|  |  |
| --- | --- |
| Minnesota Pollution Control Agency (MPCA), 520 Lafayette Road North, St. Paul, MN 55155-4194 | Settling Review Checklist  NPDES/SDS Permit Program  National Pollutant Discharge Elimination System (NPDES)/ State Disposal System (SDS)  Doc Type: Plan/Specification Review Summary |

**Purpose:** This checklist is intended for use by design engineers, to assist Minnesota Pollution Control Agency (MPCA) review engineers in the efficient review of planning and design documents. The information requested is the minimum technical data necessary for MPCA staff to review proposed designs and to determine whether there is reasonable assurance that the treatment system, when constructed, will comply with permit conditions, regulations, and criteria of the MPCA.

**Instructions:** The information in this checklist is based on the ***Recommended Standards for Wastewater Facilities published by the Great Lakes Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (Ten State Standards) 2014 Edition,*** other accepted engineering references, and MPCA recommendations. Specific references, other than Ten State Standards, are listed where appropriate. The checklist is organized according to the numbering sequence found in Ten State Standards to allow for ease in locating the entire content and text of the recommendations.

The checklist is designed so that a “**yes**” answer indicates compliance with Ten State Standards et al.

A “**no**” answer indicates a deviation from Ten State Standards et al. Answering “no” to any question will require justification that can be provided at the end of the checklist and possibly supporting information, from wastewater treatment plant operational data, to demonstrate how the intent of the recommendation will be met. Additional information may be requested based on site specific conditions.

A “**N/A**” answer means not applicable because the equipment associated with the question is not included in the design.

Wastewater Treatment Facility information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date** (mm/dd/yyyy): | |  | **MPCA Project No:** |  |
| **Title of project:** |  | | | |

Permittee information

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Facility name: | |  | | | | |
| Contact name and title: | | |  | NPDES/SDS Permit No: | MN |  |
| Email: |  | | | Phone number: |  | |

Design Engineer information

|  |  |  |  |
| --- | --- | --- | --- |
| Contact name: |  | Contact phone number: |  |
| Email: |  |  |  |

**Phase:**  Planning Phase  Design Phase

**Location:**  Primary  Intermediate  Secondary

**Type of settling:**  Circular  Rectangular

**Type of feed:**  Center  Rim

Influent Characteristics

|  |  |  |  |
| --- | --- | --- | --- |
| AWW (peak month) flow to plant |  | gpd |  |
| Recirculation flow |  | gpd |  |
| Total average flow (peak month) |  | gpd |  |
| PHWW flow (peak hourly) |  | gpd |  |
| Pump delivery rate |  | gpd |  |
| Organic loading, CBOD5 |  | lbs/day |  |
| TSS, including recirc |  | lbs/day |  |

Effluent Characteristics

|  |  |  |
| --- | --- | --- |
| Percent removal |  | % |
| Effluent CBOD5 |  | lbs/day |
| Effluent TSS |  | lbs/day |

70. Settling *(Only use a “NA” answer if the equipment associated with the question is not included in the design)*

| ***71. General*** | | **Yes** | **No** | **N/A** |
| --- | --- | --- | --- | --- |
| **71.1 Number of Units** | | | | |
| Are multiple settling units capable of independent operation provided in plants where design average flows exceed 100,000 gallons/day? Design average flow is the average of the daily volumes to be received for a continuous 12 month period expressed as a volume per unit time. | |  |  |  |
| Identify number of settling units: |  | | | |
| Identify process settling is preceded by: |  | | | |
| Identify process settling is followed by: |  | | | |
| If multiple settling units are not provided, are other provisions included to ensure continuity of treatment? | |  |  |  |
| Is room available for possible future settling units? (M&E 2014) | |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **71.2 Flow Distribution** | | | | | |
| Are effective flow splitting devices and control appurtenances (i.e., gates, splitter boxes, etc.) provided to permit proper proportioning of flow and solids loading to each settling unit, throughout the expected range of flows? Refer to Paragraph 53.7. | | |  |  |  |
| Are valves or gates provided to isolate each unit? (MOP 8 1998) | | |  |  |  |
| Is there flexibility to redistribute flow from any unit out of service to remaining units in service? (MOP 8 1998) | | |  |  |  |
| If multiple units are provided, is hydraulic capacity of remaining units sufficient to handle peak hourly flow when one unit is out of service? (MOP 8 1998) | | |  |  |  |
| If sludge is returned, is there a central collection and distribution point that includes flow splitters? (MOP 8 1998) | | |  |  |  |
| ***72. Design Considerations*** | | | | | |
| **72.1 Dimensions** | | | | | |
| Is the minimum length of flow from inlet to outlet 10 feet unless special provisions are made to prevent short circuiting? | | |  |  |  |
| Identify distance between inlet and outlet: |  | feet | | | |
| Are the vertical side water depths designed to provide an adequate separation zone between the sludge blanket and the overflow weirs? | | |  |  |  |
| Are the minimum side water depths as identified below? | | |  |  |  |
| |  |  | | --- | --- | | **Type of Settling Tank** | **Minimum Side Water Depth, feet** | | Primary | 10 | | Secondary tank following activated sludge process\* | 12 | | Secondary tank following attached growth biological reactor\* | 10 |   \*Greater side water depths are recommended for secondary clarifiers in excess of 4,000 square feet surface area (equivalent to 70 feet diameter). Side water depths less than 12 feet may be permitted for package plants with a design average flow less than 25,000 gallons per day, if justified based on successful operating experience. | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Identify depth of side water per unit: |  | feet |  |
| Identify diameter or length and width of each unit: |  | feet | Circular clarifiers: tank radius < five to six times the side water depth  Rectangular clarifiers: maximum length < ten times the side water depth (M&E 2014) |

|  |  |  |
| --- | --- | --- |
| ***72.1 Dimensions (continued)*** | | |
| Identify surface area, including inlet baffle: |  | ft2 |
| Identify surface area, downstream of inlet baffle for activated sludge: |  | ft2 |
| Identify detention time at average wet weather flow: |  | hr |
| Identify detention time at peak hourly wet weather flow: |  | hr |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **72.2 Surface Overflow Rates** | | | | | |
| **72.21 Primary Settling Tanks** | | | **Yes** | **No** | **N/A** |
| Does primary settling tank sizing reflect the degree of solids removal needed and the need to avoid septic conditions during low flow periods? | | |  |  |  |
| Is sizing calculated for both the design average and design peak hourly flow conditions, and the larger surface area determined is the one that is used? | | |  |  |  |
| Identify capacity: |  | ft3 | | | |
| Are the following surface overflow rates not exceeded in the design? | | |  |  |  |
| |  |  |  | | --- | --- | --- | | **Type of Primary Settling Tank** | **Surface Overflow Rates at:**\* | | | **Design Average Flow, gpd/ft2** | **Design Peak Hourly Flow, gpd/ft2** | | Tanks not receiving waste activated sludge\*\* | 1,000 | 1,500-2,000 | | Tanks receiving waste activated sludge | 700 | 1,200 |   \*Surface overflow rates shall be calculated with all flows received at the settling tanks. Primary settling of normal domestic wastewater can be expected to remove approximately one-third of the influent BOD when operating at an overflow rate of 1,000 gallons per day/square foot.  \*\*Anticipated BOD removal should be determined by laboratory tests and should consider the character of the wastes. Significant reduction in BOD removal efficiency will result when the peak hourly overflow rate exceeds 1,500 gallons per day/square foot. | | | | | |
| **72.22 Intermediate Settling Tanks** | | | | | |
| Has it been determined that surface overflow rates for intermediate settling tanks following series units of fixed film reactor processes should not exceed 1,200 gallons per day per square foot based on the design peak hourly flow? | | |  |  |  |
| Has it been determined that higher surface settling rates to 1,500 gallons per day per square foot based on the peak hourly flow are shown to have no adverse effects on subsequent treatment units? | | |  |  |  |
| **72.23 Final Settling Tanks** | | | | | |
| Have settling tests been conducted where a pilot study of biological treatment is warranted by unusual waste characteristics, treatment requirements, or where proposed loadings go beyond the limits set forth in this section? | | |  |  |  |
| **72.231 Final Settling Tanks – Attached Growth Biological Reactors** | | | | | |
| Has it been determined that surface overflow rates for settling tanks following trickling filters or rotating biological contactors shall not exceed 1,200 gallons per day per square foot based on the design peak hourly flow? | | |  |  |  |
| **72.232 Final Settling Tanks – Activated Sludge** | | | | | |
| Are activated sludge settling tanks designed to meet thickening and solids separation requirements to perform properly while producing a concentrated return flow? | | |  |  |  |
| Are the surface and weir overflow rates adjusted for the various processes to minimize the problems with sludge loadings, density currents, inlet hydraulic turbulence, and occasional poor sludge settleability, since the rate of recirculation of return sludge from the final settling tanks to the aeration or reaeration tanks is quite high in activated sludge processes? | | |  |  |  |
| Is the size of the settling tank based on the larger of the surface areas determined for surface overflow rate and solids loading rate? | | |  |  |  |
| Is the design such that the following design criteria are not exceeded? | | |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | | **Treatment Process** | **Surface Overflow Rate at Design Peak Hourly Flow\*, gpd/ft2** | **Peak Solids Loading Rate\*\*\*, lb/day/ft2** | | Conventional, Step Aeration, Complete Mix, Contact Stabilization, Carbonaceous Stage of Separate Stage Nitrification | 1,200\*\* | 40 | | Extended Aeration Single Stage Nitrification | 1,000 | 35 | | 2 Stage Nitrification | 800 | 35 | | Activated Sludge with Chemical addition to Mixed Liquor for Phosphorus Removal | 900\*\*\*\* | As Above |   \*Based on influent flow only.  \*\*Plants needing to meet 20 mg/L suspended solids should reduce the surface overflow rate to 1,000 gallons per day per square foot.  \*\*\*The clarifier peak solids loading rate shall be calculated based on the design maximum day flow rate plus the design maximum return sludge rate requirement and the design MLSS under aeration.  \*\*\*\*When phosphorus removal to a concentration of less than 1.0 mg/L is required. | | | | | | |
| Identify surface settling rate (calculated downstream of inlet baffle for activated sludge): |  | gpd/ft2 | | AWW flow | | |
| Identify surface settling rate (calculated downstream of inlet baffle for activated sludge): |  | gpd/ft2 | | PHWW flow | | |
| Identify loading rate at peak rate for activated sludge process: |  | lb/day/ft2 | | | | |
| **72.3 Inlet Structures** | | | **Yes** | | **No** | **N/A** |
| Are inlets and baffling designed to dissipate the inlet velocity, to distribute the flow equally, both horizontally and vertically, and to prevent short circuiting? | | |  | |  |  |
| Is the use of flocculation zones considered for secondary settling tanks? | | |  | |  |  |
| Are channels designed to maintain a velocity of at least 1 foot per second at one-half of the design average flow? Design average flow is the average of the daily volumes to be received for a continuous 12 month period expressed as a volume per unit time. | | |  | |  |  |
| Are corner pockets and dead ends eliminated and corner fillets or channeling used where necessary? | | |  | |  |  |
| Are provisions made for the elimination or removal of floating materials that may accumulate in inlet structures? | | |  | |  |  |
| **72.4 Weirs** | | | | | | |
| **72.41 General** | | | | | | |
| Are overflow weirs readily adjustable over the life of the structure to correct for differential settlement of the tank? | | |  | |  |  |
| **72.42 Location** | | | | | | |
| Are overflow weirs located to optimize actual hydraulic detention time and minimize short circuiting? | | |  | |  |  |
| Are peripheral weirs placed at least 1 foot from the wall? | | |  | |  |  |
| Are multiple weir troughs located sufficiently far apart to avoid excessive upward velocity between the troughs? (MOP 8 1998) | | |  | |  |  |
| If the clarifier is rectangular, is the ratio of distance of weirs from end wall to total length 25 percent? (MOP 8 1998) | | |  | |  |  |
| **72.43 Design Rates** | | | | | | |
| Is the design such that weir loadings shall not exceed the rates identified below? | | |  | |  |  |
| |  |  | | --- | --- | | **Average Plant Capacity** | **Loading Rate at Design Peak Hourly Flow, gpd/lin ft** | | Equal to or less than 1 MGD | 20,000 | | Greater than 1 MGD | 30,000 | | | | | | | |

|  | | | | | | | **Yes** | **No** | **N/A** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| If pumping is required, will pumps be operated as continuously as possible? | | | | | | |  |  |  |
| If pumping is required, will weir loading be related to pump delivery rates to avoid short circuiting? | | | | | | |  |  |  |
| Identify weir overflow rate (if pumping to clarifier, use pump delivery rate): |  | | gal/day/ft | | Use the horizontal length at the overflow water level at AWW flow to calculate the lineal feet of weir length, especially with an intermittent notch type weir | | | | |
| **72.44 Weir Troughs** | | | | | | | | | |
| Are weir troughs designed to prevent submergence at design peak hourly flow, and to maintain a velocity of at least 1 foot per second at one-half design average flow? | | | | | | |  |  |  |
| Identify weir trough velocity: | |  | | ft/s | | | | | |
| If sludge recirculation pumps are used for mixing, are they provided in accordance with appropriate requirements of Paragraph 87.1? | | | | | | |  |  |  |
| **72.5 Submerged Surface** | | | | | | | | | |
| Will the tops of troughs, beams, and similar submerged construction elements have a minimum slope of 1.4 vertical to 1 horizontal? | | | | | | |  |  |  |
| Will the underside of such elements have a slope of 1 to 1 to prevent the accumulation of scum and solids? | | | | | | |  |  |  |
| **72.6 Unit Dewatering** | | | | | | | | | |
| Do unit dewatering features conform to the provisions outlined in Paragraph 54.3? | | | | | | |  |  |  |
| Does the bypass design provide for distribution of the plant flow to the remaining settling tanks? | | | | | | |  |  |  |
| Is each unit constructed with load bearing walls, piping, valves and other appurtenances to allow bypassing and dewatering each unit individually? (MOP 8 1998) | | | | | | |  |  |  |
| Is there sufficient tank bottom slope provided to provide complete drainage of the tank? (MOP 8 1998) | | | | | | |  |  |  |
| **72.7 Freeboard** | | | | | | | | | |
| Do walls of the settling tanks extend at least 6 inches above the surrounding ground surface and provide no less than 12 inches of freeboard? | | | | | | |  |  |  |
| Is additional freeboard or the use of wind screens provided where larger settling tanks are subject to high velocity wind currents that would cause tank surface waves and inhibit effective scum removal and to reduce heat loss during cold periods? | | | | | | |  |  |  |
| ***73. Sludge and Scum Removal*** | | | | | | | | | |
| **73.1 Scum Removal** | | | | | | | | | |
| Are full surface mechanical scum collection and removal facilities, including baffling, provided for all settling tanks? | | | | | | |  |  |  |
| Are the unusual characteristics of scum that may adversely affect pumping, piping, sludge handling and disposal recognized in the design? | | | | | | |  |  |  |
| Are provisions made to remove scum from the wastewater treatment process and direct it to either a scum concentrator or to the sludge treatment processes? | | | | | | |  |  |  |
| Are other special provisions for scum disposal considered in the design? | | | | | | |  |  |  |
| If scum is discharged to a digester, is consideration given to increased operation and maintenance to maintain complete mix of the digester? (MOP 8 1998) | | | | | | |  |  |  |
| Is consideration given to using positive displacement pumps and using piping with a high “C” factor to prevent grease accumulation? (MOP 8 1998) | | | | | | |  |  |  |
| **73.21 Sludge Hopper** | | | | | | | | | |
| Is the minimum slope of the side walls 1.7 vertical to 1 horizontal? | | | | | | |  |  |  |
| Are hopper wall surfaces smooth with rounded corners to aid in sludge removal? | | | | | | |  |  |  |
| Do hopper bottoms have a maximum dimension of 2 feet? | | | | | | |  |  |  |
| Are sludge hoppers with extra depth for sludge thickening avoided? | | | | | | |  |  |  |
| Is suction withdrawal provided for activated sludge plants designed for nitrification? (MOP 8 1998) | | | | | | |  |  |  |
| Are provisions provided to waste sludge directly to the primary clarifier to blend the secondary sludge with primary sludge before going to the digester? (M&E 2014) | | | | | | |  |  |  |
| **73.23 Sludge Removal Pipeline** | | | | | | | | | |
| Does each sludge hopper have an individually valved sludge withdrawal line at least 6 inches in diameter? | | | | | | |  |  |  |
| Will the static head available for withdrawal of sludge be 30 inches or greater as necessary to maintain a 3 foot per second velocity in the withdrawal pipe? | | | | | | |  |  |  |
| Is clearance between the end of the withdrawal liner and the hopper walls sufficient to prevent “bridging” of the sludge? | | | | | | |  |  |  |
| Will adequate provisions be made for rodding or back-flushing individual pipe runs? | | | | | | |  |  |  |
| Will provisions be made to allow for visual confirmation of return sludge? | | | | | | |  |  |  |
| Will piping be provided to return sludge for further processing? | | | | | | |  |  |  |
| **73.24 Sludge Removal Control** | | | | | | | | | |
| Will separate settling tank sludge lines drain to a common sludge well? | | | | | | |  |  |  |
| Will sludge wells equipped with telescoping valves or other appropriate equipment be provided for viewing, sampling, and controlling the rate of sludge withdrawal? | | | | | | |  |  |  |
| Are provisions provided to return and waste sludge concurrently? (MOP 8 1998) | | | | | | |  |  |  |
| Will provisions be provided to add chlorine to return sludge lines for control of sludge bulking? (MOP 8 1998) | | | | | | |  |  |  |
| Identify method for viewing, sampling, and controlling rate of sludge withdrawal: | | | | | |  | | | |
| Will a means of measuring the sludge removal rate be provided? | | | | | | |  |  |  |
| Will air-lift sludge removal for the removal of primary sludges be avoided? | | | | | | |  |  |  |
| Identify type of sludge removal: | | | | | |  | | | |
| ***74. Protective and Service Facilities*** | | | | | | | | | |
| **74.1 Operator Protection** | | | | | | | | | |
| Will all settling tanks be equipped to enhance safety for operators? | | | | | | |  |  |  |
| Will safety features appropriately include machinery covers, life lines, stairways, walkways, handrails, and slip resistant surfaces? | | | | | | |  |  |  |
| **74.2 Mechanical Maintenance Access** | | | | | | | | | |
| Does the design provide for convenient and safe access to routine maintenance items such as gear boxes, scum removal mechanisms, baffles, weirs, inlet stilling baffle areas, and effluent channels? | | | | | | |  |  |  |
| If sidewalls are extended more than three feet above the liquid level or four feet above the ground level, are convenient walkways and/or steps provided to facilitate cleaning and maintenance? (MOP 8 1998) | | | | | | |  |  |  |
| Are covers provided when clarifier influent temperature is at or near freezing or when clarifiers follow an activated sludge system with 12 hours or more detention time? | | | | | | |  |  |  |
| If covers are provided, do they allow for easy accessibility for inspection and maintenance? | | | | | | |  |  |  |
| **74.3 Electrical Equipment, Fixtures and Controls** | | | | | | | | | |
| Does electrical equipment, fixtures and controls in enclosed settling basins and scum tanks, where hazardous concentration of flammable gases or vapors may accumulate, meet the requirements of the National Electrical Code for Class I, Division 1, Group D locations? | | | | | | |  |  |  |
| Will the fixtures and controls be located to provide convenient and safe access for operation and maintenance? | | | | | | |  |  |  |
| Will adequate area lighting be provided? | | | | | | |  |  |  |
| When clarifiers are covered, will lighting inside the cover be provided? (MOP 8 1998) | | | | | | |  |  |  |

|  |
| --- |
| Justification for all questions answered with a “no”: |
|  |
| Additional comments: |
|  |

**References**

GLUMRB (2014 Edition) *Recommended Standards for Wastewater Facilities* (Ten State Standards), Health Research, Inc., Health Education Services Division, Albany NY.

Metcalf & Eddy, Inc. (2014) *Wastewater Engineering, Treatment and Resource Recovery*, 5th ed., McGraw-Hill, New York. (M&E 2014)

WEF (1998) *Design of Municipal Wastewater Treatment Plants, Manual of Practice No. 8,* Water Environmental Federation, Alexandria, VA. (MOP 8 1998)

**Acronym definitions**

AWW Average Wet Weather

BOD Biochemical Oxygen Demand

ft2 feet squared

ft3 feet cubed

ft/s feet per second

gal/day/ft gallons per day per foot

gpd gallons per day

gpd/ft2 gallons per day per square foot

gpd/lin ft gallons per day per linear foot

hr hour

lbs/day pounds per day

lb/day/ft2 pounds per day per square foot

mg/L milligrams per liter

MGD Million Gallons per Day

MLSS Mixed Liquor Suspended Solids

PHWW Peak Hourly Wet Weather