MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Title 10—DEPARTMENT OF NATURAL RESOURCES
Division 20—Clean Water Commission
Chapter 8—Minimum Design Standards

WORKING DOCUMENT

Strawman

The Department presents these draft materials for stakeholder review and discussion only.
Subject to the Red Tape Reduction review.

The Missouri Department of Natural Resources has identified 10 CSR 20-8, Minimum Design Standards, as a potential rulemaking amendment. This workgroup has been convened for the purpose of informal and voluntary public participation and discussions regarding the development of this rule prior to initiating formal rulemaking.

Under Governor Greitens' leadership, all state agencies are working to reduce regulations and other government processes that unnecessarily burden individuals and businesses while doing little to protect or improve public health, safety, and our natural resources. The Missouri Department of Natural Resources is committed to limiting regulation to what is necessary to protect Missouri's environment, implementing statutory mandates, and maintaining state control of programs. Any further proposed changes to rules discussed on this page are being developed with these goals in mind. We welcome your comments to help ensure that our regulations provide required protections but do not add unnecessary costs.

LEGEND: **STRAWMAN – 12/19/17**
Text to be *[deleted]* is in italics and bracketed.
Added text is **bolded**.

Title 10—DEPARTMENT OF NATURAL RESOURCES
Division 20—Clean Water Commission
Chapter 8—*[Design Guides]* Minimum Design Standards

10 CSR 20-8.160 Settling.

[PURPOSE: The following criteria have been prepared as a guide for the design of settling tanks. This rule is to be used with rules 10 CSR 20-8.110–10 CSR 20-8.220 for the planning and design of the complete treatment facility. This rule reflects the minimum requirements of the Missouri Clean Water Commission as regards adequacy of design, submission of plans, approval of plans, and approval of completed sewage works Deviation from these minimum requirements will be allowed where sufficient documentation is presented to justify the deviation. These criteria are taken largely from Great Lakes-Upper Mississippi River Board of State Sanitary Engineers Recommended Standards for Sewage Works and are based on the best information presently available. These criteria were originally filed as 10 CSR 20-8.030. It is anticipated that they will be subject to review and revision periodically as additional information and methods appear. Addenda or supplements to this publication will be furnished to consulting engineers and city engineers. If others desire to receive addenda or supplements, please advise the Clean Water Commission so that names can be added to the mailing list.]

PURPOSE: The following minimum criteria have been prepared as a standard for the design of wastewater systems. This rule is to be used with rules 10 CSR 20-8.110 through 10 CSR 20-8.500 for the planning and design of a treatment facility. It is not reasonable or practical to include all aspects of design in these standards. The design engineer may use other appropriate reference materials for these design aspects not addressed in this rule, which include but are not limited to: copies of all ASTM International and American Water Works Association (AWWA) standards pertaining to wastewater systems and appurtenances, design manuals such as Water Environment Federation's Manuals of Practice, Department prepared guides and other wastewater design manuals containing principles of accepted engineering practice. This rule specifies minimum standards for the design and construction of wastewater systems, in addition to engineering experience and judgement in accordance with standards of practice.

[(1) Definitions. Definitions as set forth in the Clean Water Law and 10 CSR 20-2.010 shall apply to those terms when used in this rule, unless the context clearly requires otherwise. Where the terms shall and must are used, they are to mean a mandatory requirement insofar as approval by the agency is concerned, unless justification is presented for deviation from the requirements. Other terms, such as should, recommend, referred and the like, indicate discretionary requirements on the part of the agency and deviations are subject to individual consideration.]

[(2) Exceptions. This rule shall not apply to facilities designed for twenty-two thousand five hundred gallons per day (22,500 gpd) (85.4m^3) or less (see 10 CSR 20-8.020 for the requirements for those facilities).]

(1) Applicability. Wastewater systems shall be designed based on criteria contained in this

rule, published standards, applicable federal and state requirements, standard textbooks, current technical literature and applicable safety standards. To the extent of any conflict between the above criteria, the requirement in this rule shall prevail.

(A) This rule shall not apply to animal waste management systems. Regulations for these facilities are found in 10 CSR 20-8.300.

(B) This rule shall not apply to agrichemical facilities. Regulations for these facilities are found in 10 CSR 20-8.500.

(*[3]***2**) General Considerations.

(A) Number of Units. Multiple **settling** units capable of independent operation are desirable and shall be provided in all *[plants]* **wastewater treatment facilities** where design flows exceed one hundred thousand (100,000) *[gpd (379m^3/d)]* **gallons per day**. *[Plants not having]* **Wastewater treatment facilities without** multiple **settling** units shall **be designed to** include other provisions to assure continuity of treatment.

[(B) Arrangement. Settling tanks shall be arranged in accordance with subsection 10 CSR 20-8.140(5)(E).]

(*[C]***B**) Flow Distribution. Effective flow *[measurement]* **splitting** devices and control appurtenances (*[that is, valves,]* **i.e.,** gates, splitter boxes, etc.) shall be provided to permit proper proportion**ing** of flow **and solids loading** to each **settling** unit**, throughout the expected range of flows**.

[(D) Tank Configuration. Consideration should be given to the probable flow pattern in the selection of tank size and shape, and inlet and outlet type and location.]

(*[4]***3**) Design *[Considerations]*.

[(A) Dimensions. The minimum length of flow from inlet to outlet should be ten feet (10') (3 m) unless special provisions are made to prevent short-circuiting. The sidewater depth for primary clarifiers shall be as shallow as practicable, but not less than seven feet (7') (2.1 m). Clarifiers following the activated sludge process shall have sidewater depths of at least twelve feet (12') (3.7 m) to provide adequate separation zone between the sludge blanket and the overflow weirs. Clarifiers following fixed film reactors shall have sidewater depth of at least seven feet (7') (2.1m).]

(A) Side Water Depth. The minimum side water depth shall be as follows in Table 160-1, included herein:

Table 160-1. Minimum Side Water Depth.

Type of Settling Tank	Minimum Side Water Depth (ft)
Primary	**10**
Final following activated sludge process	**12**
Final following attached growth biological reactor	**10**

(B) Surface *[Settling Rates (]*Overflow Rates*[)]*.

[1. Primary settling tanks. Surface settling rates for primary tanks should not exceed one thousand (1000) gpd per square foot (41m^3/m^2/day) at design average flows or one

thousand five hundred (1500) gpd per square foot (61m^3/m^2/day) for peak hourly flows. Clarifier sizing shall be calculated for both flow conditions and the larger surface area determined shall be used. Primary settling of normal domestic sewage can be expected to remove thirty to fifty percent (30–50%) of the influent BOD. However, anticipated BOD removal for sewage containing appreciable quantities of industrial wastes (or chemical additions to be used) should be determined by laboratory tests and consideration of the quantity and character of the wastes.

2. Intermediate settling tanks. Surface settling rates for intermediate settling tanks following series units of fixed film reactor processes shall not exceed one thousand five hundred (1500) gpd per square foot (61m^3/m^2/day) based on peak hourly flow.

3. Final settling tanks. Settling tests should be conducted wherever pilot study of biological treatment is warranted by unusual waste characteristics or treatment requirements. Testing shall be done where proposed loadings go beyond the limits set forth in this section. Surface settling rates for settling tanks following trickling filters or rotating biological contractors shall not exceed one thousand two hundred (1200) gpd gallons per day per square foot (49m^3/m^2/day) (1,200 gpd/ft^2) based on the design peak hourly flow. Final settling tanks following activated sludge processes must be designed to meet thickening as well as solids separation requirements. Since the rate of recirculation of return sludge from the final settling tanks to the aeration or re-aeration tanks is quite high in activated sludge processes, surface settling rate and weir overflow rate should be adjusted for the various processes to minimize the problems with sludge loadings, density currents, inlet hydraulic turbulence and occasional poor sludge settleability. The hydraulic design of intermediate and final settling tanks following activated sludge processes shall be based upon the anticipated peak hourly rate for the area downstream of the inlet baffle. The hydraulic loadings shall not exceed—one thousand two hundred (1200) gpd per square foot (49m^3/m^2/day) for conventional, step aeration, contact stabilization and the carbonaceous stage of separate-stage nitrification; one thousand (1000) gpd per square foot (41m^3/m^2/day) for extended aeration; and eight hundred (800) gpd per square foot (33m^3/m^2/day) for the separate nitrification stage. The solids loading for all activated sludge processes shall not exceed fifty pounds (50 lbs.) solids per day per square foot (244 kg/m^2/day) at the peak rate. Consideration should be given to flow equalization.]

1. Primary settling tanks. Calculate the surface overflow rates for both design average flow and design peak hourly flow from Table 160-2, included herein; the larger area shall determine the size of the settling tank.

Table 160-2. Maximum Primary Settling Tank Surface Overflow Rates.

Type of Primary Settling Tank	Surface Overflow Rates[1]: At Design Average Flow (gpd/ft^2)	At Design Peak Hourly Flow (gpd/ft^2)
Tanks not receiving waste activated sludge	1,000	3,000
Tanks receiving waste activated sludge	700	1,700

[1] Calculate surface overflow rates with all flows received at the settling tanks.

2. Final settling tanks – attached growth biological reactors. Surface overflow rates for settling tanks following attached growth biological reactors shall not exceed one thousand two hundred gallons per day per square foot (1,200 gpd/ft^2) based on the design peak hourly flow.

3. Final settling tanks – activated sludge. The following design criteria in Table 160-3, included herein, shall not be exceeded:

Table 160-3. Maximum Activated Sludge Final Settling Tank Rates.

Treatment Process	Surface Overflow Rate at Design Peak Hourly Flow[1] (gpd/ft^2)	Peak Solids Loading Rate[2] (lb/day/ft^2)
With diurnal flow equalization[3]	1,000	35
Without diurnal flow equalization[3]	150 x Peaking Factor[4]	35
Conventional, Step Aeration, Complete Mix, Contact Stabilization, Carbonaceous Stage of Separate Stage Nitrification	1,200 [5]	40
Extended Aeration Single Stage Nitrification	1,000	35
Multi-Stage Nitrification	800	35
Activated Sludge with Chemical addition to Mixed Liquor for Phosphorus Removal	900	35

[1] **Based on influent flow only.**

[2] **Calculate the peak solids loading rate based on the design maximum day flow rate plus the design maximum return sludge rate requirement and the design mixed liquor suspended solids under aeration.**

[3] **Applicable to wastewater treatment facilities with a design average flow of less than one hundred thousand gallons per day (100,000 gpd).**

[4] **Refer to 10 CSR 20-8.110(3) Equation 110-1 to determine the peaking factor.**

[5] **Wastewater treatment facilities needing to meet twenty milligrams per liter (20 mg/L) suspended solids or less should reduce the surface overflow rate to one thousand gallons per day per square foot (1,000 gpd/ft^2).**

[(C) Inlet Structures. Inlets should be designed to dissipate the inlet velocity, to distribute the flow equally, both horizontally and vertically, and to prevent short-circuiting. Channels should be designed to maintain a velocity of at least one foot (1') per second (0.3m/s) at one-half (1/2) the design flow. Corner pockets and dead ends should be eliminated and corner

fillets or channeling used where necessary. Provisions shall be made for elimination or removal of floating materials in inlet structures.]

(*[D]***C**) Weirs.

1. General. Overflow weirs shall be **readily** adjustable *[for leveling]* **over the life of the structure to correct for differential settlement of the tank**.

[2. Location. Overflow weirs shall be located to optimize actual hydraulic detention time, and minimize short-circuiting.

*3. Design rates. Weir loadings should not exceed**:** ten thousand (10,000) gpd per lineal foot (124m^3/m/day) for plants designed for average flows of 1.0 mgd (3,785m^3/day) or less. Higher weir loadings may be used for plants designed for larger average flows but should not exceed fifteen thousand (15,000) gpd per lineal foot (186m^3/m/day). If pumping is required, weir loadings should be related to pump delivery rates to avoid short-circuiting.*

4. Weir troughs. Weir troughs shall be designed to prevent submergence at maximum design flow and to maintain a velocity of at least one foot (1') per second (0.3m/s) at one-half (1/2) the design flow.]

2. Design rates. The following weir loadings in Table 160-4, included herein, shall not be exceeded:

Table 160-4. Maximum Weir Loading Rates.

Average Wastewater Treatment Facility Capacity (million gallons per day or MGD)	**Loading Rate at Design Peak Hourly Flow (gpd/lf)**
Less than 0.1	**10,000**
0.1 through 1.0	**20,000**
Greater than 1.0	**30,000**

(*[E]***D**) Submerged Surfaces. *[The tops of troughs, beams and similar submerged construction elements shall have a minimum slope of 1.4:1; t]***T**he underside of the **tops of troughs, beams, and similar submerged construction** elements *[should]* **shall** have a **minimum** slope of one **vertical** to one **horizontal** (1:1) to prevent the accumulation of scum and solids.

[(F) Unit De-watering. Unit de-watering features shall conform to the provisions outlined in 10 CSR 20-8.140(6). The unit isolation design should also provide for redistribution of the plant flow to the remaining units.]

(*[G]***E**) Freeboard. Walls of settling tanks shall extend at least six inches (6") *[(15 cm)]* above the surrounding ground surface and shall provide not less than twelve inches (12") *[(30 cm)]* **of** freeboard. *[Additional freeboard or the use of wind screens is recommended where larger settling tanks are subject to high velocity wind currents that would cause tank surface waves and inhibit effective scum removal.]*

[(5) Sludge and Scum Removal.

(A) Scum Removal. Effective scum collection, and removal, including baffling, shall be provided for all settling tanks. The unusual characteristics of scum which may adversely affect pumping, piping, sludge handling and disposal should be recognized in design.

(B) Sludge Removal. Sludge collection and withdrawal facilities shall be so designed as to

assure rapid removal of the sludge. Suction withdrawal should be provided for activated sludge plants designed for reduction of the nitrogenous oxygen demand and is encouraged for those plants designed for carbonaceous oxygen demand reduction.

1. Sludge hopper. The minimum slope of the side walls shall be 1.7:1. Hopper wall surfaces should be made smooth with rounded corners to aid in sludge removal. Hopper bottoms shall have a maximum dimension of two feet (2') (.6m). Extra depth sludge hoppers for sludge thickening are not acceptable.

2. Cross-collectors. Cross-collectors serving one (1) or more settling tanks may be useful in place of multiple sludge hoppers.

3. Sludge removal piping. Each hopper shall have an individually-valved sludge withdrawal line at least six inches (6") (15 cm) in diameter. The static head available for withdrawal of sludge shall be thirty inches (30") (76 cm) or greater as necessary to maintain a three-foot (3') per second (0.9m/s) velocity in the withdrawal pipe. Clearance between the end of the withdrawal line and the hopper walls shall to be sufficient to prevent bridging of the sludge. Adequate provisions shall be made for rodding or back-flushing individual pipe runs. Piping shall also be provided to return waste sludge to primary clarifiers.

*4. Sludge removal control. Sludge wells equipped with telescoping valves or other appropriate equipment shall be provided for viewing, sampling**,** and controlling the rate of sludge withdrawal. The use of easily maintained sight glass and sampling valves may be appropriate. A means of measuring the sludge removal rate shall be provided. Air lift type of sludge removal will not be approved is not appropriate for removal of primary sludges. Sludge pump motor control system shall include time clocks and valve activators for regulating the duration and sequencing of sludge removal.]*

(4) Sludge Removal.

(A) Settling floor. The minimum slope of the settling floor shall be one vertical to twelve horizontal (1:12).

(B) Sludge hopper. The minimum slope of the sludge hopper side walls shall be 1.7 vertical to one horizontal (1.7:1) (i.e., sixty degrees (60°) above the horizontal). When used, dual sludge hoppers shall provide a minimum water depth of two feet (2') over the junction of sixty degrees (60°) walls between hoppers.

(*[6]***5**) Protective and Service Facilities.

(A) Operator Protection. *[All settling tanks shall be equipped to enhance safety for operators. These]* **Safety** features shall appropriately include machinery covers, life lines, **all** stairways*[,]* **and** walkways*[,]* **with** handrails**,** and slip*[-]* resistant surfaces. **Also, refer to 10 CSR 20-8.140(7).**

(B) Mechanical Maintenance Access. The design shall provide for convenient and safe access to routine maintenance items such as gear boxes, scum removal*[,]* mechanism**,** *[and]* baffles, weirs, inlet stilling baffle area**s,** and effluent channels.

(C) Electrical **Equipment,** Fixtures**,** and Controls. **For** *[E]***e**lectrical **equipment,** fixtures**,** and controls in enclosed settling basins **and scum tanks, where hazardous concentrations of flammable gases or vapors may accumulate,** *[shall be suitable for hazardous locations (National Electrical Code for Class I, Group D, Division 1 location)]* **refer to 10 CSR 20-8.140(6)(B)**. The fixtures and controls shall be located so as to provide convenient and safe

access for operation and maintenance. *[Adequate area lighting shall be provided.]*

AUTHORITY: section 644.026, RSMo Supp. 1988. Original rule filed Aug. 10, 1978, effective March 11, 1979. *Original authority 1972, amended 1973, 1987, 1993.*