

# **WASTEWATER OPERATOR CERTIFICATION GUIDE**

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**Illinois Environmental Protection Agency  
Division of Water Pollution Control  
Wastewater Operator Certification  
Guide**

The purpose of this guide is to provide information about the wastewater operator certification program. For ease of use, this guide is divided into the following sections:

FAQ's (Frequently Asked Questions)

Municipal/Domestic Operator Certification Program

Industrial (Class K) Operator Certification Program

Operator – In – Training Program

Collection System Operator Certification Program

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## **FAQ's (Frequently Asked Questions)**

### **1. Is the wastewater operator certification program mandatory or voluntary?**

The **wastewater operator certification program** is a **mandatory** program. This means that each wastewater treatment facility in Illinois is required to be operated by a wastewater operator who is certified at or above the certification level required for the treatment facility. However, a **voluntary** certification program for **collection system operators** has been implemented. Since this is a voluntary program, it means that a certified collection system operator is not required to operate a collection system, although it is strongly recommended by the Agency.

### **2. How are wastewater treatment facilities classified in Illinois?**

Wastewater treatment facilities are classified as either industrial or domestic facilities.

Industrial wastewater treatment facilities require Class K certified wastewater operators.

Domestic wastewater treatment facilities are classified in one of 4 groups as follows:

- Group 4 - Septic tank and lagoon treatment systems. Group 4 facilities require a wastewater operator certified at the Class 4 or higher level (Class 3, Class 2, or Class1).
- Group 3 - Fixed film processes and Imhoff tank systems with a design average flow of 1.0 MGD or less, and all primary treatment systems. Group 3 facilities require a wastewater operator certified at the Class 3 or higher level (Class 2, or Class1).
- Group 2 - Activated sludge systems with a design average flow of 1.0 MGD or less. Group 2 facilities require a wastewater operator certified at the Class 2 or higher level (Class1).
- Group 1 - All domestic wastewater treatment systems over 1.0 MGD, excluding lagoon systems and primary treatment systems. Group 1 facilities require a wastewater operator certified at the Class 1 level.

### **3. What are the wastewater operator certification levels available in Illinois?**

Domestic: Class 4 (lowest level)  
Class 3  
Class 2  
Class 1 (highest level)

Industrial (Class K): Facility Specific  
General (Water Remediation)

Operator-In-Training: Basic  
Intermediate  
Advanced

Collection System Operator

### **4. What are the eligibility requirements for each certification level?**

Class 4: 1 year wastewater operating experience  
Class 3: 3 years wastewater operating experience **and** high school education or equivalent  
Class 2: 6 years wastewater operating experience **and** high school education or equivalent  
Class 1: 8 years wastewater operating experience **and** high school education or equivalent  
Class K: Active supervision and/or operation of an industrial wastewater treatment facility  
Operator-In-Training Basic: 3 months wastewater operating experience **or** 1 wastewater course  
Operator-In-Training Intermediate: 1 year wastewater operating experience  
Operator-In-Training Advanced: 3 years wastewater operating experience **and** high school education or equivalent  
Collection System Operator: 1 year collection system operating experience **and** high school education or equivalent

**5. Are there any substitutions that can be used to help satisfy the eligibility requirements?**

Yes, for the Operator-In-Training Intermediate, Operator-In-Training Advanced, Class 4 Class 3, Class 2, and Class 1 certification levels, up to 50% of the total requirement may be combined credit received for completed wastewater courses, college credits, and related experience.

The Operator-In-Training Intermediate and Class 4 levels receive an additional 3 months substitution credit for high school completion or the equivalent.

For collection system operator certification, up to 9 months credit may be granted for completion of collection system courses and/or wastewater courses, and/or for wastewater operating experience.

**6. What is a wastewater operator?**

A wastewater operator is a person who regularly makes recommendations concerning, or is responsible for, process control decisions at a wastewater treatment facility.

**7. What is wastewater operating experience?**

Wastewater operating experience is time spent performing the duties of a wastewater operator.

**8. What is related experience?**

Related experience is experience operating collection systems or drinking water supplies or laboratory or maintenance experience at a wastewater treatment facility.

**9. What is a wastewater course?**

A wastewater course is defined as a course consisting of 3 quarter hours, or 2 semester hours, or 3 continuing education units on wastewater collection, treatment, operations, maintenance, or management from an accredited college, university, or technical vocational and trade school that is approved by the Agency. Training events that meet this definition will receive 3 months of credit toward the certification eligibility requirements. Training events which do not meet this definition will receive credit at the same rate as college/university courses.

The amount of credit that may be given for wastewater courses is dependent on the level of certification being sought. The maximum credit for wastewater courses per certification level is given below. Any wastewater courses which cannot be credited at the 3 month rate will be credited at the same rate as college university courses.

<u>Certification Level</u>	<u>Maximum Credit for Wastewater Courses</u>
Class 1	24 months (8 wastewater courses)
Class 2	12 months (4 wastewater courses)
Class 3	6 months (2 wastewater courses)
Class 4	6 months (2 wastewater courses)

**10. How is credit applied if my job duties consist of both wastewater operating experience and related experience?**

If your job duties consist of both wastewater operating experience and related experience, credit is assessed based on the percentage of time spent performing each type of experience. If 50% or more of time at work is classified as wastewater operating experience, full credit is given for wastewater operating experience and zero credit is given for related experience. If less than 50% of time at work is classified as wastewater operating experience, half credit is given for wastewater operating experience and half credit is given for related experience.

**11. How often and where are wastewater examinations offered?**

Examinations are offered every month at a minimum of 4 sites around the state. In the Greater Chicago metropolitan area an exam is offered every month. In all other areas of the state, exams are offered once every 2 months (every other month). At times, additional special exams may be offered.

Generally, exams are offered at Agency regional office facilities. Exceptions are the Greater Chicago metropolitan area, the Greater St. Louis metropolitan area, and special exams; all of which utilize non-Agency sites.

**12. How do I obtain wastewater certification?**

The necessary steps to become certified are:

- Submit completed application to operator certification unit. Applications are available from the operator certification unit or from any of the Agency’s 7 regional offices. The regional offices are located in Rockford, Maywood, Peoria, Champaign, Springfield, Collinsville, and Marion.
- Application is reviewed and applicant is sent either an examination admittance letter or a letter indicating experience credit given and the amount of eligibility shortfall.

- Obtain a score of 70 on a certification examination.

**13. To become certified at a particular level, must I work up to that level by passing the examinations for all of the lower certification levels?**

No, you may take any examination that you are eligible for. You do not have to pass the lower level examinations first.

**14. If I fail an examination, how long must I wait to retake it?**

There is no minimum period you must wait before you can retake an examination. You can take an examination the next time it is offered.

**15. Can I schedule to take an examination for the same certification level on more than one examination date?**

No, you may only schedule for one examination date and location at a time. If you are scheduled for an examination, you may not schedule to take the same examination again until after you receive your examination results notification letter. The number of examinees that can be accommodated at each examination site is limited and if an individual schedules at more than one examination, it denies someone else the opportunity to take an examination.

If you are scheduled for an examination and, after scheduling, find out you will not be able to attend as planned, you may contact the Operator Certification Unit to change your scheduled examination date.

**16. Can I just show up at an examination site and take an examination?**

No, you must first be determined eligible to take an examination. Eligibility is determined through the application process described above in Item #11. In addition, each examination site will accommodate only a certain number of examinees and, even if you are eligible, there is no guarantee that there will be room for you. All scheduling for examinations will be done on a first come first served basis through the Operator Certification Unit.

**17. Can I take a certification examination before I meet the eligibility requirements for that certification level?**

No, you must satisfy the eligibility requirements for a particular certification level before you will be allowed to take the corresponding examination.

**18. What is the purpose of the Operator-In-Training certificates?**

The Operator-In-Training Basic certificate is intended to recognize individuals who are just beginning a career in the wastewater treatment field. This examination stresses basic general knowledge of wastewater treatment processes.

The Operator-In-Training Intermediate and Advanced certificates are intended to provide an alternative route for obtaining Class 2 certification for operators at activated sludge facilities

located in large metropolitan areas. These examinations stress the activated sludge treatment processes rather than the treatment processes included on the Class 4 and Class 3 examinations since these operators are not familiar with the operation of lagoons, trickling filters, packed towers, etc.

**19. Can an individual with an Operator-In-Training certificate be considered as the properly certified operator for a wastewater treatment facility?**

No, the properly certified operator for a particular wastewater treatment facility must be certified at a level equal to or higher than the certification level required for that facility. An Operator-In-Training certificate does not meet this requirement.

**20. Does the properly certified wastewater operator need to be present at the wastewater treatment facility all the time that it is in operation?**

The properly certified operator must exercise direct and active field supervision of the wastewater treatment facility. Situations will dictate whether or not the physical presence of the properly certified operator is required on site. However in all situations, it is expected that the properly certified operator have sufficient knowledge of the treatment facility to handle the situation expeditiously and correctly.

**21. What is the difference between the general and the facility specific Class K certificates?**

The general Class K certificate, also referred to as a Class K-WR, is intended only for treatment or pretreatment facilities which treat groundwater contaminated with gasoline, diesel fuel, jet fuel, fuel oil, and/or kerosene. Most of these facilities are associated with entities which store petroleum fuels underground, such as gas stations. The main treatment process involved is either air stripping or activated carbon canister. Facilities treating groundwater contaminated with other substances, such as solvents, require facility specific Class K certification. An operator who holds Class K-WR certification may operate any treatment or pretreatment facility in Illinois which treats groundwater contaminated with gasoline, diesel fuel, jet fuel, fuel oil, and/or kerosene.

A facility specific Class K certificate, as the name implies, is issued for the operation of the specific industrial wastewater treatment or pretreatment facility for which the operator wrote the examination. An operator, with a facility specific Class K certificate, who leaves the facility he is certified for to operate another industrial wastewater treatment or pretreatment facility must apply for and pass the Class K examination for the second industrial wastewater treatment or pretreatment facility in order to be properly certified for the second facility. In addition, an operator who holds a facility specific Class K industrial wastewater treatment or pretreatment facility which is upgraded to include additional and/or different treatment processes than the original facility must apply for and pass the Class K examination for the upgraded industrial wastewater treatment or pretreatment facility in order to be properly certified for the upgraded facility.

**22. How long is a wastewater certificate in effect? Do wastewater certificates have to be renewed?**

There is no renewal requirement for wastewater operator certificates at the present time. Currently, a wastewater operator certificate has no expiration date. There are two ways a certified operator may become uncertified. One is that an operator may voluntarily return his certification to the Operator Certification Unit. The other is that the Agency may revoke an operator's certificate due to improper actions performed by the operator in the course of operating a wastewater treatment facility.

It should be noted that although there is no renewal requirement for wastewater certificates at the present time, this does not preclude the institution of wastewater certificate renewal at some point in the future.

**23. Are there any fees associated with wastewater operator certification?**

There are no fees associated with wastewater operator certification at the present time. However, this does not preclude the institution of wastewater certification fees at some point in the future.

**24. Is there any continuing education requirement associated with wastewater operator certification?**

There is no continuing education requirement associated with wastewater operator certification at the present time. However, this does not preclude the institution of a continuing education requirement for wastewater operator certification in the future.

**25. Does Illinois have reciprocity with wastewater certifying authorities from any other states or provinces?**

Yes, depending on the reciprocal state. The certifying state's rules and regulations, in conjunction with an individual's qualifications, are used to determine the specific Illinois certificate that can be issued. However, according to Illinois regulations, if another state does not accept Illinois' program for reciprocity, then Illinois cannot accept that state for reciprocity. It should be noted that, due to the uniqueness of Illinois' industrial certification program, it is not possible to consider issuing Class K certificates by reciprocity.

**26. Can the Agency 'discipline' wastewater operators?**

Yes, the Agency can 'discipline' wastewater operators through the certificate sanction process. Potential causes for sanction include, but are not limited to, the following:

- Obtaining or attempting to obtain certification by fraud or deceit.
- Gross negligence or gross misconduct in the operation of a wastewater treatment facility or pretreatment facility.
- Falsification of records and reports that are required by the Environmental Protection Act or any rules promulgated under it.
- Willful failure to maintain records and reports that are required by the Environmental Protection Act or any rules promulgated under it.
- Willful non-submission of records and reports that are required by the Environmental Protection Act or any rules promulgated under it.

- Willful violation of the Environmental Protection Act or any rules that are promulgated under it.
- A final judgment in a civil action or a conviction in a criminal action that an operator has performed any of the acts listed above.

Sanctions include, but are not limited to, prohibition of application for certification, probation, suspension, and revocation.

#### **27. What does it mean if my wastewater certificate is on probation?**

Probation means that a wastewater operator has been put on notice that for a period of time the Agency will be closely watching his operational practices. If the operator does not get things turned around during the specified time period, additional sanctions could be imposed. Probation is generally for short periods of time.

#### **28. What does it mean if my wastewater certificate is suspended?**

A suspended wastewater certificate is considered invalid during the suspension period. A certificate may be suspended for a period of up to 18 months. During the suspension period, experience obtained is not considered for credit toward meeting certification eligibility requirements. At the end of the suspension period, the certificate is again considered valid and experience obtained is again considered for credit toward meeting certification eligibility requirements.

#### **29. What does it mean if my wastewater certificate is revoked?**

A revoked certificate is considered invalid. A certificate may be revoked for a period of not less than 18 months and not more than 4 years. Experience obtained during the revocation is not considered for credit toward meeting certification eligibility requirements. At the end of the revocation period, an operator must apply for and pass the certification examination for the desired level of certification to become certified as a wastewater operator again.

## **Municipal/Domestic Operator Certification Program**

All publicly owned wastewater treatment facilities and domestic wastewater treatment works not owned by an industry are classified in one of four groups. These groups are:

- Group 1 – all wastewater treatment facilities over 1.0 MGD DAF excluding lagoon systems and primary treatment systems
- Group 2 – activated sludge systems with a DAF of 1.0 MGD or less
- Group 3 – fixed film processes and Imhoff tank systems with a DAF of 1.0 MGD or less and all primary treatment systems
- Group 4 – all lagoon treatment systems

The certified wastewater operator requirements for each group of wastewater treatment facilities are as follows:

- Group 1 wastewater treatment facilities require a certified Class 1 wastewater operator
- Group 2 wastewater treatment facilities require a certified Class 2 or Class 1 wastewater operator
- Group 3 wastewater treatment facilities require a certified Class 3, Class 2, or Class 1 wastewater operator
- Group 4 wastewater treatment facilities require a certified Class 4, Class 3, Class 2, or Class 1 wastewater operator

The eligibility requirements for the Class 1, Class 2, Class 3, and Class 4 wastewater certification examinations are given below.

- Class 1** - Requires a total of 8 years experience  
Minimum eligibility requirement - High school completion or GED certificate plus 4 years wastewater operator experience and the equivalent of 4 years substitutional experience
- Class 2** – Requires a total of 6 years experience  
Minimum eligibility requirement - High school completion or GED certificate plus 3 years wastewater operator experience and the equivalent of 3 years substitutional experience
- Class 3** - Requires a total of 3 years experience  
Minimum eligibility requirement - High school completion or GED certificate plus 1½ years wastewater operator experience and the equivalent of 1½ years substitutional experience
- Class 4** - Requires a total of 1 year experience  
Minimum eligibility requirement - 3 months wastewater operator experience and high school completion or GED certificate and the equivalent of 6 months substitutional experience

Wastewater operator experience includes direct hands-on physical operation of wastewater treatment equipment and/or wastewater treatment processes, direct active field supervision of wastewater treatment equipment and/or wastewater treatment processes, and/or direct and active involvement in process control decisions for wastewater treatment processes. Wastewater operator experience may be acquired at either domestic/municipal or industrial wastewater treatment facilities.

Substitutional experience includes credit for completion of wastewater courses, credit for completed college work, credit for completion of college programs one year or more in length designed specifically for wastewater treatment works operation, credit for experience operating collection systems or drinking water supplies, and credit for laboratory or maintenance experience at a wastewater treatment works.

## **Industrial (Class K) Operator Certification Program**

Currently, there are two types of Class K (Industrial) certificates offered. The first type is "facility specific" and covers a particular industrial wastewater treatment facility or pretreatment facility. Individuals who pass a "facility specific" Class K examination are issued a certificate that is only valid for the specific industrial wastewater treatment facility or pretreatment facility for which the examination was taken. Individuals seeking wastewater operator certification for multiple industrial wastewater treatment facilities or pretreatment facilities requiring facility specific Class K certification must complete and pass the facility specific Class K examination for each treatment facility.

Persons seeking certification for a surface water or groundwater remediation treatment system for contamination resulting from gasoline, diesel fuel, kerosene, jet fuel, or heating oil may opt to take another type of Class K examination. A general Class K examination is available which covers treatment systems associated with these water remediation systems. Individuals who pass this general exam are issued a Class K general certificate that is valid for all water remediation systems for contamination resulting from gasoline, diesel fuel, kerosene, jet fuel, or heating oil.

Any individual who actively operates an industrial wastewater treatment facility or pretreatment facility or who actively supervises the operation of an industrial wastewater treatment facility or pretreatment facility is eligible for Class K wastewater operator certification. Currently, there are no minimum education or experience eligibility requirements for Class K wastewater operator certification. A completed Class K certification application must be submitted for each industrial wastewater treatment facility or pretreatment facility for which Class K wastewater operator certification is sought.

## **Operator-In-Training Program**

The Operator-In-Training program has 3 different levels – Basic, Intermediate, and Advanced. The Basic Level provides pre-service and entry level operators certification for general knowledge of wastewater treatment plant operations. The Intermediate Level and Advanced Level provide an alternative for operators employed at Group 1 or Group 2 wastewater treatment facilities to work toward Class 2 wastewater operator certification. The Intermediate Level and Advanced Level Operator-In-Training examinations emphasize wastewater treatment processes found at Group 1 and Group 2 wastewater treatment facilities. Possession of an Operator-In-Training certificate does not allow an individual to function as the properly certified wastewater operator for any wastewater treatment facility.

The eligibility requirements for Operator-In-Training certification are given below.

### **Operator-In-Training – Advanced Level**

Requires a total of 3 years experience

Minimum eligibility requirement - High school completion or GED certificate plus 1½ years wastewater operator experience and the equivalent of 1½ years substitutional experience

### **Operator-In-Training – Intermediate Level**

Requires a total of 1 year experience

Minimum eligibility requirement - 3 months wastewater operator experience and high school completion or GED certificate and the equivalent of 6 months substitutional experience

### **Operator-In-Training – Basic Level**

Requires either 3 months of wastewater operator experience or completion of 1 wastewater course

## **Collection System Operator Certification Program**

This is a voluntary program available to individuals directly involved in the operation and maintenance of collection systems/sewers who choose to participate in a certification program.

There is one level of collection system operator certification.

The minimum eligibility requirements for this certificate are:

High school completion or GED certificate plus 6 months collection system operating experience and the equivalent of 6 months substitutional experience.

## Certification Examinations

### Municipal/Domestic, Operator-In-Training, & Collection System Examinations

The questions used on wastewater and collection system examinations were developed by wastewater professionals (instructors, certified operators, etc.). Each question has been validated by a panel comprised of experts who, collectively, have many years of experience in the wastewater and/or collection system operations field. Every question, with each of the four answer selections, has been examined for content, readability, accuracy, and relation to the corresponding Task Analysis. The validation process is on-going. New questions, as they are developed, are validated. Validated questions, which through use and statistical evidence are shown to be unreliable (i.e., they do not test what they are supposed to test), are returned to the review panel for restructuring or removal from the question bank. Finally, all questions in the question bank are periodically reviewed by the review panel to make sure they are still current and valid for wastewater operators.

Each exam question is related to one of the following subject categories:

Activated Sludge	Mathematics
Chemical Addition	Motors
Collection Systems	Preliminary Treatment
Digesters	Primary Treatment
Disinfection	Pumps and Pumping
Electrical	RBC's
Flow Measurement	Recordkeeping
General Information	Rules and Regulations
Imhoff Tanks	Safety and Health
Intermittent Sand Filters	Secondary Sedimentation
Laboratory	Sludge Drying Beds
Lagoons	Sludge Handling
Maintenance	Tertiary Treatment
Management	Trickling Filters

Each examination version has a minimum of 100 multiple choice questions taken from the categories which are applicable for the certification level being tested on that particular examination. Although slight variations in subject categories and numbers of questions per subject category may exist between versions of examinations for the same certificate level, every effort is made to maintain consistency and equality between different examination versions for the same certificate level.

The table below indicates the subject categories generally associated with each of the four municipal/domestic certification examinations.

<u>Category</u>	<u>Class 4</u>	<u>Class 3</u>	<u>Class 2</u>	<u>Class 1</u>
Activated Sludge	-	-	X	X
Chemical Addition	-	X	X	X
Collection Systems	X	X	X	X
Digesters	-	X	X	X
Disinfection	X	X	X	X
Electrical	X	X	X	X
Flow Measurement	X	X	X	X
General Information	X	X	X	X
Imhoff Tanks	-	X	X	X
Intermittent Sand Filters	X	X	X	X
Laboratory	X	X	X	X
Lagoons	X	X	X	X
Maintenance	X	X	X	X
Management	X	X	X	X
Mathematics	X	X	X	X
Motors	X	X	X	X
Preliminary Treatment	-	X	X	X
Primary Treatment	-	X	X	X
Pumps and Pumping	X	X	X	X
RBC's (rotating biological contactors)	-	X	X	X
Recordkeeping	X	X	X	X
Rule and Regulations	X	X	X	X
Safety and Health	X	X	X	X
Secondary Clarifiers	-	X	X	X
Sludge Drying Beds	-	X	X	X
Sludge Handling	-	X	X	X
Tertiary Treatment	-	X	X	X
Trickling Filters	-	X	X	X

The subject categories generally associated with the Operator-In-Training examination are:

activated sludge, chemical addition, digesters, disinfection, electrical, flow measurement, general information, laboratory, maintenance, mathematics, motors, preliminary treatment, primary treatment, pumps and pumping, safety, secondary clarifiers, sludge drying beds, sludge handling

The subject categories generally associated with the Collection System examination are:

chemical addition, collection systems, flow measurement, general information, maintenance, management, mathematics, motors, preliminary treatment, pumps and pumping, recordkeeping, rules and regulations, safety

Individuals taking these examinations are given scratch paper, pencils, answer sheet, and one examination booklet containing questions, formulas and conversion factors. The only items that may be brought to the examination site are the examinee's examination admittance letter, a photo ID, and a calculator which must be non-programmable and incapable of storing alpha-numeric data. Other electronic devices (cell phones, iPods, blackberries, etc.) must be turned off the entire time an individual is in the examination room. A maximum of three hours is allowed to complete the examination. A copy of the conversion factors and formulas provided with each examination is included at the end of this study guide. Familiarization with the format should cut down on referencing time during the examination.

Examination results are sent to an examinee's home address, usually within 2 weeks of the day the examination is taken. Each examinee receives a letter indicating whether he/she passed the examination accompanied by a detailed breakdown of performance on the examination. Examinees who fail to achieve a score of 70% on an examination can use these results to determine the areas to focus on for further study.

Examinees that score less than 70% on an examination may reschedule for the same level of examination without submitting another application, by returning the examination rescheduling form provided with their examination results or by calling the wastewater operator certification staff.

#### Industrial (Class K) Examinations

The examinations consist of multiple choice questions covering basic wastewater mathematics and essay questions designed to test an individual's knowledge of the wastewater facilities for which certification is sought. Examinees should be capable of providing, without the use of supplemental aids, information pertaining to an industrial wastewater treatment works in the following areas:

- Flow schematics;
- Purpose of each treatment unit;
- Theory of operation (principles of treatment) for each treatment unit;
- Measures used to prevent and correct process upsets;
- Methods used for solids handling;
- Sludge disposal techniques;
- Sources, characteristics, and concentrations of the wastes treated;
- Removal efficiencies for each treatment unit;
- Effluent monitoring requirements;
- Laboratory techniques and interpretation of laboratory results;
- Safety considerations;
- Rules and regulations which apply;
- Record keeping

Individuals taking a Class K examination are given scratch paper, pencils, and one examination booklet containing questions, formulas and conversion factors. The only items that may be brought to the examination site are the examinee's examination admittance letter, a photo ID, and a calculator which must be non-programmable and incapable of storing alpha-numeric data. Other electronic devices (cell phones, iPods, blackberries, etc.) must be turned off the entire time an individual is in the examination room. A maximum of three hours is allowed to complete the examination. A copy of the conversion factors and formulas provided with each examination is included at the end of this study guide. Familiarization with the format should cut down on your referencing time during the examination.

Examination results are sent to an examinee's home address, usually within 4 weeks of the day the examination is taken. Each examinee receives a letter indicating whether he/she passed the examination.

Examinees that score less than 70% on an examination may reschedule for the same level of examination without submitting another application by returning the examination scheduling form provided with their examination results or by calling the wastewater operator certification staff.

## **Wastewater Certification Examination Scheduling**

Every month approximately 100 individuals are scheduled to write wastewater operator certification examinations. Most of the facilities used to administer wastewater operator certification examinations are conference rooms located in State Regional Office buildings. The number of individuals that can be scheduled for a wastewater certification examination at a specific location is limited by the physical size of the room used. Thus, there is a maximum number of individuals that we can schedule for a given examination site.

If an application is received early enough, in most instances we are able to schedule an individual for the examination site and examination date requested. At times, if the situation warrants, an additional examination session at a specific location may be scheduled. Individuals who attempt to schedule for a second examination date and location when they are already scheduled for a different examination date and location, or individuals who have taken an examination and do not wait to receive their examination results before scheduling to retake an examination aggravate the scheduling situation. In order to give everyone an equal opportunity to take a wastewater certification examination, we offer the following guidelines for wastewater examination scheduling:

1. Indicate a first and second choice for examination date and/or examination location when submitting a wastewater certification application or scheduling to retake an examination. In almost all cases, an individual will be scheduled for one of his/her two choices.
2. Wait until examination results are received before scheduling to retake an examination. If you think you did that poorly, your time would be best spent seeking additional wastewater treatment knowledge until your actual score is received.
3. If you know ahead of time that you cannot make it to an examination for which you are scheduled, contact us as soon as possible to cancel so that another individual can possibly be scheduled in your place. Your name will be removed from the list of the examination you cancel for and, should you show up for that examination anyway, there is no guarantee that there will be room for you to take the examination or that there will be an examination booklet for you.

## **Contract Operation**

Owners of wastewater treatment works, rather than employing a properly certified wastewater operator, may choose to meet the certified wastewater operator requirement by contracting either with an individual wastewater operator with the required wastewater certificate or with a contract operations firm. In either case, a copy of the signed contract is required to be submitted to the Agency for review. The section of the wastewater operator certification rules pertaining to contract operation is included below.

### **Section 380.1000 General**

- a) The owner of a wastewater treatment works or pretreatment works who enters into a contractual agreement with a properly certified operator for the operation of a wastewater treatment works or pretreatment works shall submit a copy of the contractual agreement to the Agency.
- b) The contractual agreement must be submitted to the Agency within seven days of the effective date of the contractual agreement. The Agency must be notified by the owner in writing within seven days should the contract be terminated prior to the expiration date of the contract.

### **Section 380.1005 Contract Provisions**

The contract must include the following:

- a) The parties involved, including names, addresses and phone numbers of each and the Social Security number of the contract operator;
- b) The specific starting and expiration dates of the contract;
- c) The minimum number of visits to be made to the wastewater treatment works by the contract operator each week;
- d) The duties and responsibilities of each party involved including, at a minimum, the party responsible for:
  - 1) Proper operation of the wastewater treatment works including meeting all NPDES permit effluent requirements;
  - 2) Sample collection pursuant to the NPDES Permit;
  - 3) Preparation and submittal of Discharge Monitoring Reports;
  - 4) Laboratory analysis;
  - 5) Maintaining lift stations;
  - 6) Maintaining spare parts inventory;
  - 7) Maintaining required operating records and reports;
  - 8) Providing labor and materials for correcting any maintenance and operational problems;
  - 9) Maintaining, and if necessary, implementing an emergency operating plan;
  - 10) Performing preventive maintenance on equipment as recommended by the manufacturer; and
  - 11) Performing routine operational control testing as recommended by the Agency.
- e) The signature of each party of the contract.

### **Section 380.1010 Non-party Operators**

- a) When the properly certified operator is not a party to the contract, the operator must sign a document indicating acceptance of responsibilities of the certified operator as specified in the contract.
- b) In the event that a different properly certified operator is assigned to operate the wastewater treatment works, which is the subject of the contract, the new operator shall sign and submit a document as required in Subsection (a) above.

### **Section 380.1015 Documentation of Contract Provisions**

The contract operator shall maintain records to document that all contract provisions are being met.

### **Section 380.1020 Contract Approval**

The Agency will approve a contract agreement when the contractual operator is properly certified and the provisions of Sections 380.1000, 380.1005 and 380.1010 are satisfied. The Agency will withdraw an approval when it is determined that the contract provisions are not being met or are inadequate to assure proper operation of the wastewater treatment works.

### **Section 380.1025 Contract Modifications and Extensions**

Modifications or extensions to contractual agreements must be submitted to the Agency as a new contract.

## **Training Opportunities**

Whether you are just starting in the wastewater treatment field or have been in the field for many years, there is training and resources available to meet most any need. In addition to the many training materials that are available (see Suggested Study/Reference Materials section below for the most widely used/recognized), various community colleges throughout the state offer classroom courses on wastewater treatment. In areas where no formal classroom wastewater training is available, individuals may opt to take one or more of the home study courses that are available. Individuals seeking hands-on training along with classroom instruction should check out the 1 year water and wastewater training program through the Environmental Resources Training Center (ERTC) located on the campus of Southern Illinois University at Edwardsville. In addition, local, state, and national operator groups offer timely technical sessions at their meetings/conferences on various aspects of wastewater treatment. Some equipment manufacturers also provide training on various topics, usually pertaining to the equipment that they handle.

## **Operator Organizations**

Wastewater operator groups function at the local, state, and national levels. In addition to the information presented via the technical sessions at their meetings/conference, these groups provide a framework for networking amongst individual operators. A listing of wastewater operator groups is given below.

### **Local Groups**

Central Illinois Professional Wastewater Operators (CIPWO)  
<http://www.orgsites.com/il/cipwo/>

Fox Valley Operators Association  
<http://www.fvoa-illinois.org/>  
Contact: Dan Lannguth (Secretary/Treasurer) 815-356-3700

Heart of Illinois Water Pollution Control Operators  
Contact: Harold Saline (Secretary/Treasurer) 309-343-9087

Kish-Rock Water Pollution Control Operators  
Contact: Jennifer Murphy (Secretary) 815-765-2239

Mid-Central Water Pollution Control Operators  
Contact: Mark Odorizzi 636-343-8880

Mississippi – Kaskaskia Valley Water Pollution Control Operators (MISKA)  
<http://www.mis-ka.com/index.html>

Miss-Rock Water Pollution Control Operators  
Contact: Tom Glendenning (Secretary/Treasurer) 815-234-5261

North Central Water & Wastewater Operators Association  
Contact: Scott Wallis 815-875-4622

Southern Illinois Wastewater Operators (SIWO)  
Contact: Phil Brandenburg (Secretary) 618-542-3849

### **Statewide Groups**

Illinois Association of Water Pollution Control Operators (IAWPCO)  
<http://www.iawpco.org/>

Illinois Water Environment Association (IWEA)  
<http://www.iweasite.org/>

### **Regional Groups**

Central States Water Environment Association  
<http://www.wef.org/>

### **National Groups**

Water Environment Association (WEF)  
<http://www.wef.org/>

# **SOURCES OF WASTEWATER STUDY/REFERENCE MATERIALS**

## **SOURCE ADDRESSES**

Southern Illinois University, Edwardsville  
Environmental Resources Training Center  
Campus Box 1075  
Edwardsville, IL 62026-1075  
(618) 650-2030  
[www.siu.edu/ertc/](http://www.siu.edu/ertc/)  
email: [siue-ertc@siue.edu](mailto:siue-ertc@siue.edu)

Kenneth Kerri  
Department of Civil Engineering  
California State University, Sacramento  
6000 J Street  
Sacramento, CA 95819  
(916) 278-6142  
[www.owp.csus.edu](http://www.owp.csus.edu)  
email: [wateroffice@owp.csus.edu](mailto:wateroffice@owp.csus.edu)

Illinois Environmental Protection Agency  
DWPC/Permit Section/Watershed Unit #15  
P.O. Box 19276  
Springfield, IL 62794-9276  
(217) 782-1696

Illinois Environmental Protection Agency  
BOW/Compliance Assurance Section #19  
P.O. Box 19276  
Springfield, IL 62794-9276  
(217) 782-9720  
[www.epa.state.il.us/water/operator-cert/waste-water/index.html](http://www.epa.state.il.us/water/operator-cert/waste-water/index.html)  
email: [Dianne.Potter@illinois.gov](mailto:Dianne.Potter@illinois.gov)

Association of Boards of Certification  
[www.abccert.org/testing\\_services/default.asp](http://www.abccert.org/testing_services/default.asp)

CRC Press, Inc./Lewis Publishers  
2000 Corporate Blvd., N.W.  
Boca Raton, FL 33431  
(800) 272-7737

National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161

ORD Publications  
P.O. Box 19962  
Cincinnati, OH 45219  
(513) 569-7562

Technomic Publishing Co., Inc.  
851 New Holland Avenue, Box 3535  
Lancaster, PA 17604  
800/233-9936 or 717/291-5609

Texas Water Utilities Association  
1106 Clayton Lane, Suite 101-E  
Austin, TX 78723-1033

Water Environment Federation  
Publications Order Department  
601 Wythe Street  
Alexandria, VA 22314-1994  
(800) 666-0206  
[www.wef.org/onlineeducation/](http://www.wef.org/onlineeducation/)  
email: [pubs@wef.org](mailto:pubs@wef.org)

## **Suggested Study/Reference Materials**

### **SACRAMENTO STATE UNIVERSITY:**

Operation of Wastewater Treatment Plants, a Field Study Training Program

- a. Volume I
- b. Volume II

Operation and Maintenance of Wastewater Collection Systems, a Field Study Training Program

- a. Volume I
- b. Volume II

Advanced Waste Treatment, a Field Study Training Program

### **ENVIRONMENTAL RESOURCES TRAINING CENTER (ERTC):**

Math Review for Wastewater Certification

Stabilization Pond Filtration

Guide to Microscopic Evaluation for Sewage Treatment Operations

**NOTE: ERTC offers the Sacramento State University courses (books and grading) to individuals who are interested in completing them for a grade. Individuals who wish to obtain the books only for reference purposes (i.e. do not want to enroll in the course), should obtain the books directly from Sacramento State University.**

### **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY (IEPA):**

35 Ill. Adm. Code, Subtitle C: Water Pollution

Design Criteria for Sludge Application on Land (35 Ill. Adm. Code 391)  
(Request from Permits Section)

Procedures for the Certification of Operators of Wastewater Treatment Works  
(35 Ill. Adm. Code 380) (Request from Compliance Assurance Section)

**ORD PUBLICATIONS &/or NATIONAL TECHNICAL INFORMATION SERVICE (NTIS):**

1. Stabilization Ponds Operations Manual, (USEPA 430/9-77-012)
2. Aerobic Biological Wastewater Treatment Facilities, (USEPA 430/9-77-006, N/055-001-01071-1)
3. Anaerobic Sludge Digestion, (USEPA 430/9-76-001)

**WATER ENVIRONMENT FEDERATION (WEF):**

(NOTE: WEF's Technical Publications Catalog includes many items in addition to those listed below.)

MOP 1 Safety and Health in Wastewater Systems

MOP 11 Operation of Wastewater Treatment Plants

Standard Methods for the Examination of Water and Wastewater - Latest Edition

Math Workbook for Collection System Operators

Wastewater Treatment Operator Grades I & II Exam Survival Guide

WEF/ABC Certification Study Guide for Wastewater Treatment Personnel

WEF/ABC Certification Study Guide for Collection Systems Personnel

MOP OM-10 Operation and Maintenance of Trickling Filters, RBC's, and Related Processes

MOP 16 Anaerobic Sludge Digestion

MOP OM-8 Operation and Maintenance of Sludge Dewatering Systems

Basic Maintenance of Circular Secondary Clarifiers - PROBE

Basic Maintenance of Rectangular Secondary Clarifiers - PROBE

MOP 5 Aeration in Wastewater Treatment

MOP OM-7 Operation of Extended Aeration Package Plants

Basic Activated Sludge Process Control - PROBE

Basic Maintenance of Diffused Aeration Systems - PROBE

Basic Maintenance of Mechanical Aeration Systems - PROBE

Wastewater Biology: The Microlife

Wastewater Biology: The Life Processes

Activated Sludge Microbiology

MOP OM-9 Activated Sludge

MOP 2 Preliminary Treatment for Wastewater Facilities

MOP FD-1 Sludge Thickening

MOP FD-9 Wastewater Residuals Stabilization

MOP FD-14 Sludge Conditioning

**TECHNOMIC PUBLISHING CO., INC.**

Applied Math for Wastewater Plant Operators

**CRC PRESS, INC./LEWIS PUBLISHERS**

Management & Supervision for Working Professionals

**TEXAS WATER UTILITIES ASSOCIATION:**

Manual of Wastewater Treatment

**Resources Pertaining to Treatment Facility Security**

1. Water & Wastewater Security Product Guide "Visual Surveillance Monitoring" (USEPA)  
<http://cfpub.epa.gov/safewater/watersecurity/guide/productguide.cfm?page=visualsurveillance>
2. Protecting Your Community's Assets: A Guide For Small Wastewater Systems (NETCSC)  
[http://www.nesc.wvu.edu/netcsc/netcsc\\_resource.htm](http://www.nesc.wvu.edu/netcsc/netcsc_resource.htm)
3. VSAT (AMSA)  
<http://www.vsatusers.net/>
4. Emergency Preparedness USA (FEMA)

5. Guarding Against Terrorist & Security Threats: Suggested Measures for Drinking Water & Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small & Medium Community Water Systems to Comply with the Public Health Security & Bioterrorism Preparedness & Response Act of 2002 (USEPA)  
[http://www.epa.gov/safewater/watersecurity/pubs/small\\_medium\\_ERP\\_guidance040704.pdf](http://www.epa.gov/safewater/watersecurity/pubs/small_medium_ERP_guidance040704.pdf)
  
6. Guidance for Water Utility Response, Recovery, & Remediation Actions for Man-made &/or Technological Emergencies  
<http://www.epa.gov/safewater/watersecurity/pubs/er-guidance.pdf>

## **Wastewater Operator Certification Contact Information**

Illinois Environmental Protection Agency  
Bureau of Water  
DWPC/CAS #19  
P.O. Box 19276  
Springfield, IL 62794-9276  
Telephone: 217/782-9720  
Fax: 217/557-1407

Wastewater Operator Certification Website:

<http://www.epa.state.il.us/water/operator-cert/waste-water/index.html>

# Wastewater Conversion Factors & Mathematical Formulas

## CONVERSION FACTORS

Pi ( $\pi$ ) = 3.14

1 gallon of water = 8.34 pounds

1 gallon of water = 4 quarts = 8 pints = 3.785 liters

1 Population Equivalent (PE) = 0.17 pounds BOD/capita/day

" = 0.20 pounds SS/capita/day

" = 100 gallons water/capita/day

1 day = 24 hours = 1440 minutes

1 square foot ( $\text{ft}^2$ ) = 144 square inches ( $\text{in}^2$ )

1 square yard ( $\text{yd}^2$ ) = 9 square feet ( $\text{ft}^2$ )

1 cubic foot ( $\text{ft}^3$ ) = 7.5 gallons = 1728 cubic inches ( $\text{in}^3$ )

1 cubic yard ( $\text{yd}^3$ ) = 27 cubic feet ( $\text{ft}^3$ )

1 acre = 43560 square feet ( $\text{ft}^2$ )

1 horsepower (HP) = 33,000 foot-pounds/minute ( $\text{ft}\cdot\text{lb}/\text{min}$ ) = 746 watts = 0.746 kilowatts (kw)

1 foot of water = 0.433 pounds/square inch (psi)

1 pound/square inch (psi) = 2.31 feet of water

1 inch mercury = 1.13 feet

1 mile = 5,280 feet

## VOLUMES, AREAS, & PERIMETERS

GIVEN: V = Volume, L = Length, H = Height, W = Width, r = radius, d = diameter,  $\pi$  = Pi,

b = base, P = Perimeter, C = Circumference

### VOLUMES

Rectangular Solid:  $V = L \times W \times H$

Cylinder:  $V = \pi r^2 H = \frac{\pi d^2 H}{4} = 0.785 d^2 H$

Sphere:  $V = \frac{4}{3} \pi r^3$

Cone:  $V = \frac{1}{3} \pi r^2 H$

Pyramid:  $V = \frac{1}{3} L \times W \times H$

### PERIMETER

Polygon:  $P = L_1 + L_2 + L_3 + \dots + L_n$

Circle:  $C = \pi d$

### AREA

Rectangle:  $A = L \times W$

Triangle:  $A = \frac{1}{2} b \times H$

Circle:  $A = \pi r^2 = \frac{\pi d^2}{4} = 0.785 d^2$

Trapezoid:  $A = \frac{1}{2} (b_1 + b_2) H$

## PROCESS FORMULAS

### TEMPERATURE

$$^{\circ}\text{F} = 9/5 ^{\circ}\text{C} + 32$$

$$^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$$

$$^{\circ}\text{K} = ^{\circ}\text{C} + 273$$

### FLOW MEASUREMENT

$$90^{\circ} \text{ V-notch weir: } Q = 2.5H^{2.5}$$

$$\text{Sharp-crested weir: } Q = 3.33LH^{1.5}$$

$$\text{Cippolletti weir: } Q = 3.367LH^{1.5}$$

$$\text{Proportional weir: } Q = 7.57mH$$

$$\text{Parshall flume: } Q = 4WH^{1.52}W^{0.026}$$

### ELECTRICITY

$$\text{Power} = \text{Current} \times \text{Voltage}$$

$$\text{Voltage} = \text{Current} \times \text{Resistance}$$

$$\text{Average Current} = \frac{\text{Line 1 Current} + \text{Line 2 Current} + \text{Line 3 Current}}{3}$$

$$\text{Current Imbalance} = \frac{\text{Average Current} - \text{Maximum Deviation}}{\text{Average Current}} \times 100$$

### MISCELLANEOUS

$$\text{Efficiency} = \frac{(\text{In} - \text{Out})}{\text{In}} \times 100\%$$

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Detention Time} = \frac{\text{Volume}}{\text{Flow Rate}}$$

$$\text{Application Rate} = \text{Concentration} \times \text{Flow} \times \text{Conversion Factor}$$

$$\text{Loading Rate} = \frac{\text{Concentration} \times \text{Flow} \times \text{Conversion Factor}}{\text{Area}}$$

### LABORATORY

$$\text{BOD}_5 \text{ (mg/l)} = (\text{Initial DO} - \text{Final DO}) \times \frac{\text{Bottle Volume}}{\text{Sample Volume}}$$

$$\text{SS Concentration (mg/l)} = \frac{\text{Weight of Solids (gr)}}{\text{Amount of Sample (ml)}} \times \text{Conversion Factor(s)}$$

$$\% \text{ Capture} = \frac{\text{Sludge SS} - \text{RAS SS}}{\text{Wet Sludge}} \times 100$$

$$\% \text{ Solids} = \frac{\text{Dry Sample}}{\text{Wet Sample}} \times 100$$

$$\% \text{ Moisture} = \frac{\text{Wet Sludge} - \text{Dry Solids}}{\text{Wet Sludge}} \times 100$$

$$\% \text{ Volatile Solids} = \frac{\text{Dry Sample} - \text{Ash}}{\text{Dry Sample}} \times 100$$

$$\% \text{ Reduction in Volatile Matter} = \frac{\text{In} - \text{Out}}{\text{In} - (\text{In} \times \text{Out})} \times 100$$

### **CLARIFIER**

$$\text{Detention Time} = \frac{\text{Volume}}{\text{Flow Rate}}$$

$$\text{Weir Overflow Rate} = \frac{\text{Flow}}{\text{Length}}$$

$$\text{Surface Settling Rate} = \frac{\text{Flow}}{\text{Surface Area}}$$

### **PROCESS CONTROL**

$$F/M = \frac{\text{lbs of BOD}}{\text{lbs of MLSS}}$$

$$(Q + RQ) \text{ MLSS} = RQ \times \text{RAS}$$

$$\text{MLSS (mg/l)} = \frac{\text{MLSS (lbs)}}{\text{Volume} \times \text{Conversion Factor(s)}}$$

$$\text{SDI} = \frac{\text{MLSS (mg/l)}}{\text{Settled Sludge Volume (ml) (30 minutes)} \times 10} \text{ or } \frac{100}{\text{SVI}}$$

$$\text{SVI} = \frac{\text{Settled Sludge Volume (ml) (30 minutes)} \times 1000}{\text{MLSS (mg/l)}}$$

$$\text{Gould's Sludge Age} = \frac{\text{lbs of MLSS [Aeration Tank(s)]}}{\text{lbs of TSS (Influent)}}$$

$$\text{MCRT} = \frac{\text{lbs of MLSS (Aeration Tank)} + \text{lbs of Solids (Clarifier)}}{[(\text{RAS(mg/l)} \times \text{WAS Flow}) + (\text{Effluent SS(mg/l)} \times \text{Flow})] \times \text{Conversion Factor}}$$

$$\text{Mixed Concentration} = \frac{(\text{Upstream Flow} \times \text{Upstream Concentration}) + (\text{Effluent Flow} \times \text{Effluent Concentration})}{\text{Downstream Flow}}$$

### **SLUDGE LAND APPLICATION**

$$\text{lb/ton} = \text{mg/l} \times 0.002$$

$$1 \text{ mg/kg} = 0.002 \text{ lbs/ton}$$

$$\text{gal/acre} = \frac{\text{wet tons}}{\text{acre}} \times \frac{2000 \text{ lbs}}{\text{ton}} \times \frac{1 \text{ gal}}{8.34 \text{ lbs}}$$

$$\text{mg/l (dry)} = \text{mg/l (wet)} \times \frac{100}{\% \text{ Total Solids}}$$

$$\text{Dry Tons} = \text{Wet Tons} \times \frac{\% \text{ Total Solids}}{100}$$

$$\text{Plant Available Nitrogen(PAN)(mg/kg)} = \text{Ammonia Nitrogen(mg/kg)} + \text{Organic Nitrogen(mg/kg)}$$

$$\text{Organic Nitrogen(mg/kg)} = \text{Total Kjeldahl Nitrogen(TKN)(mg/kg)} - \text{Ammonia Nitrogen(mg/kg)}$$

### WEST PROCESS CONTROL METHOD FOR ACTIVATED SLUDGE

$$F = 31.2 \text{ lbs/ft}^3 \times H^2 \times L$$

$$R_Q = \frac{\text{MLSS} \times Q}{\text{RAS}}$$

$$1 - \frac{\text{MLSS}}{\text{RAS}}$$

$$\text{CFP} = \frac{\text{ATC} - \text{FEC}}{\text{RSC} - \text{ATC}}$$

$$R_Q = \frac{Q \times M}{\frac{1,000,000}{\text{SVI}} - M}$$

$$\text{ATC} = \frac{(\text{CFP} \times \text{RSC}) + \text{FEC}}{\text{CFP} + 1.0}$$

$$\text{WCR} = \frac{\text{MLTSS}}{\text{ATC}}$$

$$\text{RSC} = \frac{\text{ATC} + (\text{ATC} - \text{FEC})}{\text{CFP}}$$

$$\text{SLU} = \frac{\text{Volume} \times \text{Centrifuged Concentration}}{100}$$

$$\text{RSP} = \frac{\text{ATC} - \text{PEC}}{\text{RSC} - \text{ATC}}$$

$$\text{SSC} = \frac{1000 \times \text{ATC}}{\text{SSV}}$$

$$\text{ATC} = \frac{(\text{RSP} \times \text{RSC}) + \text{PEC}}{\text{RSP} + 1.0}$$

$$\text{CFP} = \frac{\text{ATC}}{\text{RSC} - \text{ATC}}$$

$$\text{RSC} = \frac{\text{ATC} + (\text{ATC} - \text{PEC})}{\text{RSP}}$$

$$\text{ATC} = \frac{\text{CFP} \times \text{RSC}}{\text{CFP} + 1.0}$$

$$\text{CSU} = \frac{\text{BLV} \times \text{CSC}}{100}$$

$$\text{RSC} = \text{ATC} + \frac{(\text{ATC})}{\text{CFP}}$$

$$\text{CDT} = \frac{\text{CV} \times 24}{\text{CFI}}$$

$$\text{ASU} = \frac{\text{AV} \times \text{ATC}}{100}$$

$$\text{CSDT} = \frac{\text{CSU}}{\text{CSUO}}$$

$$\text{RSU} = \frac{\text{RSF} \times \text{RSC}}{100}$$

$$\text{OFR} = \frac{\text{CFO}}{\text{CFA}}$$

$$\text{ADT @ AFI} = \frac{\text{AV} \times 24}{\text{AFI}}$$

$$\text{SAH} = \frac{\text{ADT} \times 24}{\text{ADT} + \text{CSDT}}$$

$$\text{ADT @ TFL} = \frac{\text{AV} \times 24}{\text{AFI} + \text{RSF}}$$

$$\text{AGE} = \frac{\text{ASU} + \text{CSU}}{\text{TXU/day}}$$

$$\text{CSFD} = \frac{\text{RSF} \times (\text{RSC} - \text{ATC})}{\text{SSC} - \text{ATC}}$$

$$\text{AAG} = \frac{\text{AGE} \times \text{SAH}}{24}$$

$$\text{SCR} = \frac{\text{SSC} \times 60}{\text{RSC}}$$

AAG	- Aeration Age	OFR-	Final Clarifier Surface Overflow Rate
ADT	- Aeration Tank Detention Time	PEC	- Primary Effluent Concentration
AFI	- Aeration Tank Wastewater Flow(In)	RAS	- Return Activated Sludge
AGE	- Sludge Age	RSC	- Return Sludge Concentration
ASU	- Aeration Tank Sludge Units	RSF	- Return Sludge Flow
ATC	- Aeration Tank Concentration	RSP	- Return Sludge Percentage
AV	- Aeration Tank Volume	RSU	- Return Sludge Units
BLV	- Sludge Blanket Volume	SAH	- Sludge Aeration Hours
CDT	- Final Clarifier Detention Time	SCR	- Sludge Concentration Ratio
CFA	- Final Clarifier Area	SLU	- Sludge Units
CFI	- Final Clarifier Flow(In)	SSC	- Settled Sludge Concentration
CFO	- Final Clarifier Flow(Out)	SSV	- Settled Sludge Volume
CFP	- Final Clarifier Sludge Flow Percentage	SVI	- Sludge Volume Index
CSC	- Final Clarifier Sludge Concentration	TFL	- Total Flow
CSDT	- Final Clarifier Sludge Detention Time	TXU	- Total Excess Sludge Units to
CSF	- Final Clarifier Sludge Flow		
Waste			
CSFD	- Final Clarifier Sludge Flow Demand	VSS	- Volatile Suspended Solids
CSU	- Final Clarifier Sludge Units	WAS	- Waste Activated Sludge
CSUO	- Final Clarifier Sludge Units Out of Clarifier		
CV	- Final Clarifier Volume	WCR-	Sludge Weight to Concentration Ratio
FEC	- Final Effluent Solids Concentration	XFP	- Excess Sludge Flow
MCRT	- Mean Cell Residence Time	XSC	- Excess Sludge Concentration
MLSS	- Mixed Liquor Suspended Solids	XSF	- Excess Sludge Flow to Waste
MLTSS	- Mixed Liquor Total Suspended Solids	XSU	- Total Excess Sludge Units to
Waste			
MLVSS	- Mixed Liquor Volatile Suspended Solids		