation to prevent freezing.

(d) **Blocking.** Provide reaction blocking, tie rods, or joints designed to prevent movement at all tees, bends, plugs and hydrants to prevent movement of the pipe.

(e) **Pressure and leakage testing.** Test the installed pipe for leakage in accordance with AWWA standard specifications. Leakage must not exceed 10 gal/inch diameter per mile of pipe per 24 hours at 150 psi testing pressure.

(f) **Disinfection and testing.** Disinfect all waterlines according to AWWA standard specifications. Obtain safe bacteriological samples on two consecutive days before placing the

waterline into service.

(g) **Permeation of system by organic compounds.** Where distribution lines are installed in areas of soil or groundwater contamination by organic compounds use:

(1) pipe and joint materials that are not subject to permeation by organic compounds.

(2) non-permeable materials for all portions of the system including water mains, service connections, and hydrant leads.

(h) **Separation of water mains and sewers from contamination sources.**

(1) **Horizontal separation.**

(A) Measure the separation distance edge to edge.

(B) Locate water mains at least 10 feet horizontally from any existing or proposed sewer lines.

(C) Locate water mains at least 5 feet horizontally from any existing or proposed storm sewers, raw water lines, petroleum product lines, natural gas lines, and other buried utility lines.

(D) Locate cast iron waterlines at least 10 feet from any gasoline storage tank and lines and PVC water lines at least 50 feet horizontally from any gasoline storage tank and lines.

(E) Locate waterlines at least 15 feet from all parts of septic tanks and absorption fields, or other sewage treatment and disposal systems.

(2) **Vertical Separation.**

(A) Measure the separation distance from edge to edge.

(B) Lay waterlines crossing sewer lines to provide a minimum vertical distance of 24 inches between the water main and the sewer line. Arrange the piping so that joints in a 20-foot length of PVC or 18-foot length of cast iron sewer pipe will be equidistant from the water main. Where a water main crosses under a sewer, provide adequate structural support for the sewer to prevent damage to the water main.

(C) Maintain a 2-foot vertical separation between waterlines and any existing or proposed storm sewers, raw water lines, petroleum product lines, natural gas lines, and other buried utility lines.

(3) **Special conditions.** When it is impossible to obtain proper horizontal and vertical separation as stipulated ~~above~~in (1) and (2) of this subsection, design and construct the other line equal to water pipe, and pressure test it to assure water tightness of joints adjacent to the water line prior to backfilling.

~~(I)~~(i) **Surface water crossings.**

(1) **Above-water crossings.** Adequately support and anchor the pipe. Provide protection from damage and freezing. Make waterline accessible for repair or replacement.

(2) **Underwater crossings.** Provide a minimum cover of 2 feet over the pipe. For waterlines crossing a well defined channel bottom greater than 15 feet in width, construct the waterline as follows:

(A) design the pipe for river crossings and have flexible, restrained or welded watertight joints,

(B) provide valves at both ends of water crossings so that the section can be isolated for testing or repair. The valves must be easily accessible and not subject to flooding. The valve closest to the supply source must be in a manhole, and

(C) make permanent taps on each side of the valve within the manhole to allow insertion of a small meter for testing to determine leakage and for sampling purposes.

(j) **Tracer wire**. Install metal tracer wire on all non-ferrous piping used for public water supply

mains.

APPENDIX E. GRAVEL SUPPORT FOR RAPID RATE SLOW SAND FILTERS [REVOKED]

APPENDIX E. GRAVEL SUPPORT FOR RAPID RATE AND SLOW SAND FILTERS [NEW]

Size	Depth
2½ to 1½ inches	5 to 8 inches
1½ to ¾ inches	3 to 5 inches
¾ to ½ inches	3 to 5 inches
½ to 3/16 inches	2 to 3 inches
3/16 to 3/32 inches	2 to 3 inches

Appendix E, Table I. Daily design flow

Motels or Hotel (1 bedroom per unit)	200 GPD
Motels (Kitchen facilities) per unit	250 GPD
Institution per Person:	
Resident workers	100 GPD
Non-resident Workers	20 GPD
Factories per person (excl. Industrial waste) each shift	20 GPD
Day school per pupil	8 GPD
Boarding School per pupil	75 GPD
Restaurants per patron	15 GPD
Trailer Parks per Unit	250 GPD
Drive-In Theater per car space	10 GPD
Self-service laundry (per customer)	50 GPD
Country Club per member	50 GPD
Service station per vehicle served	15 GPD
Retail store per toilet	500 GPD
Urban residence per person	100 GPD
Farm Residence per person	100 GPD
Livestock	
Beef Cow	12 GPD
Dairy Cow	50 GPD
Hog or sheep	4 GPD
Chicken	4 GPD
Turkey	7 GPD

Appendix E, Table II. Orifice sizing

Orifice Size (inches)	Head in Feet			
	2	4	6	8
	Gallons of Water Delivered per Day			
1/16	95	135	165	191
1/8	381	539	660	762
3/16	858	1,213	1,485	1,715
1/4	1,525	2,156	2,641	3,049
5/16	2,382	3,369	4,126	4,764
3/8	3,430	4,851	5,941	6,860
7/16	4,669	6,603	8,087	9,338
1/2	6,098	8,624	10,562	12,196
3/4	13,271	19,404	23,765	27,442
1	24,393	34,497	42,249	48,785
1-1/4	38,113	53,901	66,015	76,227
1-1/2	54,884	77,617	95,061	109,767
1-3/4	74,702	105,646	129,389	149,405
2	97,571	137,986	168,998	195,142

$$\mathbf{Q = C_d A(2gh)^{1/2}}$$

$$\mathbf{C_d = 0.60}$$

$$\mathbf{g = 32.2\ ft/s^2}$$

$$\mathbf{A\ is\ ft^2,\ 1\ ft^2 = 144\ in^2}$$

Appendix E, Figure 1. General Well Design
Appendix E. Figure 2. General Well Design

These two figures are drawings that are currently incompatible with the Word format of the other Chapter 626 appendices. See customer assistance for hard copies of these drawings.