TCEQ REGULATORY GUIDANCE
Occupational Licensing and Registration Division
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Process Control Tests for Activated Sludge Domestic Wastewater Treatment Facilities

This guide is for owners and operators of activated sludge domestic wastewater treatment facilities to provide a list of recommended process control tests that may be performed to effectively operate their system. The specific circumstances of your system will determine which process control tests will best suit your facility's needs. Please note that this publication is for general guidance only and does not take the place of any rules or regulations.

Why Are Process Control Tests Important?

Activated sludge wastewater treatment facilities require regular monitoring and adjustments. Knowing when to adjust the process is essential to meeting permitted discharge criteria and protecting public health, the environment, and the treatment system's infrastructure. This document can help you determine what process control tests and testing frequencies you should implement at your facility to help identify necessary operational adjustments and avoid effluent quality violations. Such violations could lead to enforcement action against the permit holder, and possibly your own license.

What Parameters Do I Test For?

The information below describes parameters to test for during process control, why each parameter is important for process control, typical concentrations for each parameter under normal operating conditions, and how to identify issues and conduct basic troubleshooting. The information is not meant to be comprehensive. Results outside of the typical concentrations may require process adjustment or troubleshooting specific to your facility. Always consult your Operation and Maintenance (O&M) Manual. Operation and Troubleshooting guidance can be found on the TCEQ website (Appendix C).

Based on the design of your wastewater treatment facility (WWTF), some parameters may not be applicable. The parameter types and frequencies will depend on facility operation conditions such as the type of treatment process, upsets, whether the facility is in compliance, collection system waste characterization, and/or budget. Facilities of all sizes and types will benefit from periodically utilizing some of these process control tests. Recommendations for which parameters to test for, where to sample, and how often to sample can be found in Tables 3 through 7.

Alkalinity as CaCO3

Why is it important?

- To confirm there is enough alkalinity to complete the nitrification process.
- Alkalinity is a buffer (Bicarbonates - HCO_3) to prevent the effluent pH from dropping too low during the nitrification process.
- A general rule is that 8 mg/l alkalinity is needed per 1 mg/l of influent NH_3-N.
- In a nitrification activated sludge process, nitrifiers use alkalinity as a carbon source.
- If pH drops below 6.70, that indicates significant decrease in nitrification.
- If pH is significantly above 8.33, bicarbonates are chemically converted towards carbonates (CO_3) and/or hydroxides (OH^-) as pH goes higher.

What typical values should I expect?

- Influent alkalinity should be sufficient to maintain an effluent concentration of at least 20 mg/l alkalinity as $CaCO_3$
- Influent alkalinity should be greater than [Influent NH_3-N concentration mg/l x 7.14] + 20 mg/l

Biological Oxygen Demand (BOD_5)

Why is it important?

- To calculate the WWTF's removal efficiency of BOD_5.
- To monitor activity in the collection system.
- Many WWTFs have $CBOD_5$ effluent limits; however, BOD_5 is a better monitoring tool because it takes carbonaceous & nitrifying microbial activity into consideration.

What typical values should I expect?

- Influent: 50 – 400 mg/l
- Effluent: limits should be established in the TCEQ permit

Chemical Oxygen Demand (COD)

Why is it important?

- To calculate the WWTF's removal efficiency of BOD_5.
- To identify suspicious activity in the collection system.
- To quickly validate or estimate the BOD_5 concentration (i.e. To obtain COD data in a few hours instead of five days for BOD_5).
- BOD_5 concentration is always less than and/or equal to the COD concentration.

What typical values should I expect?

- Influent: 75-800 mg/l

Dissolved Oxygen (DO)

Why is it important?

- To ensure aerobic conditions are maintained in the treatment process.
- DO concentration of 1.0 mg/l is adequate to support aerobic microbial activity, but 2.0 mg/l is a good safety margin.
- DO readings should be taken throughout the treatment process at various depths, but routine samples should be taken at the same sampling points.

What typical values should I expect?

- Influent: > 0.5 mg/l
- Aeration: 1 – 4 mg/l
- Clarifier: 0.7- 2 mg/l
- Effluent: See permit
- Digester: > 1.5 mg/l

Food to Microorganism (F/M) Ratio

Why is it important?

- To characterize process designs and operating conditions.
- To identify the proper number of organisms for the system.
- F/M ratio = Influent flow (MGD) x Influent CBOD (mg/l) x 8.34 divided by MLVSS (mg/l) x Volume of aeration system (g).
- This parameter measures the amount of incoming food (lbs. of influent $CBOD_5$) divided by the lbs. of microorganisms.
- Measured in grams substrate/grams biomass per day.

What typical values should I expect?

- 0.04 – 0.1 g substrate/g biomass per day for extended aeration
- 0.2 – 0.4 g substrate/g biomass per day for other activated sludge modes

Flow Rate- Million Gallons per Day (MGD)

Why is it important?

- To calculate loadings.

- To identify inflow/infiltration (I/I).

What typical values should I expect?

Refer to facility design or permitted flow.

Influent Metals Scan

Why is it important?

- To confirm there are no potential toxic or hazardous metallic waste discharges into your collection system.
- Elevated concentrations of heavy metals can have an adverse impact on biomonitoring, sludge disposal (TCLP, BLF on nitrifying bacteria), etc.
- Some metals are an essential nutrient to support the eco-system process (e.g. Fe, Mn, Ca, Na, K, Zn, etc.).
- Other heavy metals can have a toxic impact on the facility and low concentrations can cause upsets (e.g. Ag, As, Pb, Cr, Cr^{+6}, Be, Se, etc.).

What typical values should I expect?

- Refer to your municipality's Rate Order, Ordinance, and/or Pre-Treatment Limits to determine what concentrations are allowable for each metal.
- These levels should be established to minimize adverse impact on the treatment systems infrastructure.

Microscopic Examination

Why is it important?

- To monitor your process's eco-system.
- Observe the following:
  - Most abundant species,
  - Estimate the number of stalked ciliates,
  - Estimate the number of rotifers,
  - Identify the most advanced species,
  - Identify the presence of filamentous organisms.

What typical values should I expect?

- Microbes/Enumeration (Estimated) should be reported as High, Moderate, or Low Counts.

Mixed Liquor Volatile Suspended Solids (MLVSS)/Mixed Liquor Suspended Solids (MLSS)

Why is it important?

- To ensure there is sufficient active biomass available to consume the applied quantity of organic pollutant.

What typical values should I expect?

- MLSS: 600 – 3000 mg/l
- MLVSS/MLSS: 0.75

Ammoniacal Nitrogen (NH3-N)/Total Kjeldahl nitrogen (TKN-N)/Nitrate nitrogen (NO3-N)

Why is it important?

- To calculate WWTF's removal efficiency of NH_3-N.
- To identify biodegradation in collection systems (i.e. state of nitrogen cycle).
- To identify lift station pump cycling.
- TKN is either higher or equal to NH_3.

What typical values should I expect?

- TKN-N: 15 – 80 mg/l
- NH_3-N: 15 – 75 mg/l
- NO_3-N: < 1.0 mg/l

Oxidation-Reduction Potential (ORP)

Why is it important?

- ORP measures a substance's capability to oxidize or reduce another substance.
- To monitor the following biochemical reactions:
  - Nitrification
  - Denitrification
  - CBOD (Oxidation State)
  - Biological Phosphorus Removal
  - Biological Odor Production [e.g. sulfide formation (H_2S)] and others.
- Oxidation-reduction reactions involve carbon (C), phosphorus (P), sulfur (S), and nitrogen (N) and their change from oxidized states (containing oxygen) such as nitrate

(NO_3-) and sulfate (SO_4^{2-}) and reduced states (containing hydrogen) such as ammonia (NH_3) and sulfides (H_2S).

- ORP is measured in millivolts (mV).
- ORP meter must be calibrated before usage.

What typical values should I expect?

Table 1. Typical Values of ORP

Biochemical Reaction[1]	**ORP, mV**
Nitrification	+100 to +350
CBOD degradation with free molecular oxygen	+50 to +250
Biological phosphorus removal	+25 to +250
Denitrification	+50 to -50
Sulfide (H_2S) formation	-50 to -250
Biological phosphorus release	-100 to -250
Acid formation (fermentation)	-100 to -225
Methane production	-175 to -400

Oxygen Update Rate (OUR) and Specific Oxygen Update Rate (SOUR)

Why is it important?

- To determine if microbes are stable (normal DO consumption rate), unstable (high IOD), or dead bugs (there is toxicity to microbes).
- OUR is expressed as amount of DO consumed by microorganisms in a given amount of time.
- SOUR is expressed as milligrams of O_2/gm VSS/hr.

What typical values should I expect?

SOUR: 0.5-1.0 mg O_2/gm VSS/hr for stabilized sludge

pH

Why is it important?

- To characterize waste stream contents.
- pH can impact biological and chemical reactions.

[1] Adapted from YSI Environmental Application Note ©2008 YSI Inc. *"ORP Management in Wastewater as an Indicator of Process Efficiency*

What typical values should I expect?

6.00-9.00 pH Units are typical.

Phosphorus, Total and Soluble (ortho-phosphate)

Why is it important?

- To calculate the WWTF's removal efficiency of total phosphorus.
- Soluble phosphorus (orthophosphate) is available for biological metabolism without further breakdown.
- Soluble phosphorus cannot be removed in primary or secondary treatment units.
- To determine amount of chemicals needed for phosphorus removal.

What typical values should I expect?

Influent total phosphorus: 4-12 mg/l

Return Activated Sludge (RAS)/ Waste Activated Sludge (WAS)

Why is it important?

- To assess the return and wasting rates.
- To use for process control calculations.

What typical values should I expect?

RAS, % of influent depends on aeration process.

Settleability (SV30) %

Why is it important?

- To determine the floc's characteristics.
- Occasionally, after the 30-minute level has been recorded, allow your 1-liter graduate cylinder or settlometer to stand for an addition 2 hours under the same ambient conditions to confirm no inversion or split blankets occurred.

What typical values should I expect?

- Floc should settle with uniformity.
- Old Sludge settles within five minutes.
- Young Sludge settles very slowly (greater than five minutes).

Sludge Blanket Depth

Why is it important?

- To confirm the clarifier's free-board water depth is sufficient to prevent solids carrying-over into the overflow trough.
- To verify physical appearance and physical characteristics.
- To confirm no split blankets.
- To verify color and no septic layers (conditions).
- To measure floc uniformity.
- Sludge sampler should be stabbed at 4 quadrants of clarifier.

What typical values should I expect?

Sludge Blanket should be less than 25 percent of the total Water Depth.

Sludge Retention Time (SRT), Sludge Age or Mean Cell Residence Time (MCRT)

Why is it important?

- To characterize process designs and operating conditions.

$$\text{Sludge age} = \frac{\text{lbs of MLSS in aeration basin}}{\text{daily lbs of TSS in the influent}}$$

$$\text{SRT} = \frac{\frac{\text{lbs}}{\text{day}}\text{ of SS in aeration basin}}{\frac{\text{lbs}}{\text{day}}\text{of SS wasted from the system}}$$

$$\text{MCRT} = \frac{\text{lbs MLSS in secondary system}}{\frac{\text{lbs}}{\text{day}}\text{of SS wasted} + \frac{\text{lbs}}{\text{day}}\text{ of SS in effluent}}$$

What typical values should I expect?

- SRT: 1-5 days depending on treatment goal and temperature (i.e. SRT range for complete nitrification can range from 3-18 days).
- Sludge Age: 3-15 days or 15-30 days for extended aeration.

Sludge Volume Index (SVI)

Why is it important?

- To assess the floc's particle size, shape & settling characteristics. i.e. physical appearance & physical characteristics.

$$\text{SVI} = \frac{\text{Settled Sludge Volume } (\frac{\text{ml}}{\text{l}})}{\text{Mixed Liquor Suspended Solids } (\frac{\text{g}}{\text{l}})} \times 1{,}000$$

What typical values should I expect?

- 50-150 mg/l
- Bulking sludge: above 150 mg/l

Temperature (C/F)

Why is it important?

- Important relation with DO Solubility.
- Deviations in DO can impact settling characteristics & microbial activity.
- For more details, see DO Meter's Saturation Tables.

What typical values should I expect?

Temperature should be between 17°C/62.6 °F and 24°C/75.2 °F.

Total Suspended Solids (TSS)

Why is it important?

- To monitor and maintain solids inventory.

What typical values should I expect?

- Influent: 120 – 400 mg/l
- Effluent: See TCEQ permit

TSS Organic Concentration

Why is it important?

- To calculate the WWTF's removal efficiency.
- To identify biodegradation in collection system.

- To identify Inflow/Infiltration (I/I).
- To confirm organic concentration at less than 30 percent is mostly inert (silt).

What typical values should I expect?

- Influent: TSS Organic Concentration: 70% – 95%
- Organic Concentration: should not be significantly different from other chambers in the process.

Volatile Organic Compounds (VOCs)

Why is it important?

- To confirm there are no potential toxic or hazardous waste discharges into your collection system.
- Total Petroleum Hydrocarbons (TPH) and VOCs can upset a WWTF in hours.
- Common sources—BTEX via leaking Underground Storage Tanks (USTs) and perchloroethylene or tetrachloroethylene from dry cleaners—can destroy components of the collection system.
- VOCs can cause high immediate oxygen demand on influent and/or process causing septic conditions.

What typical values should I expect?

In domestic waste VOCs should be Non-Detect; except occasionally some low concentration of Total Tri-Halo Methane (TTHMs) from chlorinated compounds that can occur when bleach comes in contact with wastewater organic waste.

Volatile Suspended Solids (VSS)

Why is it important?

- To calculate WWTP's removal efficiency.
- To identify Inflow/Infiltration (I/I).
- To monitor and maintain solids inventory.

What typical values should I expect?

- Solid levels ranges will vary according to the type of process.
- Influent: 95 – 315 mg/l
- Activated sludge: 1700 – 5200 mg/l

How Should I Implement the Control Tests?

The minimum process control tests of this guide are separated into tables (Tables 3 through 7) based on the permitted daily average flow of wastewater from a facility, as measured in million gallons per day (MGD).

Refer to your O&M manuals to determine other procedures that should be performed in conjunction with the process control tests, including the recommended ranges of solids concentrations, amount of dissolved oxygen, and performing microscopic evaluations of activated sludge.

You must submit to TCEQ all data results for parameters that are limited in or required by your permit, if the parameters are tested by an approved method at the sampling point designated in the permit. These results will be included in the calculations and reporting values submitted for compliance on the self-monitoring report. Parameters you monitor at locations that are not included in the permit, but that you use for assessing a facility's performance, do not need to be reported as compliance monitoring on the self-monitoring report.

The process control testing in this guidance is voluntary. If you choose to perform some or all the recommended process control tests, proper recordkeeping of the results can help identify trends and problems before they lead to violations. This guide is not meant to replace your Operational and Maintenance (O&M) manual.

What Process Control Table Should I Use?

Below are Process Control Tables that describe what parameters, sample locations, sample types and frequency are appropriate for facilities with different permitted discharge amounts. Table 2 shows which process control test is appropriate for your facility based on the permitted daily average flow.

Table 2. What Process Control Test Table Should I Use?

Activated Sludge Mode	Permitted Daily Average Flow	Minimum Chief Operator License	Process Control Test Table
Extended Aeration and Oxidation Ditch Systems	≤ 0.1 MGD	D	Table 6
	< 0.1 MGD – 1.0 MGD	C	Table 6 or Table 7*
	> 1.0 MGD – 5.0 MGD	B	Table 5
	> 5.0 MGD – 10 MGD	B	Table 4
	> 10.0 MGD	A	Table 3
Other Modes	≤ 0.05 MGD	D	Table 6 or Table 7*
	> 0.050 MGD – 1.0 MGD	C	Table 6 or Table 7*
	> 1.0 MGD – 5.0 MGD	B	Table 5
	> 5.0 MGD – 10 MGD	B	Table 4
	> 10.0 MGD	A	Table 3
* If the facility process includes biological nutrient removal, refer to Table 7			

Process Control Schedules for WWTFs based on Permitted Flow (MGD)

Table 3. Process Control Tests for Facilities with a Permitted Flow Greater than 10 MGD

FACILITY LOCATION	SAMPLE PARAMETER	SAMPLE LOCATION	SAMPLE TYPE	SAMPLE FREQUENCY
Raw Influent	NH_3-N	Influent	Composite[2]	Daily
	$CBOD/BOD_5$	Influent	Composite	Daily
	TSS	Influent	Composite	Daily
	pH	Influent	Grab	Daily
	Flow (rate)	Influent	Totalizer or Instantaneous	Daily
	Alkalinity ($CaCO_3$)	Influent	Grab	Weekly
Primary Clarifier	$CBOD/BOD_5$	Effluent	Composite/Grab[3]	Daily
	pH	Effluent	Grab	Daily
	TSS	Effluent	Composite/Grab[4]	Daily
Aeration Basin	Dissolved oxygen	In situ	Grab	1/shift
	Temperature	In situ	Grab	Daily
	Return sludge TSS	RAS line	Grab	Daily
Aeration Basin	Return sludge flow	RAS line	Totalizer or Instantaneous	Daily
	Waste sludge flow	WAS line	Totalizer	Daily
	DO uptake rate	Effluent	Grab	Daily
	Mixed liquor TSS/VSS	Effluent	Grab	Daily
	Microscopic examination	Effluent	Grab	Daily
	Settleability (SV30)	Effluent	Grab	1/shift
	Computation of SVI	N/A	N/A	Daily
	Computation of F/M	N/A	N/A	Daily
	SRT, sludge age, or MCRT	N/A	N/A	Daily
Secondary Clarifier	pH	Effluent	Grab	Daily
	TSS	Effluent	Composite	Daily
	$CBOD/BOD_5$	Effluent	Composite	Daily
	NH_3-N	Effluent	Composite	Daily
	Dissolved oxygen	Effluent	Grab	Daily
	Sludge blanket depth	As appropriate	Measurement	1/shift
Sidestreams (digester/thickener decant, sludge dewatering, etc.)	$CBOD_5/BOD_5$		As needed to determine the added loading on the treatment facility	
	NH_3-N			
	TSS			
Final Effluent	As required by permits			

[2] Composite samples throughout this guidance refer to flow-weighted composite samples (Reminder: be sure sampler is not in time mode).
[3] Separate flow monitoring for raw influent and primary effluent location is only necessary when flow equalization or other recycled streams would cause volume and/or quality to differ.
[4] Composite sample is preferred, if possible.

Table 4. Process Control Tests for Facilities with a Permitted Flow Greater than 5 to 10 MGD

FACILITY LOCATION	SAMPLE PARAMETER	SAMPLE LOCATION	SAMPLE TYPE	SAMPLE FREQUENCY
Raw Influent	$CBOD/BOD_5$	Influent	Composite	Daily
	NH_3-N[5]	Influent	Composite	Daily
	TSS	Influent	Composite	Daily
	Alkalinity	Influent	Grab	Weekly
	pH	Influent	Grab	Daily
	Flow	Influent	Totalizer or Instantaneous	Daily
Primary Clarifier	$CBOD/BOD_5$	Effluent	Composite	Daily
	TSS	Effluent	Composite	Daily
	pH	Effluent	Grab	2/week
	Flow[6]	Effluent	Totalizer	Daily
Aeration Basin	NH_3-N	Effluent	Grab	2/week
	DO	In situ	Grab	Daily
	Temperature	In situ	Grab	Daily
	Return sludge TSS	RAS line	Grab	Daily
	Return sludge flow	RAS line	Totalizer	Daily
	Waste sludge flow	WAS line	Totalizer	Daily
	Mixed liquor TSS/VSS	Effluent	Grab	Daily
	Settleability (SV30)	Effluent	Grab	Daily
	Microscopic examination	Effluent	Grab	Weekly
	Computation of SVI	N/A	N/A	2/week
	Computation of F/M ratio	N/A	N/A	2/week
	Computation of SRT, sludge age, and/or MCRT	N/A	N/A	2/week
Sidestreams (digester/thickener decant, sludge dewatering, etc.)	CBOD, NH_3-N, TSS	As needed to determine the added loading on the treatment facility		
Final Effluent	As required by permit			

[5] Test and monitor ammonia (NH_3-N) if applicable to the facility permit.
[6] Separate flow monitoring for raw influent and primary effluent location is only necessary when flow equalization or other recycled streams would cause volume and/or quality to differ.

Table 5. Process Control Tests for Facilities with a Permitted Flow Greater than 1 to 5 MGD

FACILITY LOCATION	SAMPLE PARAMETER	SAMPLE LOCATION	SAMPLE TYPE	SAMPLE FREQUENCY
Raw Influent	$CBOD_5/BOD_5$	Influent	Composite	2/week
	TSS	Influent	Composite	2/week
	NH_3-N	Influent	Composite	2/week
	Alkalinity	Influent	Composite	Weekly
	pH	Influent	Grab	2/week
	Flow	Influent	Totalizer or Instantaneous	Daily
Primary Clarifier[7]	$CBOD_5/BOD_5$	Effluent	Composite	2/week
	TSS	Effluent	Composite	2/week
	COD	Effluent	Composite	2/week
	pH	Effluent	Grab	2/week
	NH_3-N	Effluent	Composite	2/week
	Flow	Effluent	Totalizer	Daily
Aeration Basin	DO	In situ	Grab	Daily
	Temperature	In situ	Grab	Daily
	Return sludge TSS	RAS line	Grab	2/week
	Return sludge flow	RAS line	Totalizer	Daily
	Waste sludge flow	WAS line	Totalizer	Daily
	Mixed liquor TSS/VSS	Effluent	Composite	2/week
	MLSS centrifuge solids	Effluent	Composite	Daily
	pH	Effluent	Grab	2/week
	Settleability (SV30)	Effluent	Grab	Daily
	Microscopic examination	Effluent	Grab	Weekly
Secondary Clarifier	Dissolved oxygen	Effluent	Grab	Daily
	Sludge blanket depth	As appropriate	Measurement	Daily
Final Effluent	As required by permit			

[7] Separate monitoring for raw influent and primary effluent location is only necessary when flow equalization or other recycled streams would cause volume and/or quality to differ.

Table 6. Process Control Tests for Facilities with a Permitted Flow Less Than 1 MGD

FACILITY LOCATION	SAMPLE PARAMETER	SAMPLE LOCATION	SAMPLE TYPE	SAMPLE FREQUENCY
Raw Influent[8]	$CBOD_5/BOD_5$	Influent	Grab	2/month
	TSS/VSS	Influent	Grab	2/month
	NH_3-N	Influent	Grab	2/month
	pH	Influent	Grab	2/month
Aeration Basin	MLSS/MLVSS (or centrifuge, with correlated data from periodic MLVSS values)	RAS line and effluent	Grab	2/month
	Dissolved oxygen	Effluent	In situ	1/week
	Settleability (SV30)	Effluent	Grab	1-3/week
	pH	Effluent	Grab	1/week
	Microscopic examination	Effluent	Grab	1/week
Aeration Basin	Computation of SVI	N/A	N/A	As data is collected
	Computation of F/M ratio	N/A	N/A	As data is collected
	Computation of SRT, sludge age, and/or MCRT	N/A	N/A	As data is collected
Secondary Clarifier	Sludge blanket depth	As appropriate	In situ	1/week
Final Effluent	As required by permit			

[8]Frequency of sampling may need to be increased or decreased depending on facility size or conditions.

Table 7. Process Control Tests for Facilities with Biological Nutrient Removal

FACILITY LOCATION	SAMPLE PARAMETER	SAMPLE LOCATION	SAMPLE TYPE	SAMPLE FREQUENCY
Raw Influent	NH_3-N/TKN	Influent	Composite	Daily
	$CBOD_5$/BOD_5	Influent	Composite	Daily
	TSS	Influent	Composite	Daily
	COD	Influent	Composite	Daily
	pH	Influent	Composite	Daily
	Flow	Influent	Composite	Daily
	Alkalinity ($CaCO_3$)	Influent	Composite	Weekly
	Total Phosphorus[9]	Influent	Grab	Weekly
	Soluble Phosphorus[9]	Influent	Grab	Weekly
Primary Clarifier	$CBOD_5$/BOD_5	Effluent	Composite	Daily
	COD	Effluent	Composite	Daily
	pH	Effluent	Composite	Daily
	TSS	Effluent	Composite	Daily
	Total Phosphorus[9]	Effluent	Grab	Weekly
	Soluble Phosphorus[9]	Effluent	Grab	Daily
Aeration Basin	Dissolved oxygen	In situ	Grab	1/shift
	Temperature	In situ	Grab	Daily
	Return sludge TSS	RAS line	Grab	Daily
	Return sludge flow	RAS line	Totalizer or Instantaneous	1/shift
	Return sludge Total Phosphorus[10]	RAS line	Grab	Daily
	Nitrate-nitrogen	RAS line	Grab	Weekly
	Waste sludge flow	WAS line	Grab	1/shift
	Waste Sludge TSS	WAS line	Grab	Daily
	Mixed liquor TSS/VSS	Effluent	Grab	Daily
	pH	Effluent	Grab	Daily
	Soluble Phosphorus[9]	Effluent/ End of anaerobic zone	Grab	Daily/weekly
	Microscopic examination	Effluent	Grab	Daily
	Settleability (SV30)	Effluent	Grab	1/shift
	NH_3-N	Effluent	Grab	Daily
	Internal recycle flow	In situ	Totalizer or Instantaneous	Daily
	Nitrate	Beginning of anoxic zone/ end of anoxic zone	Grab	Weekly
	ORP	Anaerobic zone/ Selector zones/ Effluent	Grab	1/shift
Secondary Clarifier	pH	Effluent	Grab	Daily
	TSS	Effluent	Grab	Daily
	$CBOD/BOD_5$	Effluent	Grab	Daily
	Dissolved oxygen	Effluent	Grab	Daily
	Sludge blanket depth	As appropriate	Measurement	1/shift
Final Effluent	As required by permit			
Recycled Streams (Decant, Filtrate, Centrate)	NH_3-N	Effluent	Grab	Daily
	TSS	Effluent	Grab	Daily
	BOD5	Effluent	Grab	Daily
	Total Phosphorus[9]	Effluent	Grab	Daily
	Flow	Effluent	Totalizer or Instantaneous	Daily

[9] Only necessary if total phosphorus is limited in your permit.

Appendix A: Common Abbreviations and Acronyms

BOD_5 – Biochemical Oxygen Demand (5-day)
$CBOD_5$ – Carbonaceous Biochemical Oxygen Demand (5-day)
COD – Chemical Oxygen Demand
DO – Dissolved Oxygen
F/M Ratio – Food to Microorganism Ratio
MCRT – Mean Cell Residence Time
MGD – Million Gallons per Day
MLSS – Mixed Liquor Suspended Solids
MLVSS – Mixed Liquor Volatile Suspended Solids
mg/L – Milligrams per Liter
NH_3-N – Ammonia Nitrogen
ORP – Oxidation-Reduction Potential
pH – Potential of Hydrogen
RAS – Return Activated Sludge
SRT – Sludge Retention Time
SVI – Sludge Volume Index
TAC – Texas Administrative Code
TCEQ – Texas Commission on Environmental Quality
TDS – Total Dissolved Solids
TSS – Total Suspended Solids
VSS – Volatile Suspended Solids
WAS line – Waste Activated Sludge Line
WWTF – Wastewater Treatment Facility

Appendix B: Definitions and Terms

Activated Sludge – Aerated domestic wastewater containing aerobic microorganisms which help to break down the wastewater.

Activated sludge process – A type of wastewater treatment process in which activated sludge is aerated for the microorganisms to digest the organic matter in the wastewater. The activated sludge microorganisms are subsequently separated from the wastewater and wasted or returned to the process.

Aeration Basin – A holding and/or treatment tank provided with artificial aeration to promote the biological oxidation of wastewaters.

Alkalinity – The quantitative capacity of an aqueous solution to neutralize an acid.

Biochemical Oxygen Demand, 5-day (BOD_5) – The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter.

Carbonaceous Biochemical Oxygen Demand, 5-day ($CBOD_5$) – The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter, but in which the contribution from nitrogenous bacteria has been suppressed.

Collection system – Pipes, conduits, lift stations, force mains, and all other constructions, devices, and appurtenant appliances used to transport domestic wastewater to a wastewater treatment facility.

Daily Average Flow – The arithmetic average of all determinations of the daily discharge within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily discharge, the determination shall be the average of all instantaneous measurements taken during a 24-hour period or during the period of daily discharge if less than 24 hours. Daily average flow determination for intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.

Dissolved Oxygen (DO) – The concentration of oxygen dissolved in wastewater or surface water.

Domestic wastewater – Waste and wastewater from humans or household operations that is discharged to a collection system or otherwise enters a treatment facility. Domestic wastewater includes wastewater from connections to houses, hotels, non-industrial office buildings, institutions, or sanitary waste from industrial facilities.

Effluent – Liquid that flows out of a process or confined space. This term may also be used to identify items or properties associated with effluent (e.g. effluent constituents, effluent limits, or effluent pump). Wastewater treated or untreated, that flows out of a wastewater treatment facility.

Facility – All contiguous land and fixtures, structures, or appurtenances used for storing, processing, or disposing of waste. (See also the definition relating to wastewater treatment facility.)

Grab Sample – An individual sample collected in less than 15 minutes.

Influent – Liquid that flows into a process or confined space. This term may also be used to identify items or properties associated with influent (e.g., influent constituents, influent limits, or influent pump).

Mean Cell Residence Time (MCRT) – the average time (in days) that a microorganism will spend in the activated sludge process.

Mixed Liquor Suspended Solids– the mixture of raw or settled wastewater and active sludge contained in an aeration basin.

Nutrient Removal – Nutrient removal generally refers to the removal of nitrogen and/or phosphorus from wastewater. Biological processes, membrane filtration, sand filtration, or a combination of these processes may be used for nutrient removal.

Operator – The individual, corporation, organization, government, governmental subdivision or agency, business trust, estate, partnership, or any other legal entity or association responsible for the overall operation of a facility or beneficial use site.

Oxidation Reduction Potential (ORP) – A measurement that indicates the degree to which a substance is capable of oxidizing or reducing another substance. Measuring the balance between oxidized and reduced compounds in a solution will detect the presence of significant concentrations of oxidized compounds. Can be used for automatic detection of excess electron acceptors (i.e. DO, nitrate and nitrite) in reactors.

Owner – The individual, corporation, organization, government, governmental subdivision or agency, business trust, estate, partnership, or any other legal entity or association who owns a facility or part of a facility.

Permit – A written document issued by TCEQ or EPA. which, by its conditions, may authorize the permittee to construct, install, modify, or operate in accordance with stated limitations a specified facility for waste discharge, for solid waste storage, processing or disposal, or for underground injection.

pH – A measure of hydrogen ion concentration; a measure of the acidity or alkalinity of a solution. The pH scale usually ranges from 0 to 14.

Primary Clarifier – Primary treatment of sewage is removal of floating and settleable solids through sedimentation. Primary clarifiers reduce the content of suspended solids and pollutants embedded in those suspended solids.

Sludge Volume Index (SVI) – the volume of 1 gram of sludge after 30 minutes of settling. It is determined by placing a mixed-liquor sample in a 1 to 2-liter cylinder and measuring the settled volume after 30 minutes and the corresponding MLSS concentration. SVI is measured in mL/g

Total Dissolved Solids (TDS) – A measure of the dissolved solids in wastewater or effluent.

Total Suspended Solids (TSS) – A measure of the suspended solids in wastewater or effluent.

Volatile Suspended Solids (VSS) – A water quality measure obtained from the loss on ignition of the mass of measured total suspended solids. The ignition typically takes place in an oven at a temperature of 550˚C to 600˚C.

Wastewater Treatment Facility (WWTF)– Wastewater facilities used in the storage, treatment, recycling, reclamation and/or disposal of domestic wastewater (sewage), industrial wastes, agriculture wastes, recreational wastes, or other wastes, including sludge handling or disposal facilities under the jurisdiction of the TCEQ.

Appendix C: Additional Wastewater Resources

The TCEQ Small Business and Local Government Assistance Program[10] has information designed to assist wastewater operators.

For guidance on managing small domestic wastewater systems, review RG-530.[11]

Explore Operation and Troubleshooting guidance[12] on the TCEQ website.

Find licensing information for wastewater operators and registration information for wastewater treatment plants and wastewater collection systems[13] on the TCEQ website or contact the TCEQ's Occupational Licensing Section at 512-239-6300 or licenses@tceq.texas.gov.

For confidential environmental compliance assistance for small businesses and local governments, contact Small Business and Local Government Assistance online[14] or via the hot line at 800-447-2827.

The rules for wastewater occupational licensing are contained in Title 30 of the Texas Administrative Code, Chapter 30, Subchapters A and J.[15]

[10] www.tceq.texas.gov/assistance/water#wastewater
[11] www.tceq.texas.gov/assistance/water/wastewater/managing-small-domestic-wastewater-systems-rg-530
[12] www.tceq.texas.gov/assistance/water/wastewater/help-for-wastewater-treatment-plant-owners-and-operators
[13] www.tceq.texas.gov/licensing/licenses/wwlic
[14] www.tceq.texas.gov/assistance
[15] www.tceq.texas.gov/rules/indxpdf.html#30