SECTION .0700 - SURFACE WATER TREATMENT FACILITIES

15A NCAC 18C .0701 FLASH OR RAPID MIXING FACILITY

Mixing shall be adequate to obtain rapid and thorough dispersal of the chemicals in the raw water before it enters the flocculation basins. The design of the flash mix facilities shall provide sufficient and efficient transfer of energy to the water to effect thorough mixing.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015.

15A NCAC 18C .0702 AIR MIXING

Diffused air mixing may be used only in conjunction with mechanical or baffled mixers.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015.

15A NCAC 18C .0703 MECHANICAL FLOCCULATION

(a) Basin Inlet and Outlet. The design of inlets and outlets of flocculation basins shall prevent short circuiting of the water and destruction or deterioration of the floc.
(b) Detention Period. The flocculation basins shall have a theoretical detention period of not less than 30 minutes.
(c) Agitator Control. The agitators of flocculation basins shall be equipped with variable speed controls.
(d) Paddles. Peripheral speed and paddle configuration shall be designed to obtain optimum velocity gradient.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Amended Eff. July 1, 1994;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015;
Amended Eff. July 1, 2019.

15A NCAC 18C .0704 BAFFLED MIXING AND FLOCCULATION BASINS

(a) Detention Period. The theoretical detention period of baffled mixing and flocculation shall be at least 25 minutes.
(b) Velocities
    (1) The velocity of the water between the baffles shall be as follows:
        (A) first third of basin -- 1.5 feet per second;
        (B) second third of basin -- 0.75 feet per second; and
        (C) last third of basin -- 0.4 to 0.5 feet per second.
    (2) The velocity of the water under and over the baffles shall not exceed the velocity between the baffles.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015.

15A NCAC 18C .0705 CONDUITS: PIPES AND FLUMES: GATES AND VALVES

Conduits conducting flocculated or coagulated water to sedimentation basins shall have sufficient capacity to limit velocity of flow to 0.5 feet per second. The optimum velocity to prevent both the breaking up and the settling of the floc is considered to be 0.5 feet per second.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015.

15A NCAC 18C .0706 SEDIMENTATION BASINS

(a) Inlets. Inlets to sedimentation basins shall be designed to dissipate inlet velocities before the diffusion walls or before other entrance arrangements designed to provide uniform flow across the basins.
(b) Detention Period. A theoretical detention period of four hours shall be the minimum standard unless case specific engineering evidence is presented to demonstrate equivalent treatment efficiency at a shorter period of detention.
(c) Bottom of Basin. The bottom of the basin shall be sloped and provided with a drain valve or valves for removal of sludge.
(d) Outlet. Sedimentation basin outlets shall consist of submerged weirs or orifices. The equivalent rate of flow over or through the outlet device shall not exceed 20,000 gallons per day per foot of equivalent weir length.
(e) Overflow. Sedimentation basins shall be equipped with an overflow pipe or pipes to limit the maximum water level over the filters and to prevent flooding above the walls of filters and basins.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Amended Eff. April 1, 2014;
Readopted Eff. July 1, 2019.

15A NCAC 18C .0707 SOLIDS CONTACT OR UP-FLOW UNITS

(a) Approval of Solids Contact or Up-Flow Units. Solids contact or up-flow clarification units shall be approved only if raw water characteristics are constant and shall not be approved for raw waters that have wide and rapid variations in turbidity or other qualities that adversely affect the treatment process.
(b) Water Rise Rate. The rise rate shall not exceed 1.0 gallon per minute per square foot of clarification area.
(c) Weir Loading. Weir loading shall not exceed 10 gallons per minute per foot of weir length. Horizontal flow to the collection trough shall not exceed 10 feet.
(d) Speed Agitator Equipment. Mixing and flocculation shall be accomplished by means of adjustable, variable speed agitator equipment.
(e) Sludge Withdrawal. Sludge withdrawal equipment shall include an intermittent sludge removal mechanism controlled by an adjustable automatic timer.
(f) Basin Drain. The basin shall be provided with a bottom drain that is of sufficient size to empty the basin in two hours or less.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Amended Eff. July 1, 1994;
Readopted Eff. July 1, 2019.

15A NCAC 18C .0708 GRAVITY FILTERS

(a) Filtration Rates. The standard rate of filtration for a single media filter shall be two gallons per minute per square foot. Higher filtration rates up to four gallons per minute per square foot may be approved for dual media or multi-media filters. Filtration rates in excess of four gallons per minute per square foot may be approved subject to pilot plant or plant scale demonstrations conducted in accordance with Rule .0714 of this Section, and demonstrated equivalent treatment efficiency based on case-specific engineering evidence.
(b) Wash Water Rate. The backwash rate of flow shall be designed to theoretically expand the filter media 50 percent.

(c) Rate Control Devices. Rate control equipment shall be provided to control or regulate the filtration rate and the backwash rate. If declining rate filtration is to be used, orifice plates shall be installed on each filter effluent pipe to control maximum filtration rates.
(d) Surface Washers. Filter beds shall be equipped with a revolving or fixed system of nozzles designed for agitation of the entire beds.
(e) Gauges and Flow Indicators. Gauges or meters shall be installed to indicate the rate of filtration, the loss of head, and the backwash rate for every filter.
(f) Filter Media:
- (1) Filter Sand. Filter sand shall be clean silica sand having:
  - (A) an effective size of 0.35 mm to 0.55 mm;
  - (B) a uniformity coefficient of not more than 1.70;
  - (C) a dust content passing 150 mesh tyler of less than 0.5 percent; and
  - (D) a minimum depth of at least 24 inches.
- (2) Anthracite Filter Media. If anthracite coal is used as a single filter media, it shall have an effective size of 0.35 mm to 0.55 mm and a uniformity coefficient of 1.70 or less. Minimum depth of the media shall be 24 inches.
- (3) Dual Media or Multi-media Filters. Particle sizes in dual media and mixed media filter beds shall be within 0.15 mm to 1.2 mm. Influent water quality shall be considered in specifying particle sizes of mixed media beds. The minimum depth of the filter media shall be 24 inches.

(g) Supporting Media and Underdrain System. The underdrain system and layers of gravel or other media supporting the filter media shall be designed to provide uniform filtration and uniform backwash throughout the filter media.
(h) Wash Water Troughs Elevation. The elevation of the bottom of the wash water troughs for new installations shall be above the maximum level of the expanded media during washing at the normal design wash water rate. The elevation of the top of the wash water troughs shall provide a two-inch freeboard above the expanded media at the maximum rate of wash.
(i) Turbidity Monitoring. Turbidimeters employing the nephelometric method, which measures the intensity of scattered light, shall be provided for the continuous determination of the turbidities of filtered water from each filter unit.
(j) Sampling Tap. A tap shall be installed for sampling of the effluent from each filter.
(k) Multiple Filter Units. Two or more filter units shall be provided such that the annual average daily demand can be satisfied at the approved filtration rate with one filter removed from service.
(l) Structural Design. Filters shall have vertical walls with no protrusions or curvature. Floors of filter rooms shall be designed to prevent flooding or spillage into filters through overflow drainage and a minimum of four-inch curbs around the filters.
(m) Filter to Waste. All filters shall have provisions for filtering to waste with backflow prevention.
(n) Filter Backwash. Backwash capacity to ensure cleaning of the filters shall be provided.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Amended Eff. July 1, 1994; January 1, 1978;
Readopted Eff. July 1, 2019.

15A NCAC 18C .0709 PREVENTION OF BACKFLOW AND BACK-SIPHONAGE

The following methods and devices for prevention of backflow or back-siphonage shall be provided for the conditions indicated:
- (1) Dry Chemical Feeders. Dry chemical feeders with submerged water inlets shall have a non-pressure type vacuum breaker installed on the atmospheric side of the last control valve.
- (2) Fluoride Chemical Feeders
  - (a) Sodium fluoride saturator tank make-up water lines shall have air gaps between the overflow rim of the tank and the water supply pipe of at least four inches.
  - (b) When using the positive displacement fluoride chemical solution feed pumps, if the point of application to the water supply is at atmospheric pressure and is below the maximum elevation of the solution in the fluoride solution tank, an air gap shall be installed in the fluoride discharge line at a point above the liquid level in the tank. If the point of application is a pressure line, then a pressure type vacuum breaker shall be used.

(3) Filter Surface Wash Agitators. Either a non-pressure type vacuum breaker shall be installed on the atmospheric side of the last control valve of each agitator, or pressure type vacuum breaker or an approved backflow preventer shall be installed on the pipe line supplying only the agitators.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. January 1, 1977;
Readopted Eff. December 5, 1977;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015.

15A NCAC 18C .0710 OTHER WATER TREATMENT PLANTS

Water treatment plants which provide conventional filtration treatment, as defined in Rule .0102 of this Subchapter, but do not meet the minimum design criteria for process flow times established in this Rule, may be approved to treat high quality source waters under the following conditions:

(1) A proposal shall be presented to the Department to justify deviation from minimum criteria. The proposal shall include an engineering report containing information and data to substantiate high source water quality characteristics and demonstrate water treatment plant effectiveness.

(2) The flocculation process shall have a minimum of 20 minutes theoretical detention time.

(3) The sedimentation compartment shall utilize tube settlers, plates or equivalent settling enhancement mechanisms and have a minimum of 30 minutes detention time.

(4) The filter media shall be a minimum of 24 inches in depth and consist of dual or multi-media.

(5) The source waters shall be derived from watersheds which are classified as WS-I, WS-II or WS-III and shall be protected from sources of pollution as determined by a sanitary survey in accordance with Rule .0202 of this Subchapter.

(6) The following raw water quality standards shall apply:

(a) WS-I, WS-II or WS-III raw water quality standards established by the Environmental Management Commission shall be met.

(b) In addition to Sub-Item (6)(a) of this Rule, the following maximum concentration of turbidity, coliform, fecal coliform and color shall be allowed in the water plant influent water, based on sedimentation time provided by the water treatment plant. Off-stream pre-treatment to maintain these standards shall be provided as specified in Item (7) of this Rule.

SED TIME	4 hrs.	2 hrs.	1 hr.	½ hrs.
Turbidity (NTU)	150	75	50	25
Coliform/100 ml	3,000	2,000	1,000	500
Fecal coliform/100 ml	300	200	100	50
Color (CU)	75	60	40	20

Note: Uneven values are to be interpolated.

(c) Maximum allowable fluctuations in turbidity, coliform, fecal coliform, color (up to the maximum of Sub-Item (6)(b) of this Rule, chemicals and other water quality characteristics shall be established by a pilot study conducted in accordance with Rule .0714 of this Section.

(d) The allowable raw water concentration of all other contaminants, for which drinking water standards are established in this Subchapter, shall be based on the removal capacity of the water plant as demonstrated in a pilot study conducted in accordance with Rule .0714 of this Section.

(7) Off-stream pre-treatment/storage reservoirs shall be provided to maintain the raw water quality standards of Item (6) of this Rule, equalize fluctuations and provide an unpolluted storage reserve in the event of contaminant spills as follows:

(a) Off-stream pre-treatment/storage reservoirs shall not be required for source waters derived from uninhabited watersheds classified WS-I if it is demonstrated that the raw water quality standards and fluctuations of Item (6) of this Rule are maintained in the water treatment plant influent water.

(b) Off-stream pre-treatment/storage shall not be required for source waters derived from Class I, II or III reservoirs on WS-I, WS-II or WS-III watersheds if an engineering report demonstrates to the Department the source is not vulnerable to spills and that the water quality

standards and fluctuations of Item (6) of this Rule can be maintained in the water plant influent water.

(c) For all other source waters derived from WS-I, WS-II or WS-III watersheds, a minimum of five days off-stream pre-treatment/storage shall be provided. An engineering report as described in Item (1) of this Rule shall be submitted to demonstrate that five days storage is adequate or to determine the greater storage needed to maintain the raw water quality standards and fluctuations of Item (6) of this Rule in the water treatment plant influent water.

(d) When terrain or space constraints make it infeasible to construct a pre-treatment/storage reservoir, a mechanical pre-treatment system may be approved when an engineering report demonstrates to the Department that the source is not vulnerable to contaminant spills and that the raw water quality standards and fluctuations of Item (6) of this Rule can be maintained in the water treatment plant influent water.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. July 1, 1994;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015.

15A NCAC 18C .0711 ALTERNATIVE FILTRATION TREATMENT TECHNOLOGIES

A public water system may propose an alternative filtration treatment technology as provided in Rule .2003 of this Subchapter. The Department shall approve alternative filtration treatment technologies when the following conditions have been met and equivalent treatment efficiency, based on case-specific engineering evidence, has been demonstrated.

(1) The source waters shall be derived from WS-I, WS-II, or WS-III watersheds.

(2) The raw water quality standards and fluctuations shall be as specified in Rule .0710(6) of this Section, except that the following maximum concentrations shall be allowed in the influent water to the water treatment plant: Turbidity - 20 NTU, coliform - 500/100 ml, fecal coliform - 50/100 ml, and color - 20 CU.

(3) Off-stream pre-treatment or storage shall be provided as specified in Rule .0710 of this Section, except that the raw water quality standards of Item (2) of this Rule shall be maintained in the water treatment plant influent water.

(4) If the proposed water treatment plant employs treatment techniques that are consistent with this Subchapter, a pilot study shall be conducted in accordance with Rule .0714 of this Section.

(5) If the pilot study demonstrates that the proposed water treatment plant can produce water that complies with all requirements of this Subchapter, engineering plans and specifications for the proposed plant and appurtenances shall be presented to the Department for review and approval prior to construction or letting a construction contract.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. July 1, 1994;
Readopted Eff. July 1, 2019.

15A NCAC 18C .0712 DIRECT FILTRATION

Water treatment plants which use direct filtration may be approved to treat high quality source waters derived from uninhibited watersheds classified WS-I. A proposal, including an engineering report as described in Rule .0710 Item (1) of this Section shall be submitted to the Department.

(1) The following raw water maximum contaminant concentrations shall be met: Turbidity - 5 NTU, coliform - 500/100 ml, fecal coliform - 50/100 ml, color - 15 CU. Fluctuations shall not exceed 5 percent per hour.

(2) A minimum of 5 days off-stream storage shall be provided except in cases where the source waters are derived from in-stream impoundments and it is demonstrated that the raw water quality standards and fluctuations or Item (1) of this Rule are maintained at the entrance to the water treatment plant.

(3) If the Department determines that the proposed water treatment plant provides treatment techniques that are consistent with this Subchapter and that the treatment is feasible for the source water, a pilot plant study shall be conducted in accordance with Rule .0714 of this Section.

(4) If the pilot study demonstrates to the Department that the proposed plant can consistently produce water which complies with all requirements of this Subchapter, detailed engineering plans and

specifications for the proposed plant and appurtenances shall be presented to the Department for review and approval prior to construction or letting a contract.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. July 1, 1994;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. November 23, 2015.

15A NCAC 18C .0713 PRESSURE FILTERS

(a) Pressure filters shall not be used in treatment of surface waters without prior coagulation and flocculation.

(b) Pressure filters shall be approved for treatment of existing groundwater sources under the influence of surface water under the following conditions:

(1) design standards for gravity filters shall meet the requirements set forth in Rule .0708 of this Section;
(2) overall plant design shall comply with Rule .0404 of this Subchapter;
(3) special design or operational features or modifications shall be provided when needed due to the water quality or the design of the proposed filter;
(4) if the proposed water treatment plant employs treatment techniques that are consistent with this Subchapter, a pilot plant study shall be conducted in accordance with Rule .0714 of this Section; and
(5) if the pilot study demonstrates that the proposed plant can produce water that complies with all requirements of this Subchapter, engineering plans and specifications for the proposed plant and appurtenances shall be presented to the Department for review and approval prior to construction or letting a construction contract.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. July 1, 1994;
Readopted Eff. July 1, 2019.

15A NCAC 18C .0714 PILOT PLANT STUDIES

(a) A pilot plant study proposal shall be submitted to the Department for approval before the study is conducted. The proposal shall be approved if it meets all of the following conditions and includes all of the following information:

(1) An engineering report shall describe the proposed study and shall include the information and data to justify the use of the particular plant to treat the source water.
(2) The proposed plant shall employ treatment techniques that are consistent with this Subchapter.
(3) The pilot plant shall be of the same design and operation as the proposed plant.
(4) A protocol for conducting the study shall be submitted that includes the duration, testing procedures, reporting procedures, plant scale, and other factors that affect the proposed plant operation.
(5) The study shall be conducted over a time sufficient to treat all worst-case source water conditions expected through the year.

(b) Pilot plant finished water shall not be approved by the Department for introduction into a public water system unless case specific engineering evidence is presented to demonstrate that it will not adversely impact compliance with water quality requirements specified in this Subchapter.

(c) A model plant may be proposed without on-site testing if the proposed plant or pilot plant has met the following conditions:

(1) been tested under worst case conditions on similar water;
(2) achieved the required log inactivation and removal under Section .2000 of this Subchapter for Giardia, Cryptosporidium, and viruses; and
(3) achieved a maximum of 0.3 NTU turbidity levels 95 percent of the time in filtered effluent.

(d) The pilot plant shall comply with the provisions of Section .2000 of this Subchapter.

(e) If the proposal includes a change of treatment as defined in Rule .1507 Corrosion Control and Lead and Copper Monitoring of this Subchapter, the pilot study shall consider the effect of the proposed changes in compliance with lead, copper, and water quality parameters.

History Note: *Authority G.S. 130A-315; 130A-317; P.L. 93-523;*
Eff. July 1, 1994;
Amended Eff. October 1, 2009;
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