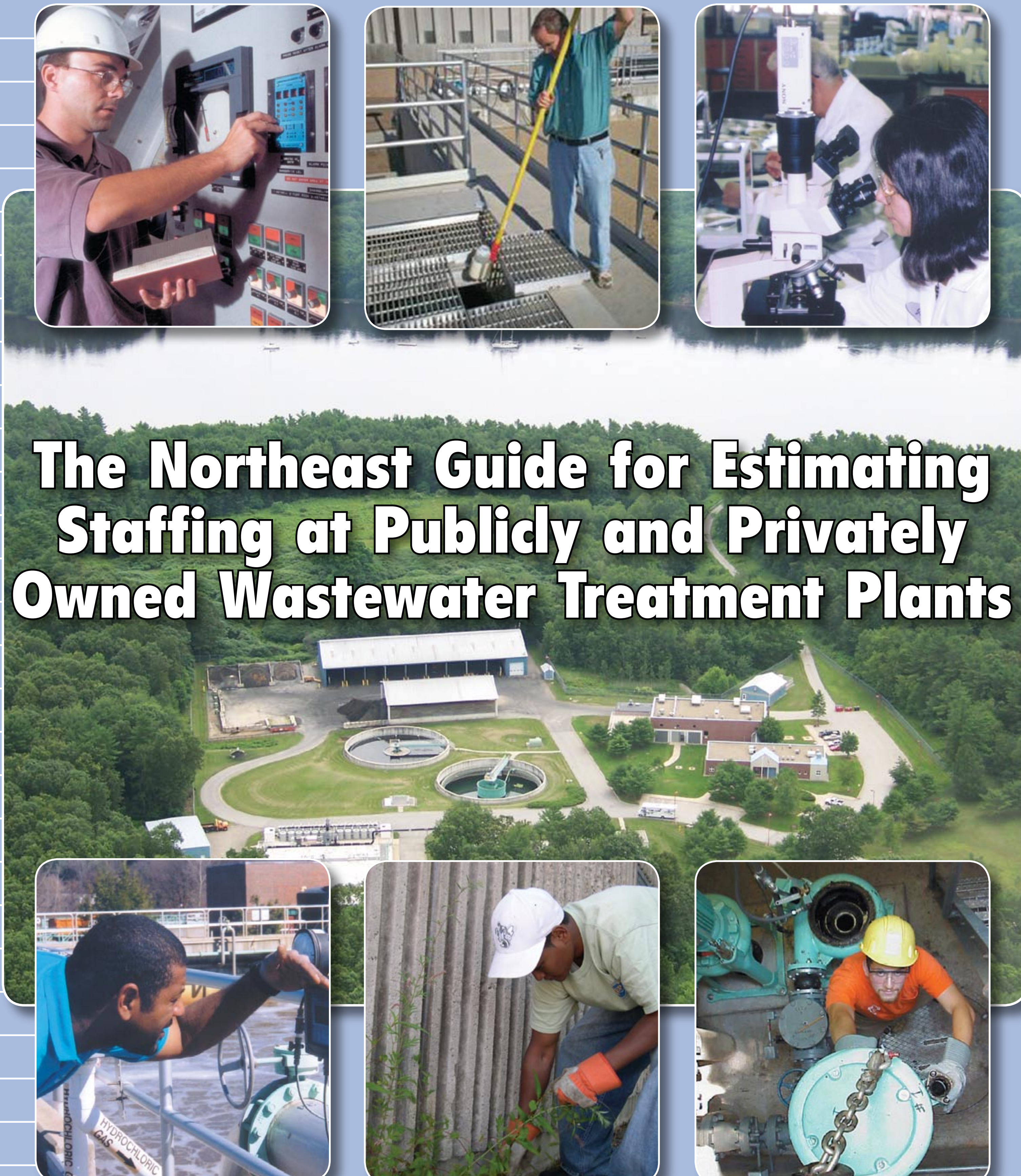

NEIWPCC

The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants

Prepared by the
New England Interstate Water Pollution Control Commission
November 2008

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Prepared by the

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Maine
Massachusetts
New Hampshire
New York
Rhode Island
Vermont

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This document is also available for download at www.neiwpcc.org.

♻ *Printed on recycled paper*

Acknowledgments

This manual was developed by the New England Interstate Water Pollution Control Commission. Established by an Act of Congress in 1947, NEIWPCC is a not-for-profit interstate agency that utilizes a variety of strategies to meet the water-related needs of its member states—Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. NEIWPCC coordinates activities and forums that encourage cooperation among the states, develops resources that foster progress on water issues, represents the region in matters of federal policy, trains environmental professionals, initiates and oversees scientific research projects, educates the public, and provides overall leadership in water management and protection. NEIWPCC regularly publishes manuals and other important technical reports and guidance; these guides provide tools and information to aid environmental professionals in planning, design, and operation, as well as compliance with regulations. They are intended to be used by individuals such as engineers, operators, and state regulators with specific information needs. Popular NEIWPCC guides include *TR-16 Guides for the Design of Wastewater Treatment Works, Sequencing Batch Reactor Design and Operational Considerations,* and *The Wastewater Treatment Plant Operators Guide to Biosolids Sampling Plans.*

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DISCLAIMER

Because personnel and operational efficiencies differ from plant to plant, the staffing estimates generated in accordance with this manual should only be used as a guide. Final staffing decisions for specific plants should be made by a person experienced with similarly situated facilities. This guide is intended to supplement, not supplant, the best professional judgment of experts.

Data and information presented in this document were gathered through a NEIWPCC workgroup process. While the information is technically sound and accurate, the user should understand that every situation is different, and precautions should always be taken where uncertainty exists. NEIWPCC is not responsible for any damages or injury that may occur as a result of using information in this guide.

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Chapter 1
Introduction

Since the passage of the original Clean Water Act in 1972, the federal government has invested more than $67 billion in building more than 16,000 municipal wastewater treatment facilities nationwide. The result has been a dramatic improvement in the quality of the nation's waters, a true environmental triumph. The plants themselves deserve much of the credit; a modern wastewater treatment facility is a marvel of applied science and technology. But much credit must also go to the men and women who operate and maintain these increasingly complex facilities. Their work is vital to supporting our investment in the nation's environmental infrastructure.

Good operators ensure a plant is run safely, efficiently, effectively. But municipalities have budgets, usually tight, and ideally, a plant has the exact amount of operators it needs—no less and no more. Such a plant is deemed to be "properly staffed." Achieving this is easier said than done.

In a 1999 review of the national 104(g) program, which provides technical assistance to small wastewater treatment plants, the U.S. Environmental Agency found that inadequate staffing was number three on the list of the top five causes of non-compliance at wastewater treatment plants. This guide addresses this problem by providing concrete information that municipal officials, plant superintendents, engineers, regulators, operators, contract operation firms, permittees, and other parties can use to estimate the staffing needs of publicly and privately owned wastewater treatment plants in the northeast United States. It may also be used as a pilot for plants in other regions of the country.

It is possible, of course, to glean some of the information in this guide from complex and expensive benchmarking and engineering operation and maintenance guides. But the goal of this publication is to give municipalities and facilities a quick, easy, and cost-effective way to estimate numerical staffing. It should be particularly helpful to those in the process of planning a new facility, upgrading current operations, or reviewing different treatment plant options, such as the addition of new operations, solids handling, or a reduction of staff.

The charts that begin on page 21 were developed to estimate the amount of staff necessary to operate and maintain wastewater treatment plants of various sizes. Because of the many differences among plants in terms of personnel and operations, the estimates prepared according to this manual should only be used as a guide. The final decision on the staff required for a particular plant is ultimately a matter of judgment, and should be made by a person experienced with similar plants in a similar area. Staffing plans must comply in all instances with the relevant state and federal regulations for operating and maintaining wastewater treatment facilities and publicly and privately owned treatment works.

Please visit our NEIWPCC Technical Guides web page at *www.neiwpcc.org/technicalguides.asp* for the latest version and updates of *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants.* If you would like to comment on the guide or if you have found any errors or omissions, notify NEIWPCC by using the feedback form provided on page 73.

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Chapter 2

The Foundation: EPA's 1973 Guide

While much of the information within this guide is entirely new, its basic premise and structure are not. Credit for that must go to the U.S. Environmental Protection Agency, which in 1973 published the widely referenced guide entitled *Estimated Staffing for Municipal Wastewater Treatment Facilities.* The guide described a four-step method that state regulatory agencies and plant managers successfully used for many years to determine the staffing needs associated with specific treatment plant processes and activities.

Over those years, however, changes in the wastewater industry diminished the guide's usefulness. It covered treatment processes that were no longer widely used. But the main problem was not what was in the guide, but what was missing. The guide, for example, did not adequately address technologies such as rotating biological contactors, oxidation ditches, and aerated lagoons. Entire treatment processes, such as sequencing batch reactors, were not included for the simple reason that they did not exist in 1973. The advent of more stringent discharge limits since the 1970s led to the development of new technologies and treatment processes such as nitrification, denitrification, and phosphorus removal—none of which were covered in the 1973 guide. Also not considered: the programs associated with the National Pretreatment Program, which had not been fully developed by 1973. Under the program, municipal wastewater plants receiving significant industrial discharges must develop local pretreatment programs to control industrial discharges into their sewer system.

Over the years, laboratory practices also grew in complexity; it is possible now to analyze for the character and quantity of a much wider range of contaminants than in the past. No longer do all plants discharge to surface waters, as was the case in the early years of wastewater treatment. There are plants implementing innovative/alternative technologies that use subsurface disposal systems and plants discharging to groundwater. The biosolids industry also grew greatly, with the advent of new practices and technologies that allow for land application and reuse. New methods of odor control at treatment plants allow treatment plants to operate continually in residential and commercial areas.

While the EPA guide does touch upon the topic of automation and the use of computer systems such as Supervisory Control and Data Acquisition (SCADA), it does so only briefly. This contrasts with the tremendous importance of these labor-saving systems in modern facilities. The use of SCADA, Geographical Information System (GIS), telemetry, automated meter-reading, computerized recordkeeping and maintenance, integrated purchasing and inventory has played a major role in improving the efficiency and effectiveness of wastewater treatment.

A review of the 1973 guide also revealed two other areas in need of improvement: the logarithmic graphs were difficult to read and understand, and some of the terminology sent the wrong message. The guide included references to plant staff as "manpower" and "workmen," despite the growing presence of women in the field.

What remained the same over the years, however, was the need for such a guide. Among those connected in any way to wastewater treatment—from consultants and contract operations firms to regulators and technical assistance providers—a strong desire exists for a systematic approach to determining staffing levels at wastewater treatment plants. Operators also recognize and express the need, since they most directly experience the impact of inadequate staff on facility operations, compliance, longevity, and morale. Furthermore, the expected absence in the future of large federal funding sources suggests that state and local governments will have to carry the burden of upgrading and repairing facilities.

For many years, the 1973 EPA guide provided an inexpensive and effective means of evaluating the staffing needs at wastewater treatment plants. But there was a consensus in the field that a new, updated version was needed—and NEIWPCC's Commissioners agreed. They gave NEIWPCC staff the go-ahead to develop a resource that together with educational opportunities, oversight, and enforcement would help ensure high-quality wastewater treatment in the Northeast long into the future.

Chapter 3
Guide Development

To assist in the development of the guide, NEIWPCC formed an Advisory Committee of Regional 104(g) members (technical assistance regulators from the Northeast), state regulators, wastewater treatment plant managers and superintendents, staff from contract operations firms, and local wastewater experts with experience in staffing wastewater treatment plants. Working with the committee, NEIWPCC developed a survey that was sent to 50 plants in New England and New York State. The survey provided an initial look into who was controlling staffing, how it was being handled, whether plants felt they were over- or understaffed, and what documents were being used to estimate staffing. There was a wide range of results, with one clear conclusion: while the 1973 EPA guide was still being used at some plants, no specific document or practice was being widely referenced to estimate staffing. This underscored the need for a new, up-to-date resource.

With input from the Advisory Committee, NEIWPCC developed the first draft of the charts for the guide. These charts, which show the number of staff hours that need to be devoted each year to completing a wide variety of tasks, were then subject to an intensive review process. This included a pilot study, in which NEIWPCC and Massachusetts Department of Environmental Protection staff visited 25 plants in New England with flows ranging from 0.25 million gallons a day up to 56 mgd. The staff visited a wide range of treatment plants, with varying processes and staffing practices. They toured municipal plants, contract operation plants, plants with out-sourced departments, and plants with additional responsibilities, such as operating and maintaining collection systems and pump stations, other wastewater and drinking water plants, landfills, and composting systems. At each stop, the managers and operators of the facility provided feedback on the accuracy of the chart estimates. Plants with detailed computer maintenance records were particularly helpful for reviewing chart estimates.

After the pilot study, NEIWPCC staff compared the actual staff numbers at each pilot study facility to the staffing estimates for that facility derived by using the charts. The Advisory Committee reviewed the results of this exercise as well as the entirety of the feedback received during the pilot study. This review led to a series of adjustments to the charts, which improved their accuracy. The final step in the review process involved sending the revised charts to managers at three wastewater treatment plants, who determined the charts yielded accurate results in all cases.

The final charts, which are published here beginning on page 21, are very detailed and cover most all wastewater activities and processes conducted at a modern wastewater treatment plant in the Northeast. However, the field of wastewater treatment is always evolving, and hence every effort has been made to design the guide so it can be easily updated to reflect changes in the field.

An alternate version of the charts has been developed using Microsoft Excel and is available in this guide. Turn to the “Interactive Excel Application” tab to access the CD. Turn to page 75 for directions on using the CD. This interactive version is user-friendly and eliminates the need for the user to make any mathematical calculations.

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Chapter 4

Additional Considerations

The charts in this guide are a tool for estimating staffing. The extensive preparation and review process has ensured they are as accurate as possible. But this publication is called a "guide" for good reason; the estimates obtained from the charts provide an indication of a plant's staffing needs, but their accuracy and relevancy in any one particular case can be affected by numerous factors.

Training and Certification

The training of a wastewater operator does not stop when he or she is hired by a plant. The majority of states in the Northeast require some level of training for operators to maintain their certification, since ongoing training reinforces and advances an operator's technical knowledge, skill, and abilities. Training expands an operator's understanding of emerging technologies and best practices. Even in states that do not have a training requirement for recertification, operators are strongly encouraged to attend programs to stay up-to-date on developments in the field.

This commitment to the benefits of training by the industry, regulators, and the operators themselves is admirable, and society reaps the benefits through increased protection of public health and the environment. But it cannot be assumed that the commitment is universal. In fact, an operator's commitment may very well be driven by the certification requirements in the state in which he or she works. The bottom line: not every operator in every plant is trained to the same degree.

The hourly estimates in the charts are, therefore, just that—estimates. They reflect the best assumptions of experts of the hours necessary to perform tasks conducted by operators, who far more often than not are "fully trained" in the tasks. Operators who are less than fully trained in a task will typically take longer to conduct it or will perform it in a less than effective or efficient manner. When using the charts, therefore, it is necessary for the user to fairly consider and appraise the training of a plant's existing staff and those it expects to hire. As stated above, state certification requirements are a factor here, but it was not practical to construct charts that reflect the varying requirements within states for training and their potential impact on the hours necessary to complete tasks.

Staffing and training are inherently intertwined; the level of the former is directly impacted by the level of the latter. This is true in every industry, and wastewater is no exception. Consistent, effective training throughout an operator's career can make a significant difference in on-the-job performance—and a plant's staffing needs.

Range of Job Responsibilities

Often, the best-run wastewater treatment plants are those that employ operators who are well trained in all operations at their facility. They are operating in compliance with the plant's discharge permit and completing all operations and maintenance responsibilities. When this occurs, the staff takes pride in their work and plant, as well as the importance of their job in protecting the environment. The cross-training of operators in areas outside their original responsibility has been found to improve efficiency, heighten motivation, contribute to effective teamwork, and contain costs.

This is not to say that a plant with operators who have strict job responsibilities and training in only certain areas cannot be run effectively. It can be. It is up to each plant's managers to make the decision about the most appropriate range of responsibilities for the facility's operators. Typically, this decision is dependent upon the capabilities not only of the existing operators but also the candidates available when job openings arise. But when considering the staffing estimates derived from the charts in this guide, it is important to contemplate whether a plant's workforce is broadly or narrowly trained. The evidence suggests that a certain number of operators working on all phases of a plant's operations and maintenance can be more efficient than the same number working on specific fixed tasks.

Age of Workforce

Research has shown that the workforce at wastewater treatment plants is aging, and this reliance on older operators is a major concern in estimating staffing. With an older staff, scheduling becomes more difficult due to increased vacation and sick leave. This problem is particularly acute at smaller treatment plants relying on a modest number of older operators, all with a significant amount of accrued time off.

In fact, during certain times of the year, a plant with an older workforce can find itself understaffed as many as three days a week. To accommodate these absences, staffing levels may need to be increased temporarily beyond what the estimates in this guide suggest. This would allow a plant with older operators to not only cover for workers on vacation or sick leave, but to also train replacements to seamlessly assume the responsibilities of the older staff once they reach retirement age.

Outsourcing and Contract Operations

Outsourcing is the practice of contracting out a specific area of work to a service provider. The contracts typically run from 36 to 60 months but can be as long as 20 years.

Areas commonly outsourced are operations, biosolids hauling and spreading, engine generator maintenance, custodial services, mowing, heating and air conditioning service, high voltage power service and repair, and laboratory testing. Outsourcing can provide access to technology, equipment, and expertise that a plant does not have internally, and can be beneficial when there are capital budget restraints or limits on capital spending. The implications for staffing levels are obvious; as tasks are outsourced, fewer staff are needed.

When contemplating outsourcing a process, it is imperative to be aware of the state procurement requirements for soliciting bids for contract operations. It is also prudent to consider the questions in the following list, which is derived from *Benchmarking Wastewater Operations: Collection, Treatment, and Biosolids Management* (Water Environment Research Foundation, 1997).

- Is the required capital investment necessary or excessive?
- Can proper specification writing give the contractor more flexibility than the plant and its municipal ownership would have?
- [If the work is kept in-house], does the amount of work performed justify the increased staffing and training costs?

- Is the work highly specialized or does it require special licensing, equipment, or experience?
- Are there enough local contractors to provide a competitive bidding situation?
- Will the workforce providing the service be of the seasonal or low-wage type?
- Does the work require state wastewater treatment plant operator certification?

Some municipalities forego running a facility and hiring staff altogether by contracting with an operations firm that runs the city's plant in its entirety. The reasons for doing so are similar to those for outsourcing—mounting regulatory and budgetary pressure, scarcity of competent personnel, and potential cost savings. While it can be difficult for a municipality to give up all responsibilities for such a large investment and key component of its infrastructure, it can be an attractive option. The key to achieving maximum benefit from private contract O&M is to select a contractor with a record of successful operations. Contracts must be well developed to ensure that the lines of responsibility between the contract operator and municipality are clearly delineated.

Shared Staffing

Occasionally public entities and contract operation firms will use one person to cover several positions at multiple wastewater plants. This is called shared staffing, and it allows a number of facilities to all benefit from a single individual's expertise. This can make sense when the person's skills do not justify a full-time position at a single plant, but can be utilized at multiple facilities in an area. Often this option is seen as desirable by contract operations firms that control numerous plants in a region. Shared staffing can also occur within a municipality, when wastewater staff are also responsible for other public duties such as operations and maintenance of drinking water facilities or collection systems.

While appealing from a cost-cutting perspective, shared staffing can pose problems during an emergency when the shared individual is needed simultaneously at all the facilities he or she covers. Municipalities considering this approach should carefully weigh the advantages and disadvantages, as well as the impact of shared staffing on their wastewater treatment plants' staffing needs.

Flexible Staffing

Due to budget constraints, strict no-hire policies, and mandates to not fill positions left open by retirement, some plants are forced to operate understaffed—and with far fewer staff than estimated by the charts in this guide. Understaffing should never be a long-term strategy, but when it must occur, it helps to have a flexible management program. Plant management should evaluate how the staff is structured, and consider ways to reconfigure plant personnel. Managers should attempt to identify operators eager to learn new responsibilities and to be cross-trained in areas outside their existing expertise.

If operators are flexible with their hours, they may be willing to work overtime to assist the plant in accomplishing tasks that might otherwise go undone. For many operators, the extra pay associated with each overtime hour is a powerful incentive, making overtime a feasible practice when hiring additional staff is impractical or impossible.

While acceptable options under some conditions, operating understaffed or consistently relying on overtime become unacceptable when the result is a neglect of fundamental operation and maintenance duties. When operator safety becomes an issue, it is even more imperative that steps are taken to increase staffing. During times of budget restraints, this can require extra flexibility on the part of management—and creative thinking.

One way to increase staff temporarily is to use part-time subject-to-call operators, who work only when needed and do not have an assigned work schedule or any guarantee of hours. The use of subject-to-call operators can not only reduce overtime and the strains caused by understaffing, it also allows plant managers to screen individuals who may be candidates for full-time vacancies when they occur. The subject-to-call option is especially attractive in areas with large pools of young candidates interested in entering the wastewater field. (It also helps if there are multiple plants in an area, which can share the talent pool.)

A flexible staffing approach utilized successfully by plants with varying flow patterns is the hiring of seasonal, part-time operators. Plants located in summer recreational areas often carry a larger staff during the summer, while the opposite is true for facilities that experience peak flows in the winter. Part-time help can do routine tasks such as mowing grass, pulling weeds, washing clarifiers, and painting, which allows full-time staff to concentrate on more specialized O&M responsibilities.

It should be noted that the use of some flexible staffing strategies, such as temporarily hiring inexperienced subject-to-call operators, is only an option when there is a numerical need-to-hire—that is, when a plant cannot complete necessary (and often tedious) tasks due to a lack of staff. This contrasts with a certified operator need-to-hire, in which a plant is required by its permit to utilize only operators with appropriate and valid state certification in certain roles. Plant managers obviously have less flexibility in such situations.

Emergency Response and Follow-Up

Although impossible to predict and hence inconceivable to include as a “task” in the staffing charts, emergency response is a fact of life at wastewater treatment plants. Emergencies will occur, and they will tie up staff time, often a great deal of it. Bear in mind that the staff time devoted to emergencies is not confined solely to the response. Invariably, a significant amount of follow-up is involved, as staff prepare appropriate notification to stakeholders and regulatory agencies. This follow-up is typically very time-consuming due to the need to obtain all the facts and ensure their accuracy. Generally the responsible operator-in-charge (also known as the direct responsible charge operator in some jurisdictions) must notify the state regulatory agency verbally and follow-up with a written report of the incident.

Given the inevitability of at least a minor emergency on occasion, it is prudent when utilizing the estimates from this guide’s charts to bear in mind that additional hours will be required periodically for emergency response and follow-up.

Chapter 5
Using the Charts

The charts that begin on page 21 are designed for publicly and privately owned wastewater treatment plants in New England and New York State with flows ranging from 0.25 million gallons a day to greater than 20 mgd. Regarding the number of hours worked per year, the EPA estimate of 1,500 hours was used. This estimate assumes a five-day work week; 6.5 hours of productive work per day; and an average of 29 days for holidays, vacations, and sick leave. Where conditions at a plant are significantly different from these assumptions, it may be necessary to use a figure other than 1,500 hours when dividing the total hours derived from the charts to determine staffing needs.

Differences in Plant Shifts

In devising the charts, it was necessary to accommodate for the fact that wastewater treatment plants differ in the number of personnel shifts per day. Some have just one shift during weekdays, others operate around the clock, while still others fall somewhere in between. When using the charts to estimate staffing at a plant, it is important to use the series of charts tailored to the staffing schedule utilized by the plant.

The charts are offered in three categories:

One Shift Plant: A facility that has one shift a day, five days a week. To arrive at the numbers on the charts, the daily hour estimates for a task were multiplied by 260 to get annual hours. The One Shift series of charts begin on page 21.

24/7 Plant: A facility that is staffed seven days a week, twenty four hours per day. For the charts, the daily hour estimates for a task were multiplied by 365 to get annual hours. The 24/7 series of charts begin on page 45.

One-Plus Shift Plant: Any facility whose staffing schedule does not fit into the previous two categories. These plants may have one shift a day, seven days a week; or perhaps one shift a day, five days a week, with a reduced number of hours on weekends. For the charts, the daily hour estimates for a task were multiplied by 320 to get annual hours. The One-Plus series of charts begin on page 33.

It must be remembered that the charts are not designed to be the sole factor in determining the number of staff needed to operate a plant, but are only to be used as a guide. Estimating is not an exact science. The staffing total derived from the charts should be looked at as a starting point for further discussion on final staffing levels. There can be no hard-and-fast rule on what jobs there should be at any one treatment plant, and each plant's administration should not feel restricted to a specific selection of job titles or shift staffing. The staffing at a plant must be designed to meet the facility's specific requirements. While the charts in this guide have been meticulously developed through input from experts, pilot testing, and review to give an accurate estimate on staffing publicly and privately owned wastewater treatment plants, the final decision on staffing is the province of each municipality and any other stakeholders in a facility.

Plant Comparisons

A final suggestion: After using the charts to arrive at an estimate of staffing for a plant, it is helpful to compare the results with actual staffing at a plant of similar size and in roughly the same area. The following questions should be helpful when conducting this comparison. The list comes from *The Cost of Clean Water: A Sewer User Rate Survey and Guidance Manual* (Connecticut DEP, 1999).

- Are the treatment processes similar?
- Are both plants of the same level of complexity?
- Are the treatment systems roughly the same age?
- Have the facilities been properly maintained in the past?
- What is the level of automation?
- Is sludge managed on-site or sent off-site for disposal?
- Do the collection systems have roughly the same mileage (within 20-30 percent)?
- Who does the O&M of the collection systems?
- Do the collection systems have roughly the same number of pumping stations?
- Are all functions being carried out by plant staff, or are some done by the public works department or town hall, e.g., maintenance and administrative duties?
- Do the facilities handle similar waste, i.e., what is the percentage of industrial flow, food preparation or processing waste, etc.?
- Is the facility operating in compliance with its NPDES permit?

If the answers to the above questions reveal considerable similarity, the staffing level at the plant being used as a point of comparison can be a tremendously helpful indicator of appropriate staffing.

Detailed Directions

NOTE: *Make copies of charts before using/writing on them.*

1. **To Start** – Choose the correct series of charts based on number of shifts per day at the plant. Select the group of charts that fits the shift set-up of the plant.
   a. One Shift Plant: Staffed for one shift, five days per week or less.
   b. 24/7 Plant: Staffed continuously 24 hours per day, 7 days per week.
   c. One-Plus Shift Plant: All other plants are under this category.

2. **Utilize appropriate design flow for the plant.**
   a. Select from the ranges of flows below:
      i. 0.25-0.5 mgd, 0.5-1.0 mgd, 1.0-5.0 mgd, 5.0-10.0 mgd, 10.0-20.0 mgd, > 20 mgd
      ii. For a flow of 0.5 mgd, use 0.25-0.5 mgd, a flow of 1.0 mgd use 0.5-1.0 mgd, and so on for 5, 10, and 20 mgd.
   b. Use this range for Charts 1, 2, and 4.
   c. After selecting the correct range of flows continue to Chart 1.

3. **Chart 1 – Basic and Advanced Operations and Processes**
   a. Proceed down the correct range of flows column circling all operations and processes conducted at the plant. Put this number in the "Total Hours for Plant" column on the far right.
   b. When specified multiply the number in the box by number of units. Use this sum for the "Total Hours for Plant" column, not the number in the box. Otherwise use the number designated in each box.
   c. Add all the hours in the "Total Hours for Plant" column and put the number on the Total line.
   d. Put the number from the Total line from Chart 1 next to Chart 1 on the Final Estimate Chart on page 32 for One Shift, page 44 for One-Plus Shift, or page 56 for 24/7.
   e. Continue to Chart 2.

4. **Chart 2 – Maintenance**
   a. Proceed down the column selecting all activities, processes and systems that are maintained at the plant.
   b. Multiply the number in the box by number of units that are available at the plant. Use the "Multiply by" box to determine units to multiply by. Place the new multiplied number in the far right column labeled "Total Hours for Plant."
   c. If the Activity Box is marked with an X, do not multiply by the number of units—just use the number designated in the box.
   d. Add all the hours in the "Total Hours for Plant" column and put the number on the Total line.
   e. Put the number from the Total line from Chart 2 next to Chart 2 on the Final Estimate Chart on page 32 for One Shift, page 44 for One-Plus Shift, or page 56 for 24/7.
   f. Continue to Chart 3.

5. **Chart 3 – Laboratory Operations**
   a. Going down the left side of the chart, circle each parameter that is tested for under the plant's discharge permit. The remaining squares for Lab QA/QC Program, Process Control Testing, Sampling for Contracted Services and Sampling for Monitoring Groundwater Wells are not part of permitting. However, circle if the plant has these programs in use.
   b. For each parameter selected, determine how many times the test is run—weekly, monthly, or quarterly (as required by the plant's discharge permit). Write in the appropriate column the frequency of testing. If the test is done less often than quarterly, do not use it for annual hours calculations.
   c. To the right of the parameter is an estimate in hours for testing time. Multiply this number by the frequency of the testing and then by 52 for weekly occurrences, 12 for monthly occurrences, or 4 for quarterly occurrences. Place this number in the Annual Hours box on the far right.
   d. Follow step c for each parameter.
   e. Add the column for annual hours and put the number on the Total line.
   f. Put the number from the Total line from Chart 3 next to Chart 3 on the Final Estimate Chart on page 32 for One Shift, page 44 for One-Plus Shift, or page 56 for 24/7.
   g. Continue to Chart 4.

6. **Chart 4 – Biosolids and Sludge Handling**
   a. Proceed down the correct range of flows column, selecting all processes conducted at the plant.
   b. If the box has a #/shift, multiply the number by the amount of shifts the process is in operation.
   c. Add all the hours from the column and put the number on the Total line.
   d. Put the number from the Total line from Chart 4 next to Chart 4 on the Final Estimate Chart on page 32 for One Shift, page 44 for One-Plus Shift, or page 56 for 24/7.
   e. Continue to Chart 5.

7. **Chart 5 - Yardwork**
   a. Determine if the plant's layout is:
      i. Small: Less than 1.0 mgd design flow
      ii. Average: Greater than 1.0 mgd and less than 10.0 mgd design flow
      iii. Large: Greater than 10.0 mgd design flow
   b. Use the selection to determine the correct column.
   c. Proceed down the column selecting all work that is conducted at the plant. Put this number in the "Total Hours for Plant" column on the far right.
   d. Vehicle maintenance is for all motorized vehicles (i.e., trucks, cars, front and back loaders, etc.). Multiply the total number of vehicles by 25 and put this number in the "Total Hours for Plant" column on the far right.
   e. Add all the hours in the "Total Hours for Plant" column and put the number on the Total line.
   f. Put the number from the Total line from Chart 5 next to Chart 5 on the Final Estimate Chart on page 32 for One Shift, page 44 for One-Plus Shift, or page 56 for 24/7.
   g. Continue to Chart 6.

8. **Chart 6 – Automation and SCADA** (a detailed description of the items in this chart can be found in Appendix A)
   a. Proceed down the column checking Yes or No for all types of automation that are used at the plant.
   b. This chart does not have a numerical effect on the final estimate of staffing but is a good tool to see what level of automation is being used at the plant. See "Appendix A: Automation and SCADA" for more information.
   c. Continue to Chart 7.

9. **Chart 7 – Considerations for Additional Staffing Considerations** (a detailed description of the items in this chart can be found in Appendix B)
   a. Proceed down the chart placing a check mark on every line where additional staff will be needed.
   b. This chart does not have a numerical estimate due to the complexity and wide range of staffing options, but the responsibilities will increase calculated staff hours. See the "Appendix B: Additional Staffing Considerations" for more information.
   c. Continue to Final Estimate Chart.

10. **Final Estimate**
    a. This chart should include the annual hours added up from each chart. If not, go back to each chart and fill in the chart estimate in annual hours with the correct box.
    b. Add the total of the five charts and put this number next to Estimated Operation and Maintenance Hours.
    c. Divide Estimated Operation and Maintenance Hours by 1500 for your Estimated Operation and Maintenance Staff. This is the estimated amount of staff to operate and maintain the plant.
    d. Go back to Chart 7 and for each checked line consider what additional staff will be needed. Put this number next to Estimated Additional Staff from Chart 7.
    e. Add Estimated Operation and Maintenance Staff with Estimated Additional Staff from Chart 7 and put this number next to Total Staffing Estimate. This is the total estimated staff needed to run the plant.

NOTE FOR CHARTS 1, 2, and 4: Interpolating Data Points

Under some flow ranges are a range of annual hours for a specified operation, process, or activity. When a square has a range of annual hours it will be necessary to interpolate the data point.

To interpolate the point we need to find X which is between Min Hours and Max Hours.

Set-up:

$$\frac{\text{Max Hours} - \text{Min Hours}}{\text{Max Flow} - \text{Min Flow}} = \frac{\text{Max Hours} - X}{\text{Max Flow} - \text{Design Flow}}$$

Then calculate for X.

For an example on interpolating a data point, turn to page 16.

Example

NOTE: The user must complete the entire chart including all the plant's units and processes before moving on to the next chart.

Plant Name: NEIWPCC example - Activated Sludge plant with 30/30 discharge permit

Design Flow – 9.0 mgd; **Actual Flow** – 4.2 mgd

One – Plus shift plant: Plant is staffed 7 days a week from 8 a.m. – 5 p.m.

CHART 1

- Select flow range of 5 – 10 mgd.
- Circle all processes from the plant.

CHART 1 (One-Plus Shift)
BASIC AND ADVANCED OPERATIONS AND PROCESSES

	Flow						
Process	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd	Total Hours for Plant
Preliminary Treatment	160	160	320	640	960	1280	
Primary Clarification (mult. by # of units)	160	160	160	320 3	320	320	**960**
Activated Sludge	640	1280	1920	1920-2560	2560-3200	7680	**2432**
Activated Sludge w/BNR	960	1920	2560	2880-3840	3840-7680	8960	
TOTAL							**3392**

- The plant has 3 primary clarification units. When directed, multiply hours by number of units.
- For hourly selections with ranges of numbers, it will be necessary to interpolate the estimated hours.

$$\frac{2560 - 1920}{10 - 5} = \frac{2560 - X}{10 - 9}$$

$$\frac{640}{5} = \frac{2560 - X}{1}$$

$$128 = 2560 - X$$

$$X = 2560 - 128$$

$$X = 2432.0 \text{ hours}$$

Example

CHART 2 (One-Plus Shift)
MAINTENANCE

	Flow							
Activity/Flow	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd	Multiply by	Total Hours for Plant
Manually Cleaned Screens	80	80	80	80	160	320	# of screens	
Mechanically Cleaned Screens	80	80	80	320 3	960	1280	# of screens	**960**
Mechanically Cleaned Screens with grinders/ washer/compactors	80	160	320	640	1280	1600	# of screens	
TOTAL								**960**

- The plant has 3 mechanically cleaned screens, so multiply the hourly estimate by 3.

CHART 3 (One-Plus Shift)
LABORATORY OPERATIONS

		How often are tests run?			
Test Required by Permit	Testing Time (hrs.)	Tested Weekly X 52	Tested Monthly X 12	Tested Quarterly X 4	Annual Hours
Acidity	0.75				
Alkalinity, total	0.75		**2**		**18**
Biochemical Oxygen Demand (BOD)	2.5	**5**			**650**
Chemical Oxygen Demand (COD)	2.5				
TOTAL					**668**

- The plant runs a BOD test 5 times per week and an alkalinity test 2 times per month.
  - BOD testing time = 2.5 x 5 x 52 = 650 hours
  - Alkalinity testing time = 0.75 x 2 x 12 = 18 hours

- Sampling time is built into testing time estimates.

Example

CHART 4 (One-Plus Shift)
BIOSOLIDS/SLUDGE HANDLING

	Flow					
Process	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd
Belt Press	320	960	1920	2560	2560	2560/shift
Plate & Frame Press	320	480	960	2560	2560	2560
Gravity Thickening	80	80	160	160	320	320
TOTAL				**2560**		

- The plant has 2 belt presses. However, since there is no multiplier use the hourly multiplier in the box.

CHART 5 (One-Plus Shift)
YARDWORK

	Size of Plant			
Work Done	Small	Average	Large	Total Hours for Plant
Janitorial/Custodial Staff	100	200	400	**200**
Snow Removal	60	120	400	
Mowing	100	120	400	
Vehicle Maintenance (per vehicle)	25	25 **7**	25	**175**
Facility Painting	60	80	160	
Rust Removal	60	80	160	
TOTAL				**375**

- The plant design flow is between 1 – 10 mgd, so the plant size is considered average. The plant handles the janitorial work and has 7 vehicles. They outsource snow removal, mowing, painting and rust removal.

Example

CHART 6 (One-Plus Shift)
AUTOMATION/SCADA

Type of Automation	Yes	No
Automated attendant or Interactive voice recognition (IVR) equipment		✔
Automated Meter Reading (AMR), Touchpad meters or other automated metering technology		✔
Automatic call director (ACD)	✔	

CHART 7 (One-Plus Shift)
CONSIDERATIONS FOR ADDITIONAL PLANT STAFFING

• Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)	____
• Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows	✔

FINAL ESTIMATES	
Chart #	**Annual Hours**
1 – Basic and Advanced Operations and Processes	**3392**
2 – Maintenance	**960**
3 – Laboratory Operations	**668**
4 – Biosolids/Sludge Handling	**2560**
5 – Yardwork	**375**
Estimated Operation and Maintenance Hours	**7955**
Estimated Operation and Maintenance Staff	**5.3 (7955 ÷ 1500)**
Estimated Additional Staff from Chart 7	**2.0**
Total Staffing Estimate	**7.3**

Chart 6 – Automation/SCADA (List all "yes" answers from Chart 6)

The plant utilizes an automatic call director.

Chart 7 – Considerations for Additional Plant Staffing (List all "yes" answers from Chart 7).
Attach supporting information to justify additional staffing needs from Chart 7.

The plant is also responsible for 275 miles of collection systems and inspects 7 pump stations.

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Chapter 6

Charts: One Shift Plant

The charts on the following pages apply to publicly and privately owned wastewater treatment facilities where operators are present for only one shift a day, five days a week. To arrive at the numbers on the charts, the daily hour estimates for a task were multiplied by 260 to determine annual hours.

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CHART 1 (One Shift)
BASIC AND ADVANCED OPERATIONS AND PROCESSES

	Flow						
Process	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**	**Total Hours for Plant**
Preliminary Treatment	130	130	260	520	780	1040	
Primary Clarification (mult. by # of units)	130	130	130	260	260	260	
Activated Sludge	520	1040	1560	1560-2080	2080-2600	6240	
Activated Sludge w/BNR	780	1560	2080	2340-3120	3120-6240	7280	
Rotating Biological Contactor	260	390-780	780-1560	1560	X	X	
Sequencing Batch Reactor (per tank)	260	260	260	260	260	260	
Extended Aeration (w/o primary)	650	1300	2080	X	X	X	
Extended Aeration w/BNR	910	1820	2600	X	X	X	
Pure Oxygen Facility	X	X	X	2080-2600	2600	4680	
Pure Oxygen Facility w/BNR	X	X	X	2600-3900	3900	6240	
Trickling Filter	260	260	520	780	1040	2080	
Oxidation Ditch (w/o primary)	650	1300	2080	X	X	X	
Oxidation Ditch w/BNR	910	1820	2600	X	X	X	
Aeration Lagoon	390	390	390	X	X	X	
Stabilization Pond	260	260	260	X	X	X	
Innovative Alternative Technologies	520	780	X	X	X	X	
Nitrification	65	65	130	130	260	520	
Denitrification	65	65	130	130	260	520	
Phosphorus Removal (Biological)	65	65	130	130	260	520	
Phosphorus Removal (Chemical/Physical)	65	130	260	520	780	1040	
Membrane Processes	65	65	130	130	260	260	

continued on page 24

CHART 1 (One Shift) *continued*
BASIC AND ADVANCED OPERATIONS AND PROCESSES

	Flow						
Process	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**	**Total Hours for Plant**
Cloth Filtration	65	65	130	130	130	130	
Granular Media Filters (Carbon, sand, anthracite, garnet)	130	260	260	390	390	780	
Water Reuse	65	65	130	130	130	130	
Plant Reuse Water	26	26	26	39	65	65	
Chlorination	130	130	260	260	260	260	
Dechlorination	130	130	260	260	260	260	
Ultraviolet Disinfection	130	130	260	260	260	260	
Wet Odor Control (mult. by # of systems)	130	130	260	260	260	260	
Dry Odor Control (mult. by # of systems)	65	65	130	130	130	130	
Septage Handling	130	130	260	260	260	260	
TOTAL							

- Activated Sludge process includes RAS and WAS pumping.
- Secondary Clarification has been built into basic operations processes.

CHART 2 (One Shift)
MAINTENANCE

Activity	Flow						Multiply by	Total Hours for Plant
	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd		
Manually Cleaned Screens	65	65	65	65	130	260	# of screens	
Mechanically Cleaned Screens	65	65	65	260	780	1040	# of screens	
Mechanically Cleaned Screens with grinders/ washer/compactors	65	130	260	520	1040	1300	# of screens	
Comminutors/ Macerators	65	65	65	130	195	260	# of units	
Aerated Grit Chambers	26	26	65	130	195	260	# of chambers	
Vortex Grit Removal	26	26	65	130	195	260	# of units	
Gravity Grit Removal	26	26	39	52	104	130	# of units	
Additional Process Tanks	26	26	26	26	26	26	# of tanks	
Chemical Addition (varying dependent upon degree of treatment)	26	26	26	26-78	78-156	208	# of chemicals added for processes	
Circular Clarifiers	65	65	130	130	195	260	# of clarifiers	
Chain and Flight Clarifiers	65	65	130	130	195	260	# of clarifiers	
Traveling Bridge Clarifiers	X	X	X	X	195	260	# of clarifiers	
Squircle Clarifiers	65	65	130	130	195	260	# of clarifiers	
Pumps	100	100	250	500	750	1500	X	
Rotating Biological Contactor	39	39	65	65	X	X	# of trains	
Trickling Filters	39	39	39	65	104	130	# of TFs	
Sequencing Batch Reactor	39	39	39	65	104	130	# of tanks	
Mechanical Mixers	26	26	26	26	39	52	# of mixers	
Aeration Blowers	52	52	52	52	78	104	# of blowers	
Membrane Bioreactor	26	26	26	52	78	104	# of cartridges	

Continued on page 26

CHART 2 (One Shift) *continued*

MAINTENANCE

Activity	Flow 0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd	Multiply by	Total Hours for Plant
Subsurface Disposal System	26	26	26	26	78	104	# of systems	
Groundwater Discharge	26	26	26	26	39	52	X	
Aerobic Digestion	26	26	26	26	39	52	# of digesters	
Anaerobic Digestion	X	52	52	78	156	260	# of digesters	
Gravity Thickening	26	26	26	26	78	104	# of basins	
Gravity Belt Thickening	39	39	39	65	104	130	# of belts	
Belt Filter Press	39	39	39	65	104	130	# of presses	
Mechanical Dewatering (Plate Frame and Centrifuges)	39	39	39	65	104	130	# of units	
Dissolved Air Floatation	X	26	26	26	78	104	# of units	
Chlorination (gas)	26	26	26	52	78	104	X	
Chlorination (liq.)	52	52	52	78	117	156	X	
Dechlorination (gas)	26	26	26	52	78	104	X	
Dechlorination (liq.)	52	52	52	78	117	156	X	
Ultraviolet	26	26	26	39	65	78	# of racks	
Biofilter	130	130	130	130	130	130	# of units	
Activated Carbon	130	130	130	195	195	260	# of units	
Wet Scrubbers	X	X	X	39	65	78	# of units	
Microscreens	26	26	26	39	65	78	# of screens	
Pure Oxygen	X	X	X	52	78	104	# of units	
Final Sand Filters	52	52	52	52	78	156	# of units	
Probes/ Instrumentation/ Calibration	26	26	26	26	26	26	# of probes in-line	
TOTAL								

CHART 3 (One Shift)
LABORATORY OPERATIONS

	How often are tests run?				
Test Required by Permit	**Testing Time (hrs.)**	**Tested Weekly X 52**	**Tested Monthly X 12**	**Tested Quarterly X 4**	**Annual Hours**
Acidity	0.75				
Alkalinity, total	0.75				
Biochemical Oxygen Demand (BOD)	2.5				
Chemical Oxygen Demand (COD)	2.5				
Chloride	0.5				
Chlorine, Total Residual	0.25				
Coliform, Total, Fecal, E.Coli	1.0				
Dissolved Oxygen (DO)	0.25				
Hydrogen Ion (pH)	0.25				
Metals	3.0				
Toxicity	2.0				
Ammonia	2.0				
Total Nitrogen	2.0				
Oil and Grease	3.0				
Total and Dissolved Phosphorus	2.0				
Solids, Total, Dissolved, and Suspended	3.0				
Specific Conductance	0.25				
Sulfate	1.0				
Surfactants	1.0				
Temperature	0.25				
Total Organic Carbon (TOC)	0.25				
Turbidity	0.25				
Bacteriological Enterococci	1.0				
Lab QA/QC Program	1.0				
Process Control Testing	3.0				
Sampling for Contracted Lab Services	0.25				
Sampling for Monitoring Groundwater Wells	0.5				
TOTAL					

• Sampling time is built into testing time estimates.

CHART 4 (One Shift)
BIOSOLIDS/SLUDGE HANDLING

	Flow					
Process	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**
Belt Filter Press	260	780	1560	2080	2080	2080/shift
Plate & Frame Press	260	390	780	2080	2080	2080
Gravity Thickening	65	65	130	130	260	260
Gravity Belt Thickening	65	65	130	130	260	520
Rotary Press	65	65	130	130	260	520
Dissolved Air Floatation	X	130	130	260	260	260
Alkaline Stabilization	65	65	65	65	65	65
Aerobic Digestion	130	130	130	260	390	520
Anaerobic Digestion	65	65	130	390	650	1040
Centrifuges	260	260	780	2080	2080	2080
Composting	260	520-780	1040	2080	2080	2080/shift
Incineration	X	X	X	X	6240	6240
Air Drying – Sand Beds	130	130	X	X	X	X
Land Application	65	130	130	X	X	X
Transported Off-site for Disposal	65	260	1040	2080	2080	2080
Static Dewatering	260	260	X	X	X	X
TOTAL						

CHART 5 (One Shift)
YARDWORK

	Size of Plant			
Work Done	**Small**	**Average**	**Large**	**Total Hours for Plant**
Janitorial/Custodial Staff	100	200	400	
Snow Removal	60	120	400	
Mowing	100	120	400	
Vehicle Maintenance (per vehicle)	25	25	25	
Facility Painting	60	80	160	
Rust Removal	60	80	160	
TOTAL				

CHART 6 (One Shift)
AUTOMATION/SCADA

Type of Automation	Yes	No
Automated attendant or interactive voice recognition (IVR) equipment		
Automated meter reading (AMR), touchpad meters or other automated metering technology		
Automatic call director (ACD)		
Billing system		
Computerized facilities management (FM) system		
Computerized preventative maintenance		
Computerized recordkeeping		
E-mail		
Geographical information system (GIS)		
Integrated purchasing and inventory		
Internet website		
Laboratory information management system (LIMS)		
Local area network (LAN)		
Supervisory control and data acquisition (SCADA)		
Telemetry		
Utility customer information system (CIS) package		

CHART 7 (One Shift)
CONSIDERATIONS FOR ADDITIONAL PLANT STAFFING

• Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)	________
• Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows	________
• Plant operators responsible for snow plowing, road/sidewalk repair, or other municipal project	________
• Plant staff involved in generating additional energy	________
• Plant receives an extra high septage and/or grease load (higher than designed organic and grease loadings) or plant takes in sludge from other treatment plants	________
• Plant is producing a Class A Biosolid product	________
• Plant operators responsible for operating generators and emergency power	________
• Plant responsible for industrial pre-treatment program	________
• Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)	________
• Plant operators responsible for machining parts on-site	________
• Age of plant and equipment (over 15 years of age)	________

NEIWPCC

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS (One Shift)

Plant Name: ____

Design Flow:__________________________ **Actual Flow:**______________________________

FINAL ESTIMATES	
Chart #	**Annual Hours**
1 – Basic and Advanced Operations and Processes	
2 – Maintenance	
3 – Laboratory Operations	
4 – Biosolids/Sludge Handling	
5 – Yardwork	
Estimated Operation and Maintenance Hours	
Estimated Operation and Maintenance Staff	
Estimated Additional Staff from Chart 7	
Total Staffing Estimate	

• Divide the total of Annual Hours by 1500 hours per year to get the Estimated Operation and Maintenance Staff needed to operate the plant. This assumes 5-day work week; 29 days of vacation, sick leave, holidays; and 6.5 hours per day of productive work.

Note: The estimate from Charts 1-5 will not be the final amount of staff necessary to run the facility. Please review Chart 7 for additional staffing needs.

Chart 6 – Automation/SCADA (List all "yes" answers from Chart 6.)

Chart 7 – Considerations for Additional Plant Staffing (List all "yes" answers from Chart 7.) Attach supporting information to justify additional staffing needs from Chart 7.

Chapter 7

Charts: One-Plus Shift Plant

The charts on the following pages apply to publicly and privately owned wastewater treatment facilities where operators are present for more than one shift a day, five days a week, but less than 24 hours a day, seven days a week. These plants, for example, may have one shift a day, seven days a week, or perhaps one shift a day, five days a week, supplemented by shorter shifts on weekends. To arrive at the numbers on the charts, the daily hour estimates for a task were multiplied by 320 to determine annual hours.

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CHART 1 (One-Plus Shift)
BASIC AND ADVANCED OPERATIONS AND PROCESSES

	Flow						
Process	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd	Total Hours for Plant
Preliminary Treatment	160	160	320	640	960	1280	
Primary Clarification (mult. by # of units)	160	160	160	320	320	320	
Activated Sludge	640	1280	1920	1920-2560	2560-3200	7680	
Activated Sludge w/BNR	960	1920	2560	2880-3840	3840-7680	8960	
Rotating Biological Contactor	320	480-960	960-1920	1920	X	X	
Sequencing Batch Reactor (per tank)	320	320	320	320	320	320	
Extended Aeration (w/o primary)	800	1600	2560	X	X	X	
Extended Aeration w/BNR	1120	2240	3200	X	X	X	
Pure Oxygen Facility	X	X	X	2560-3200	3200	5760	
Pure Oxygen Facility w/BNR	X	X	X	3200-4800	4800	7680	
Trickling Filter	320	320	640	960	1280	2560	
Oxidation Ditch (w/o primary)	800	1600	2560	X	X	X	
Oxidation Ditch w/BNR	1120	2240	3200	X	X	X	
Aeration Lagoon	480	480	480	X	X	X	
Stabilization Pond	320	320	320	X	X	X	
Innovative Alternative Technologies	640	960	X	X	X	X	
Nitrification	80	80	160	160	320	640	
Denitrification	80	80	160	160	320	640	
Phosphorus Removal (Biological)	80	80	160	160	320	640	

Continued on page 36

CHART 1 (One-Plus Shift) *continued*

BASIC AND ADVANCED OPERATIONS AND PROCESSES

	Flow						
Process	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**	**Total Hours for Plant**
Phosphorus Removal (Chemical/Physical)	80	160	320	640	960	1280	
Membrane Processes	80	80	160	160	320	320	
Cloth Filtration	80	80	160	160	160	160	
Granular Media Filters (Carbon, sand, anthracite, garnet)	160	320	320	480	480	960	
Water Reuse	80	80	160	160	160	160	
Plant Reuse Water	32	32	32	48	80	80	
Chlorination	160	160	320	320	320	320	
Dechlorination	160	160	320	320	320	320	
Ultraviolet Disinfection	160	160	320	320	320	320	
Wet Odor Control (mult. by # of systems)	160	160	320	320	320	320	
Dry Odor Control (mult. by # of systems)	80	80	160	160	160	160	
Septage Handling	160	160	320	320	320	320	
TOTAL							

- Activated Sludge process includes RAS and WAS pumping.
- Secondary Clarification has been built into basic operations processes.

CHART 2 (One-Plus Shift)
MAINTENANCE

	Flow							
Activity	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**	**Multiply by**	**Total Hours for Plant**
Manually Cleaned Screens	80	80	80	80	160	320	# of screens	
Mechanically Cleaned Screens	80	80	80	320	960	1280	# of screens	
Mechanically Cleaned Screens with grinders/ washer/compactors	80	160	320	640	1280	1600	# of screens	
Comminutors/ Macerators	80	80	80	160	240	320	# of units	
Aerated Grit Chambers	32	32	80	160	240	320	# of chambers	
Vortex Grit Removal	32	32	80	160	240	320	# of units	
Gravity Grit Removal	32	32	48	64	80	160	# of units	
Additional Process Tanks	32	32	32	32	32	32	# of tanks	
Chemical Addition (varying dependent upon degree of treatment)	32	32	32	32-96	96-192	256	# of chemicals added for processes	
Circular Clarifiers	80	80	160	160	240	320	# of clarifiers	
Chain and Flight Clarifiers	80	80	160	160	240	320	# of clarifiers	
Traveling Bridge Clarifiers	X	X	X	X	240	320	# of clarifiers	
Squircle Clarifiers	80	80	160	160	240	320	# of clarifiers	
Pumps	100	100	250	500	750	1500	X	
Rotating Biological Contactor	48	48	80	80	X	X	# of trains	
Trickling Filters	48	48	48	80	128	160	# of TFs	
Sequencing Batch Reactor	48	48	48	80	128	160	# of tanks	
Mechanical Mixers	32	32	32	32	48	64	# of mixers	
Aeration Blowers	64	64	64	64	96	128	# of blowers	
Membrane Bioreactor	32	32	32	64	96	128	# of cartridges	

Continued on page 38

CHART 2 (One-Plus Shift) *continued*
MAINTENANCE

	Flow							
Activity	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**	**Multiply by**	**Total Hours for Plant**
Subsurface Disposal System	32	32	32	32	96	128	# of systems	
Groundwater Discharge	32	32	32	32	48	64	X	
Aerobic Digestion	32	32	32	32	48	64	# of digesters	
Anaerobic Digestion	X	64	64	96	192	320	# of digesters	
Gravity Thickening	32	32	32	32	96	128	# of basins	
Gravity Belt Thickening	48	48	48	80	128	160	# of belts	
Belt Press	48	48	48	80	128	160	# of presses	
Mechanical Dewatering (Plate Frame and Centrifuges)	48	48	48	80	128	160	# of units	
Dissolved Air Floatation	X	32	32	32	96	128	# of units	
Chlorination (gas)	32	32	32	64	96	128	X	
Chlorination (liq.)	64	64	64	96	144	192	X	
Dechlorination (gas)	32	32	32	64	96	128	X	
Dechlorination (liq.)	64	64	64	96	144	192	X	
Ultraviolet	32	32	32	48	80	96	# of racks	
Biofilter	160	160	160	160	160	160	# of units	
Activated Carbon	160	160	160	240	240	320	# of units	
Wet Scrubbers	X	X	X	48	80	96	# of units	
Microscreens	32	32	32	48	80	96	# of screens	
Pure Oxygen	X	X	X	64	96	128	# of units	
Final Sand Filters	64	64	64	64	96	192	# of units	
Probes/ Instrumentation/ Calibration	32	32	32	32	32	32	# of probes in-line	
TOTAL								

CHART 3 (One-Plus Shift)
LABORATORY OPERATIONS

	How often are tests run?				
Test Required by Permit	Testing Time (hrs.)	Tested Weekly X 52	Tested Monthly X 12	Tested Quarterly X 4	Annual Hours
Acidity	0.75				
Alkalinity, total	0.75				
Biochemical Oxygen Demand (BOD)	2.5				
Chemical Oxygen Demand (COD)	2.5				
Chloride	0.5				
Chlorine, Total Residual	0.25				
Coliform, Total, Fecal, E.Coli	1.0				
Dissolved Oxygen (DO)	0.25				
Hydrogen Ion (pH)	0.25				
Metals	3.0				
Toxicity	2.0				
Ammonia	2.0				
Total Nitrogen	2.0				
Oil and Grease	3.0				
Total and Dissolved Phosphorus	2.0				
Solids, Total, Dissolved, and Suspended	3.0				
Specific Conductance	0.25				
Sulfate	1.0				
Surfactants	1.0				
Temperature	0.25				
Total Organic Carbon (TOC)	0.25				
Turbidity	0.25				
Bacteriological Enterococci	1.0				
Lab QA/QC Program	1.0				
Process Control Testing	3.0				
Sampling for Contracted Lab Services	0.25				
Sampling for Monitoring Groundwater Wells	0.5				
TOTAL					

- Sampling time is built into testing time estimates.

CHART 4 (One-Plus Shift)
BIOSOLIDS/SLUDGE HANDLING

	Flow					
Process	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**
Belt Press	320	960	1920	2560	2560	2560/shift
Plate & Frame Press	320	480	960	2560	2560	2560
Gravity Thickening	80	80	160	160	320	320
Gravity Belt Thickening	80	80	160	160	320	640
Rotary Press	80	80	160	160	320	640
Dissolved Air Floatation	X	160	160	320	320	320
Alkaline Stabilization	80	80	80	80	80	80
Aerobic Digestion	160	160	160	320	480	640
Anaerobic Digestion	80	80	160	480	800	1280
Centrifuges	320	320	960	2560	2560	2560
Composting	320	640-960	1280	2560	2560	2560/shift
Incineration	X	X	X	X	7680	7680
Air Drying – Sand Beds	160	160	X	X	X	X
Land Application	80	160	160	X	X	X
Transported Off-Site for Disposal	80	320	1280	2560	2560	2560
Static Dewatering	320	320	X	X	X	X
TOTAL						

CHART 5 (One-Plus Shift)
YARDWORK

	Size of Plant			
Work Done	**Small**	**Average**	**Large**	**Total Hours for Plant**
Janitorial/Custodial Staff	100	200	400	
Snow Removal	60	120	400	
Mowing	100	120	400	
Vehicle Maintenance (per vehicle)	25	25	25	
Facility Painting	60	80	160	
Rust Removal	60	80	160	
TOTAL				

CHART 6 (One-Plus Shift)
AUTOMATION/SCADA

Type of Automation	Yes	No
Automated attendant or Interactive voice recognition (IVR) equipment		
Automated Meter Reading (AMR), Touchpad meters or other automated metering technology		
Automatic call director (ACD)		
Billing system		
Computerized facilities management (FM) system		
Computerized preventative maintenance		
Computerized recordkeeping		
E-mail		
Geographical information system (GIS)		
Integrated purchasing and inventory		
Internet website		
Laboratory information management system (LIMS)		
Local area network (LAN)		
Supervisory control and data acquisition (SCADA)		
Telemetry		
Utility customer information system (CIS) package		

CHART 7 (One-Plus Shift)
CONSIDERATIONS FOR ADDITIONAL PLANT STAFFING

• Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)	________
• Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows	________
• Plant operators responsible for snow plowing, road/sidewalk repair, or other municipal project	________
• Plant staff involved in generating additional energy	________
• Plant receives an extra high septage and/or grease load (higher than designed organic and grease loadings) or plant takes in sludge from other treatment plants	________
• Plant is producing a Class A Biosolid product	________
• Plant operators responsible for operating generators and emergency power	________
• Plant responsible for industrial pre-treatment program	________
• Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)	________
• Plant operators responsible for machining parts on-site	________
• Age of plant and equipment (over 15 years of age)	________

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THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS (One-Plus Shift)

Plant Name: ____________________

Design Flow:____________________ **Actual Flow:**____________________

FINAL ESTIMATES	
Chart #	**Annual Hours**
1 – Basic and Advanced Operations and Processes	
2 – Maintenance	
3 – Laboratory Operations	
4 – Biosolids/Sludge Handling	
5 – Yardwork	
Estimated Operation and Maintenance Hours	
Estimated Operation and Maintenance Staff	
Estimated Additional Staff from Chart 7	
Total Staffing Estimate	

• Divide the total of Annual Hours by 1500 hours per year to get the Estimated Operation and Maintenance Staff needed to operate the plant. This assumes 5-day work week; 29 days of vacation, sick leave, holidays; and 6.5 hours per day of productive work.

Note: The estimate from Charts 1-5 will not be the final amount of staff necessary to run the facility. Please review Chart 7 for additional staffing needs.

Chart 6 – Automation/SCADA (List all "yes" answers from Chart 6.)

Chart 7 – Considerations for Additional Plant Staffing (List all "yes" answers from Chart 7.)
Attach supporting information to justify additional staffing needs from Chart 7.

Chapter 8

Charts: 24/7 Plant

The charts on the following pages apply to publicly and privately owned wastewater treatment facilities where operators are present seven days a week, 24 hours a day. To arrive at the numbers on the charts, the daily hour estimates for a task were multiplied by 365 to determine annual hours.

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CHART 1 (24/7 Plant)
BASIC AND ADVANCED OPERATIONS AND PROCESSES

	Flow						
Process	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd	Total Hours for Plant
Preliminary Treatment	182.5	182.5	365	730	1095	1460	
Primary Clarification (mult. by # of units)	182.5	182.5	182.5	365	365	365	
Activated Sludge	730	1460	2190	2190-2920	2920-3650	8760	
Activated Sludge w/BNR	1095	2190	2920	3285-4380	4380-8760	10220	
Rotating Biological Contactor	365	547.5-1095	1095-2190	2190	X	X	
Sequencing Batch Reactor (per tank)	365	365	365	365	365	365	
Extended Aeration (w/o primary)	912.5	1825	2920	X	X	X	
Extended Aeration w/BNR	1277.5	2555	3650	X	X	X	
Pure Oxygen Facility	X	X	X	2920-3650	3650	6570	
Pure Oxygen Facility w/BNR	X	X	X	3650-5475	5475	8760	
Trickling Filter	365	365	730	1095	1460	2920	
Oxidation Ditch (w/o primary)	912.5	1825	2920	X	X	X	
Oxidation Ditch w/BNR	1277.5	2555	3650	X	X	X	
Aeration Lagoon	547.5	547.5	547.5	X	X	X	
Stabilization Pond	365	365	365	X	X	X	
Innovative Alternative Technologies	730	1095	X	X	X	X	
Nitrification	91.25	91.25	182.5	182.5	365	730	
Denitrification	91.25	91.25	182.5	182.5	365	730	
Phosphorus Removal (Biological)	91.25	91.25	182.5	182.5	365	730	

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CHART 1 (24/7 Plant) *continued*
BASIC AND ADVANCED OPERATIONS AND PROCESSES

	Flow						
Process	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd	Total Hours for Plant
Phosphorus Removal (Chemical/Physical)	91.25	182.5	365	730	1095	1460	
Membrane Processes	91.25	91.25	182.5	182.5	365	365	
Cloth Filtration	91.25	91.25	182.5	182.5	182.5	182.5	
Granular Media Filters (Carbon, sand, anthracite, garnet)	182.5	365	365	547.5	547.5	1095	
Water Reuse	91.25	91.25	182.5	182.5	182.5	182.5	
Plant Reuse Water	36.5	36.5	36.5	54.75	91.25	91.25	
Chlorination	182.5	182.5	365	365	365	365	
Dechlorination	182.5	182.5	365	365	365	365	
Ultraviolet Disinfection	182.5	182.5	365	365	365	365	
Wet Odor Control (mult. by # of systems)	182.5	182.5	365	365	365	365	
Dry Odor Control (mult. by # of systems)	91.25	91.25	182.5	182.5	182.5	182.5	
Septage Handling	182.5	182.5	365	365	365	365	
TOTAL							

- Activated Sludge process includes RAS and WAS pumping.
- Secondary Clarification has been built into basic operations processes.

CHART 2 (24/7 Plant)
MAINTENANCE

Activity	Flow						Multiply by	Total Hours for Plant
	0.25-0.5 mgd	0.5-1.0 mgd	1.0-5.0 mgd	5.0-10.0 mgd	10.0-20.0 mgd	>20 mgd		
Manually Cleaned Screens	91.25	91.25	91.25	91.25	182.5	365	# of screens	
Mechanically Cleaned Screens	91.25	91.25	91.25	365	1095	1460	# of screens	
Mechanically Cleaned Screens with grinders/ washer/compactors	91.25	182.5	365	730	1460	1825	# of screens	
Comminutors/ Macerators	91.25	91.25	91.25	182.5	273.75	365	# of units	
Aerated Grit Chambers	36.5	36.5	91.25	182.5	273.75	365	# of chambers	
Vortex Grit Removal	36.5	36.5	91.25	182.5	273.75	365	# of units	
Gravity Grit Removal	36.5	36.5	54.75	73	91.25	182.5	# of units	
Additional Process Tanks	36.5	36.5	36.5	36.5	36.5	36.5	# of tanks	
Chemical Addition (varying dependent upon degree of treatment)	36.5	36.5	36.5	36.5-109.5	109.5-219	292	# of chemicals added for processes	
Circular Clarifiers	91.25	91.25	182.5	182.5	273.75	365	# of clarifiers	
Chain and Flight Clarifiers	91.25	91.25	182.5	182.5	273.75	365	# of clarifiers	
Traveling Bridge Clarifiers	X	X	X	X	273.75	365	# of clarifiers	
Squircle Clarifiers	91.25	91.25	182.5	182.5	273.75	365	# of clarifiers	
Pumps	100	100	250	500	750	1500	X	
Rotating Biological Contactor	54.75	54.75	91.25	91.25	X	X	# of trains	
Trickling Filters	54.75	54.75	54.75	91.25	146	182.5	# of TFs	
Sequencing Batch Reactor	54.75	54.75	54.75	91.25	146	182.5	# of tanks	
Mechanical Mixers	36.5	36.5	36.5	36.5	54.75	73	# of mixers	
Aeration Blowers	73	73	73	73	109.5	146	# of blowers	
Membrane Bioreactor	36.5	36.5	36.5	73	109.5	146	# of cartridges	

Continued on page 50

CHART 2 (24/7 Plant) *continued*

MAINTENANCE

	Flow							
Activity	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**	**Multiply by**	**Total Hours for Plant**
Subsurface Disposal System	36.5	36.5	36.5	36.5	109.5	146	# of systems	
Groundwater Discharge	36.5	36.5	36.5	36.5	54.75	73	X	
Aerobic Digestion	36.5	36.5	36.5	36.5	54.75	73	# of digesters	
Anaerobic Digestion	X	73	73	109.5	219	365	# of digesters	
Gravity Thickening	36.5	36.5	36.5	36.5	109.5	146	# of basins	
Gravity Belt Thickening	54.75	54.75	54.75	91.25	146	182.5	# of belts	
Belt Press	54.75	54.75	54.75	91.25	146	182.5	# of presses	
Mechanical Dewatering (Plate Frame and Centrifuges)	54.75	54.75	54.75	91.25	146	182.5	# of units	
Dissolved Air Floatation	X	36.5	36.5	36.5	109.5	146	# of units	
Chlorination (gas)	36.5	36.5	36.5	73	109.5	146	X	
Chlorination (liq.)	73	73	73	109.5	164.25	219	X	
Dechlorination (gas)	36.5	36.5	36.5	73	109.5	146	X	
Dechlorination (liq.)	73	73	73	109.5	164.25	219	X	
Ultraviolet	36.5	36.5	36.5	54.75	91.25	109.5	# of racks	
Biofilter	182.5	182.5	182.5	182.5	182.5	182.5	# of units	
Activated Carbon	182.5	182.5	182.5	273.75	273.75	365	# of units	
Wet Scrubbers	X	X	X	54.75	91.25	109.5	# of units	
Microscreens	36.5	36.5	36.5	54.75	91.25	109.5	# of screens	
Pure Oxygen	X	X	X	73	109.5	146	# of units	
Final Sand Filters	73	73	73	73	109.5	219	# of units	
Probes/ Instrumentation/ Calibration	36.5	36.5	36.5	36.5	36.5	36.5	# of probes in-line	
TOTAL								

CHART 3 (24/7 Plant)
LABORATORY OPERATIONS

	How often are tests run?				
Test Required by Permit	Testing Time (hrs.)	Tested Weekly X 52	Tested Monthly X 12	Tested Quarterly X 4	Annual Hours
Acidity	0.75				
Alkalinity, total	0.75				
Biochemical Oxygen Demand (BOD)	2.5				
Chemical Oxygen Demand (COD)	2.5				
Chloride	0.5				
Chlorine, Total Residual	0.25				
Coliform, Total, Fecal, E.Coli	1.0				
Dissolved Oxygen (DO)	0.25				
Hydrogen Ion (pH)	0.25				
Metals	3.0				
Toxicity	2.0				
Ammonia	2.0				
Total Nitrogen	2.0				
Oil and Grease	3.0				
Total and Dissolved Phosphorus	2.0				
Solids, Total, Dissolved, and Suspended	3.0				
Specific Conductance	0.25				
Sulfate	1.0				
Surfactants	1.0				
Temperature	0.25				
Total Organic Carbon (TOC)	0.25				
Turbidity	0.25				
Bacteriological Enterococci	1.0				
Lab QA/QC Program	1.0				
Process Control Testing	3.0				
Sampling for Contracted Lab Services	0.25				
Sampling for Monitoring Groundwater Wells	0.5				
TOTAL					

CHART 4 (24/7 Plant)
BIOSOLIDS/SLUDGE HANDLING

	Flow					
Process	**0.25-0.5 mgd**	**0.5-1.0 mgd**	**1.0-5.0 mgd**	**5.0-10.0 mgd**	**10.0-20.0 mgd**	**>20 mgd**
Belt Press	365	1095	2190	2920	2920	2920/shift
Plate & Frame Press	365	547.5	1095	2920	2920	2920
Gravity Thickening	91.25	91.25	182.5	182.5	365	365
Gravity Belt Thickening	91.25	91.25	182.5	182.5	365	730
Rotary Press	91.25	91.25	182.5	182.5	365	730
Dissolved Air Floatation	X	182.5	182.5	365	365	365
Alkaline Stabilization	91.25	91.25	91.25	91.25	91.25	91.25
Aerobic Digestion	182.5	182.5	182.5	365	547.5	730
Anaerobic Digestion	91.25	91.25	182.5	547.5	912.5	1460
Centrifuges	365	365	1095	2920	2920	2920
Composting	365	730-1095	1460	2920	2920	2920/shift
Incineration	X	X	X	X	8760	8760
Air Drying – Sand Beds	182.5	182.5	X	X	X	X
Land Application	91.25	182.5	182.5	X	X	X
Transported Off-Site for Disposal	91.25	365	1460	2920	2920	2920
Static Dewatering	365	365	X	X	X	X
TOTAL						

CHART 5 (24/7 Plant)
YARDWORK

	Size of Plant			
Work Done	**Small**	**Average**	**Large**	**Total Hours for Plant**
Janitorial/Custodial Staff	100	200	400	
Snow Removal	60	120	400	
Mowing	100	120	400	
Vehicle Maintenance (per vehicle)	25	25	25	
Facility Painting	60	80	160	
Rust Removal	60	80	160	
TOTAL				

CHART 6 (24/7 Plant)
AUTOMATION/SCADA

Type of Automation	Yes	No
Automated attendant or Interactive voice recognition (IVR) equipment		
Automated Meter Reading (AMR), Touchpad meters or other automated metering technology		
Automatic call director (ACD)		
Billing system		
Computerized facilities management (FM) system		
Computerized preventative maintenance		
Computerized recordkeeping		
E-mail		
Geographical information system (GIS)		
Integrated purchasing and inventory		
Internet website		
Laboratory information management system (LIMS)		
Local area network (LAN)		
Supervisory control and data acquisition (SCADA)		
Telemetry		
Utility customer information system (CIS) package		

CHART 7 (24/7 Plant)
CONSIDERATIONS FOR ADDITIONAL PLANT STAFFING

• Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)	________
• Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows	________
• Plant operators responsible for snow plowing, road/sidewalk repair, or other municipal project	________
• Plant staff involved in generating additional energy	________
• Plant receives an extra high septage and/or grease load (higher than designed organic and grease loadings) or plant takes in sludge from other treatment plants	________
• Plant is producing a Class A Biosolid product	________
• Plant operators responsible for operating generators and emergency power	________
• Plant responsible for industrial pre-treatment program	________
• Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)	________
• Plant operators responsible for machining parts on-site	________
• Age of plant and equipment (over 15 years of age)	________

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THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS (24/7 Plant)

Plant Name: ____

Design Flow:______________________ **Actual Flow:**__________________________

FINAL ESTIMATES	
Chart #	**Annual Hours**
1 – Basic and Advanced Operations and Processes	
2 – Maintenance	
3 – Laboratory Operations	
4 – Biosolids/Sludge Handling	
5 – Yardwork	
Estimated Operation and Maintenance Hours	
Estimated Operation and Maintenance Staff	
Estimated Additional Staff from Chart 7	
Total Staffing Estimate	

• Divide the total of Annual Hours by 1500 hours per year to get the Estimated Operation and Maintenance Staff needed to operate the plant. This assumes 5-day work week; 29 days of vacation, sick leave, holidays; and 6.5 hours per day of productive work.

Note: The estimate from Charts 1-5 will not be the final amount of staff necessary to run the facility. Please review Chart 7 for additional staffing needs.

Chart 6 – Automation/SCADA (List all "yes" answers from Chart 6.)

Chart 7 – Considerations for Additional Plant Staffing (List all "yes" answers from Chart 7.)
Attach supporting information to justify additional staffing needs from Chart 7.

Appendix A
Automation and SCADA Options

Automation and SCADA have had a major impact on the wastewater industry, increasing efficiency and providing for a higher level of safety. They also have had an impact on staffing. A plant with a large amount of automation will need a highly skilled staff and most likely a person directly responsible for maintaining the system. A higher amount of automation may allow a plant to reduce staffing during evening and overnight shifts, with approval from the appropriate regulatory group.

There are many options available to wastewater treatment plants for automation, and a number of them are included in Chart 6 of this guide. An explanation of each item in the chart—and the benefits provided—appears below.

Automated attendant or interactive voice recognition (IVR) equipment – A phone technology that allows a computer to detect voice and touch tones during a normal phone call. An IVR system can respond with pre-recorded or dynamically generated audio to further direct callers on how to proceed. IVR systems can be used to control almost any function where the interface can be broken down into a series of simple menu choices. Once constructed, IVR systems generally scale well to handle large call volumes.

Automated meter reading (AMR), touchpad meters, or other automated metering technology – The technology of automatically collecting data from water or energy metering devices and transferring that data to a central database for analyzing and billing. This virtually eliminates the need for meter readers to visit premises, and allows for billing to be based on actual consumption rather than on estimates based on previous consumption. AMR technologies include handheld, mobile and network technologies based on telephony platforms (wired and wireless), radio frequency (RF), or power-line transmission.

Automatic call director (ACD) – A device or system that distributes incoming calls to a specific group of terminals that agents use. It is often part of a computer telephony integration (CTI) system.

Billing system – A computer program set up to handle bill printing, payment processing, accounting reports, and delinquent payments. The system can provide demand letters, shut-off notices, and mailing label printing.

Computerized facilities management (FM) system – A software package that maintains a computer database of information about a wastewater plant's maintenance operations. This information is intended to help maintenance workers do their jobs more effectively and to help management make informed decisions. For example, it can help workers determine which storerooms contain the spare parts they need, and help managers calculate the cost of maintenance for each piece of equipment used by a plant, possibly leading to better allocation of resources. These packages may be used by any organization that must perform maintenance on equipment and property.

Computerized maintenance management system (CMMS) – A computerized process that incorporates a work order system which allows operators to write work orders without the familiar paper trail. This system eliminates the problem of duplicate work orders, and facilitates accurate cost accounting by allowing for efficient recordkeeping of labor hours, parts, and other inventory items. Preventative maintenance management, such as deciding what equipment needs maintenance and how much the work will cost, is improved by using the computerized work order system.

Computerized preventative maintenance – A computerized process for keeping track of preventative maintenance inspections and jobs, including step-by-step instructions or check lists, lists of materials required, and other pertinent details. Typically, an FM program (see above) schedules preventative maintenance jobs automatically based on schedules or meter readings. Different software packages use different techniques for reporting when a job should be performed.

Computerized recordkeeping – The use of computer software to keep track of all plant records. Plants utilizing computerized recordkeeping must have someone available to do data-entry on a regularly scheduled basis.

E-mail – A method of composing, sending, receiving, and storing messages over electronic communication systems.

Geographical information system (GIS) – A computer program that combines mapping with detailed information about the physical locations of structures such as pipes, valves, and manholes. A GIS helps operators and maintenance personnel locate utility system features or structures, and assists with the scheduling and performance of maintenance activities.

Integrated purchasing and inventory – A software product that offers a complete inventory control and warehouse management system, and is considered very beneficial to asset management. It allows users to view inventory items and assets, and provides the ability to browse purchase orders, list outstanding purchase orders, and generate reports based on purchase orders.

Internet website – A collection of pages on the World Wide Web, accessible through the Internet, that represent the work of an individual, business, or organization. A wastewater treatment plant may have its own website as a convenient means of disseminating information to the public and providing answers to frequently asked questions. A site may be set up by the municipality or by the plant itself, and will require occasional maintenance and updating by a person knowledgeable of web design and programming.

Laboratory information management system (LIMS) – A computer software program used in the laboratory for the management of samples, laboratory users, instruments, standards, and other laboratory functions such as invoicing, plate management, and work flow automation.

Local area network (LAN) – A computer network covering a small geographic area, such as a home, office, or group of buildings. When compared to larger computer networks, the defining characteristics of LANs are their much higher data-transfer rates, smaller geographic range, and lack of a need for leased telecommunication lines.

Supervisory control and data acquisition (SCADA) – A computer-monitored alarm, response, control and data acquisition system used by operators to monitor and adjust wastewater treatment processes and facilities. A SCADA system also provides for remote monitoring of lift stations and other facilities, thereby reducing personnel needs while cost-effectively checking equipment, operations, and site security. Use of remote monitoring allows a plant to deploy personnel where they are most needed and to detect problems before they escalate into major costs.

Telemetry – The process of transmitting measured data by radio to a distant station.

Utility customer information system (CIS) package – A package developed by a municipality or plant to give to citizens that contains information on the plant's treatment processes, contact phone numbers, hours of operation, etc.

Appendix B

Considerations for Additional Plant Staffing

Chart 7 of this guide contains a list of considerations not included in Charts 1-6. Detailed descriptions of the entries requiring explanation are given here. While it is difficult to provide numerical estimates of staff hours for the work associated with the entries in the Chart 7 list, the impact on operator workload must be taken into consideration when coming up with the final staffing estimate.

- **Management responsibilities (i.e., human resources, budgeting, outreach, training, town/city meetings, scheduling, etc.) and responsibility for clerical duties (i.e., billing, reports, correspondence, phones, time sheets, mailings, etc.)**

  At many plants, the chief operator also performs a wide range of functions encompassing managerial, operational, and administrative tasks. Budgeting, recordkeeping, general clerical work, and public relations often fall under the chief operator's responsibilities. The amount of time a chief operator spends on this non-hands-on work must be taken into consideration when making staffing decisions, and these additional responsibilities should be reflected in a managerial and clerical diagram, which all plants should develop in conjunction with their major stockholders. Bear in mind there are situations where plant superintendents and chief operators are almost exclusively involved in managerial tasks, and therefore they should not be included in staffing estimates developed by the charts in this guide. There are also situations where plants have the opportunity to add staff specifically to handle clerical duties. In some cases, this can be accomplished by sharing clerical staff with other town departments.

- **Plant staff responsible for collection system operation and maintenance, pump station inspections, and/or combined sewer overflows**

  Operators at many plants visited in the pilot study conducted for this guide are also responsible for maintaining the associated collection system. This is an increase in workload, and depending upon the level of automation the increase can be significant. Many operators are also responsible for the inspection and maintenance of pump stations as well as home and business sewer connections. As with collection system O&M, these additional responsibilities increase an operator's workload, often substantially. The increase is even greater if a city or town has combined sewers and plant operators are responsible for addressing combined sewer overflows (CSOs); during storm events, it may even be necessary to add additional staff to cope with the challenges posed by CSOs.

- **Plant operators responsible for snow plowing, road/sidewalk repair, or other municipal projects**

  During the pilot study, it was observed that at some plants, staff are responsible for municipal tasks entirely unrelated to wastewater treatment. These include operating their community's drinking water plant; plowing snow; assisting with composting and recycling; working at landfills and cemeteries; repairing roads and sidewalks; and doing mark-outs for Dig Safe. All these additional responsibilities put extra demands on operators, and therefore should be factored into staffing decisions.

- **Plant staff involved in generating additional energy**

  For plants using complex methods for co-generation of energy, additional staff are generally needed due to the intricate processes.

- **Plant receives an extra high septage and/or grease load (higher than designed organic and grease loadings) or plant takes in sludge from other treatment plants**

  An evaluation of available plant operator staff and the staffing necessary to meet these needs must be conducted. Plant staff should be present when septage is received and unloaded. The added laboratory work associated with receiving septage for treatment should be included in the staffing and laboratory facilities evaluation.

- **Plant is producing a Class A Biosolid product**

  Biosolids are residual solids resulting from wastewater treatment, which have been carefully treated and tested. They contain organic matter as well as plant nutrients, such as nitrogen and phosphorus, and make a good soil amendment. The quality of biosolids must be carefully managed to minimize the presence of trace toxic materials and disease-causing organisms. Producing a Class A Biosolid product is a complex process, and a plant doing so can expect to see a large increase in operations and maintenance time.

- **Plant operators responsible for operating generators and emergency power**

  These tasks can be outsourced but at plants that operate and test their generators, the impact on staff time needs to be considered.

- **Plant responsible for industrial pre-treatment program**

  In areas that have a large amount of industry discharges, a person at the receiving plant must be responsible for the industrial pre-treatment program. The amount of time this will take is directly related to the amount of industry discharges to the plant.

- **Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)**

  Many plants have staffs that are responsible for major projects that are done at the facility. Some are also responsible for assisting in town/city projects. Whether these responsibilities will be given to the plant will depend on the municipality’s set-up and the knowledge of the wastewater plant staff.

- **Plant operators responsible for machining parts on-site**

  For many larger plants it is more economical to have machinists on-site to machine parts than to purchase parts each time something is needed.

- **Age of plant and equipment**

  When a plant and its equipment are 15 years old or more, maintenance issues will become more prominent and will need to be addressed more often. Consequently, there will be an increase in maintenance labor hours.

Appendix C
Tools to Assist Staff

Having the appropriate number of staff at a wastewater treatment plant is critical, but it is only one factor in ensuring that a plant is run efficiently, effectively, and safely. The staff must also be well managed and well trained, and they should have access to tools that can assist them in their jobs. Two such tools are described below.

Operations and Maintenance (O&M) Manuals

Operation and maintenance manuals provide information and guidance for day-to-day operation of a wastewater treatment plant. It is important to check state regulations for specific O&M manual requirements and approval procedures. However, the New Hampshire Department of Environmental Services' publication, *Code of Administrative Rules* (1999) states that an O&M manual should include, at a minimum, the following:

- Information on process design assumptions
- Unit process information that includes control measures and monitoring procedures for the various processes
- Start-up procedures for each unit operation and piece of equipment
- Maintenance management systems
- Laboratory test procedures
- Safety procedures
- Organizational structure and administrative procedures
- Troubleshooting procedures
- Emergency response and operation plan
- Staffing requirements
- Process and instrumentation diagrams
- Checklists for systems and components for the operator's use in developing a maintenance program for pump stations and wastewater treatment plants

It is important that O&M manuals remain up-to-date and accessible to employees. Changes to an O&M manual should only be done by one authorized person on a set schedule. This prevents the problem of a plant possessing multiple versions of the same document, each with different information and practices.

Many treatment plants are now going to interactive computerized O&M manuals for ease of use and the ability to quickly search through multiple manuals at one time. During the conversion of manuals from their original printed form to digital, computerized versions, plants typically also convert all plant drawings, records, and specifications, thereby making them also accessible in one searchable area.

Standard Operating Procedures (SOPs)

A standard operating procedure is a set of written instructions that document a routine or repetitive activity that is done at a wastewater treatment plant. SOPs are not photocopies of test methods or equipment manuals. Instead they provide very specific directions on how personnel should perform certain tasks. An SOP is a "how-we-do-it" document, which incorporates laboratory set-up, plant layout, equipment and chemicals, and any special conditions that need to be noted.

The development and use of SOPs is an integral part of a successful quality system since they provide staff with the information to perform a job properly and facilitate consistency in the quality and integrity of a product or end-result. They may describe, for example, fundamental programmatic actions and technical actions such as analytical processes, and processes for maintaining, calibrating, and using equipment. SOPs are intended to be specific to each individual wastewater treatment plant, and if properly done, will allow the plant to maintain its quality control and quality assurance processes, and ensure compliance with governmental regulations and permits.

SOPs should be written in a concise, step-by-step, easy-to-read format. If not written correctly, they are of limited value. Of course, even the best written SOPs will fail if they are not followed. Therefore, the use of SOPs needs to be reviewed and reinforced by management. Copies of SOPs need to be readily accessible for reference in the work areas of staff actually performing the activity, either in hard copy or electronic format. And they need to remain current to be useful. Whenever procedures are changed, SOPs should be updated and re-approved. Also SOPs should be systematically reviewed on a periodic basis, e.g., every 1-2 years, to ensure that the policies and procedures remain current and appropriate.

Valid SOPs help minimize variation and promote quality through consistent implementation of a process or procedure within a plant, even when there are personnel changes. SOPs can indicate compliance with organizational and governmental requirements and can be used as a part of a personnel training program, since they provide detailed work instructions. They minimize opportunities for miscommunication and can address safety concerns. When historical data are being evaluated for current use, SOPs can also be valuable for reconstructing project activities when no other references are available. In addition, SOPs are frequently used as checklists by inspectors when auditing procedures. Ultimately, the benefits of a valid SOP are reduced work effort, along with improved comparability, credibility, and legal defensibility.

It should be noted that the term "SOP" may not always be appropriate for any one specific document, and other terms, such as protocols, instructions, worksheets, and laboratory operating procedures, may also be used. Also, please note that the recommendations here for SOPs are very general. Always check state and local regulations for additional SOP requirements that must be met. Also, be aware that a national laboratory accreditation program is being adopted by many states, which may impact the contents of an SOP.

For more specific directions on how to write an SOP, consult the various resources on the subject, such as U.S. EPA's *Guidance for Preparing Standard Operating Procedures (SOPs)* (March, 2001).

APPENDIX D
GLOSSARY OF TERMS

A

Acidity – The capacity of water or wastewater to neutralize bases. Acidity is expressed in milligrams per liter of equivalent calcium carbonate. Acidity is not the same as pH because water does not have to be strongly acidic (low pH) to have a high acidity. Acidity is a measure of how much base must be added to a liquid to raise the pH to 8.2.

Activated carbon – A highly adsorbent form of carbon used to remove dissolved organic matter from water and wastewater or to remove odors and toxic substances from gaseous emissions.

Activated sludge – A biological wastewater treatment process that speeds up the decomposition of wastes in the wastewater being treated. Activated sludge is added to the wastewater and the mixture (mixed liquor) is aerated and agitated. After some time in the aeration tank, the activated sludge is allowed to settle out by sedimentation and is disposed of (wasted) or reused (returned to the aeration tank) as needed. The remaining wastewater then undergoes more treatment.

Activated sludge w/BNR – Biological nutrient removal is the removal of nitrogen and phosphorus by biological reactions instead of chemical processes. Biological nitrogen removal is done in two steps. In the first step ammonia is oxidized to nitrate (nitrification) and various process configurations are then employed to provide the nitrate as an electron acceptor for biological respiration so that it can be reduced to molecular nitrogen (denitrification). The removal of phosphorus by BNR requires the organisms to pass through an anaerobic stage in the absence of both nitrates and dissolved oxygen.

Additional process tanks – Storage tanks for wastewater or septage. An alarm on a tank signals when the tank is full and the contents need to be pumped and properly disposed. Examples of such tanks include equalization tanks, storage tanks, hauling tanks and sludge holding tanks.

Aerated grit chamber – A chamber that offers a mechanical way to remove grit from a wastewater stream by introducing air near the bottom of the chamber creating a toroidal flow pattern. This flow pattern causes the grit to settle to the bottom of the chamber while keeping lighter organic material in suspension to be processed further downstream.

Aeration blower – The process of adding air to wastewater to keep it fresh and to keep solids in suspension is done by blowers, typically rotary positive displacement blowers and multi-stage centrifugal blowers. When dealing with mixtures of wastewater and activated sludge, adding air provides mixing and oxygen for the microorganisms treating the wastewater.

Aeration lagoon – A holding or treatment pond provided with artificial aeration to promote the biological oxidation of wastewater.

Aerobic digestion – The breakdown of wastes by microorganisms in the presence of dissolved oxygen. This digestion process may be used to treat only waste activated sludge, trickling filter sludge and primary (raw) sludge, or waste sludge from activated sludge treatment plants designed without primary settling. The treated sludge is placed in a large aerated tank where aerobic microorganisms decompose the organic matter. This is an extension of the activated sludge process.

Air drying (sand beds) – A partitioned area consisting of sand or other porous material on which sludge is dewatered by drainage and evaporation.

Alkaline stabilization – Adding an alkaline material to waste to create beneficial by-products. The alkaline stabilization process is used to treat biosolids prior to beneficial re-use.

Alkalinity – The capacity of wastewater to neutralize acids. Alkalinity is expressed in milligrams per liter of equivalent calcium carbonate. Alkalinity is not the same as pH because water does not have to strongly basic (high pH) to have a high alkalinity. Alkalinity is a measure of how much acid must be added to a liquid to lower the pH to 4.5.

Ammonia – A compound of hydrogen and nitrogen that occurs extensively in nature.

Anaerobic digestion – The solids and water in wastewater (about 5 percent solids, 95 percent water) are placed in a large tank where bacteria decompose the solids in the absence of dissolved oxygen. At least two general groups of bacteria act in balance: (1) saprophytic bacteria break down complex solids to volatile acids, the most common of which are acetic and propionic acids; and (2) methane fermenters break down the acids to methane, carbon dioxide, and water.

Automated attendant or interactive voice recognition (IVR) equipment – A phone technology that allows a computer to detect voice and touch tones during a normal phone call. Once constructed, IVR systems generally scale well to handle large call volumes.

Automated meter reading (AMR), touchpad meters, or other automated metering technology – The technology of automatically collecting data from water or energy metering devices and transferring that data to a central database for analyzing and billing.

Automatic call director (ACD) – A device or system that distributes incoming calls to a specific group of terminals that agents use. It is often part of a computer telephony integration (CTI) system.

B

Bacteriological enterococci – Indicator bacteria used to determine the presence of fecal contamination.

Belt filter press – A dewatering device that uses two fabric belts revolving over a series of rollers to squeeze water from the sludge.

Billing system – A computer program set up to handle bill printing, payment processing, accounting reports, and delinquent payments. The system can provide demand letters, shut-off notices, and mailing label printing.

Biochemical oxygen demand (BOD) – The rate at which organisms use the oxygen in water or wastewater while stabilizing decomposable organic matter under aerobic conditions. In decomposition, organic matter serves as food for the bacteria and energy results from its oxidation. BOD measurements are used as a measure of organic strength of wastes in water.

Biofilter – Odorous air is blown through organic media, e.g., wood chips, or inorganic media, e.g., plastics. Odors are eliminated through a natural biological oxidation process.

C

Centrifuge – A mechanical device that uses centrifugal or rotational forces to separate solids from liquids.

Chain and flight clarifier – A sludge collection mechanism used in rectangular sedimentation basins or clarifiers.

Chemical addition – Any water or wastewater treatment process involving the addition of chemicals to obtain a desired result, such as precipitation, coagulation, flocculation, sludge conditioning, or disinfection.

Chemical oxygen demand (COD) – A measure of the oxygen-consuming capacity of organic matter present in wastewater. COD is expressed as the amount of oxygen consumed from a chemical oxidant in mg/l during a specific test. Results are not necessarily related to the biochemical oxygen demand (BOD) because the chemical oxidant may react with substances that bacteria do not stabilize.

Chloride – The chloride ion is formed when the element chlorine picks up one electron to form an anion (negatively-charged ion). It can also refer to a chemical compound in which one or more chlorine atoms are covalently bonded in the molecule.

Chlorination – The application of chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

Chlorination (gas) – Chlorination done by using a gaseous form of chlorine.

Chlorination (liq.) – Chlorination done by adding liquid chlorine.

Chlorine, total residual – The concentration of chlorine present in water after the chlorine demand has been satisfied. The concentration is expressed in terms of the total chlorine residual, which includes both the free and combined or chemically bound chlorine residuals.

Circular clarifier – A circular tank used as a settling tank or sedimentation basin in which wastewater is held for a period of time during which the heavier solids settle to the bottom and the lighter materials float to the water surface.

Clarifier – A quiescent tank used to remove suspended solids by gravity settling.

Cloth filtration – An alternative to conventional granular media filtration technologies. Wastewater enters the tank or basin, completely submerging the cloth media. By gravity, liquid passes through the cloth media. Heavier solids are allowed to settle to the bottom portion of the filter tank. These solids are then pumped on an intermittent basis back to the headworks, digester, or other solids collection area of the treatment plant.

Coliform, total, fecal, E.Coli – One type of bacteria. The presence of coliform-group bacteria is an indication of possible pathogenic bacterial contamination. The human intestinal tract is one of the main habitats of coliform bacteria. They may also be found in the intestinal tracts of warm-blooded animals, and in plants, soil, air, and the aquatic environment. Fecal coliforms are those coliforms found in feces of various warm-blooded animals, whereas the term "coliform" also includes other environmental sources.

Comminutor – A device used to reduce the size of the solid chunks in wastewater by shredding (comminuting). The shredding action can be likened to many pairs of scissors cutting or chopping to shreds all the large solids materials in wastewater.

Composting – Stabilization process relying on the aerobic decomposition of organic matter in sludge by bacteria and fungi.

Computerized facilities management (FM) system – A software package that maintains a computer database of information about a wastewater plant's maintenance operations.

Computerized preventative maintenance – A computerized process for keeping track of preventative maintenance inspections and jobs, including step-by-step instructions or check lists, lists of materials required, and other pertinent details.

Computerized recordkeeping – The use of computer software to keep track of all plant records. Plants utilizing computerized recordkeeping must have someone available to do data-entry on a regularly scheduled basis.

D

Dechlorination – The removal of chlorine from the effluent of a treatment plant. Chlorine needs to be removed because it is toxic to fish and other aquatic life.

Dechlorination (gas) – Dechlorination done by gas.

Dechlorination (liq.) – Dechlorination done by liquid.

Denitrification – (1) The anoxic biological reduction of nitrate nitrogen to nitrogen gas. (2) The removal of some nitrogen from a system. (3) An anoxic process that occurs when nitrite or nitrate ions are reduced to nitrogen gas and nitrogen bubbles are formed as a result of this process. The bubbles attach to the biological floc in the activated sludge process and float the floc to the surface of the secondary clarifiers. This condition is often the cause of rising sludge observed in secondary clarifiers and gravity thickeners.

Dissolved air floatation – The clarification of flocculated material by contact with minute bubbles causing the air/floc mass to be buoyed to the surface, leaving behind a clarified water.

Dissolved oxygen (DO) – Molecular atmospheric oxygen dissolved in water or wastewater.

E

E-mail – A method of composing, sending, receiving, and storing messages over electronic communication systems.

Extended aeration (w/o primary) – A variation of the activated sludge process with an increased detention time to allow endogenous respiration to occur.

Extended aeration w/BNR – Biological nutrient removal is the removal of nitrogen and phosphorus by biological reactions instead of chemical processes. Biological nitrogen removal is done in two steps. In the first step, ammonia is oxidized to nitrate (nitrification) and various process configurations are then employed to provide the nitrate as an electron acceptor for biological respiration so that it can be reduced to molecular nitrogen (denitrification). The removal of phosphorus by BNR requires the organisms to pass through an anaerobic stage in the absence of both nitrates and dissolved oxygen.

F

Facility painting – The physical act of painting a wastewater treatment plant. This can be done for walls, railings, floors, etc. Painting gives the plant a more hygienic feel.

Final sand filter – Rectangular or cylindrical in cross section, typically 1 to 2 meters deep of sand, and used in treating wastewater to produce a potable product. Sand filters use biological processes to clean the water, and are nonpressurized systems. In the base of each bed is a series of herringbone drains that are covered with a layer of pebbles which in turn is covered with coarse gravel. Further layers of sand are placed on top followed by a thick layer of fine sand. The whole depth of filter material may be more than 1 meter in depth, the majority of which will be fine sand material. On top of the sand bed sits a supernatant layer of raw, unfiltered water.

G

Geographical information system (GIS) – A computer program that combines mapping with detailed information about the physical locations of structures such as pipes, valves, and manholes.

Granular media filter (carbon, sand, anthracite, garnet) – A tank or vessel filled with sand or other granular media to remove suspended solids and colloids from water or wastewater that flows through it.

Gravity belt thickening – A sludge dewatering device that uses a porous filter belt to promote gravity drainage of water.

Gravity grit removal – A preliminary wastewater treatment process to remove sand, gravel, cinders, and other heavy solid matter that have settling velocities substantially higher than those of organic putrescible solids in wastewater by sedimentation.

Gravity thickening – A process that uses a sedimentation basin designed to operate at high solids rates, usually with vertical pickets mounted to the revolving sludge scrapers to assist in releasing entrained water.

Groundwater discharge – The discharge of wastewater into the ground, as opposed to a surface waterway. It usually requires a state permit depending on flow and state.

H

Hydrogen ion (pH) – The weight of hydrogen ions in moles per liter of solution.

I

Incineration – The conversion of dewatered wastewater solids by combustion (burning) to ash, carbon dioxide, and water vapor.

Innovative alternative technologies – Onsite treatment systems that are not based on a conventional septic tank and leach field design. Alternative systems are used to accommodate a variety of site conditions (e.g., high ground water, soil with low permeability) or to provide additional treatment.

Integrated purchasing and inventory – A software product that offers a complete inventory control and warehouse management system, and is considered very beneficial to asset management.

Internet website – A collection of pages on the World Wide Web, accessible through the Internet, that represent the work of an individual, business, or organization. A wastewater treatment plant may have its own website as a convenient means of disseminating information to the public and providing answers to frequently asked questions. A site may be set up by the municipality or by the plant itself, and will require occasional maintenance and updating by a person knowledgeable of web design and programming.

J

Janitorial/custodial staff – Individuals responsible for maintaining the building, removing trash, sweeping, mopping, and general upkeep of the building.

L

Lab Quality Assurance/Quality Control (QA/QC) – Refers to the protocol that ensures all lab measurements are accurate and reproducible, and that all tests have been run according to proper procedures. Every lab should have a detailed, documented QA/QC program in place. Without one, there is no documentation to prove that the data gathered are usable.

Laboratory information management system (LIMS) – A computer software program used in the laboratory for the management of samples, laboratory users, instruments, standards, and other laboratory functions such as invoicing, plate management, and work flow automation.

Land application – The disposal of wastewater or municipal solids onto land under controlled conditions.

Local area network (LAN) – A computer network covering a small geographic area, such as a home, office, or group of buildings. When compared to larger computer networks, the defining characteristics of LANs are their much higher data-transfer rates, smaller geographic range, and lack of a need for leased telecommunication lines.

M

Macerators – A device used to reduce the size of solid chunks in wastewater by chopping or tearing. The tearing action can be likened to many pairs of scissors cutting or chopping to shreds all the large solids materials in wastewater.

Manually cleaned screens – A treatment process using a device with uniform openings to retain coarse solids. Maintenance is done by hand and rake.

Mechanical dewatering – see definitions at "Plate and frame press" and "Centrifuges."

Mechanical mixers – The use of machinery to mix air and water so oxygen can be absorbed into the water.

Mechanically cleaned screens – A treatment process using a device with uniform openings to retain coarse solids combined with a device that cleans the rack and distributes waste in a specified area.

Mechanically cleaned screens with grinders/washer/compactor – A treatment process using a device with uniform openings to retain coarse solids combined with a device that grinds and compacts solids and then cleans the bars by washing them down.

Membrane bioreactor – A surface filtration process that has the ability to produce product water with virtually no suspended solids and can remove microorganisms including viruses. The two main types of MBRs are hollow fiber and flat plate.

Membrane processes – Systems that utilize membranes to remove pollutants from wastewater.

Metals – In general, those elements that easily lose electrons to form positive ions.

Microscreen – A device with a fabric-straining media with openings between 20 and 60 microns. The fabric is wrapped around the outside of a rotating drum. Wastewater enters the open end of the drum and flows out through the rotating screen cloth. At the highest point of the drum, the collected solids are backwashed by high-pressure water jets into a trough located within the drum.

Mowing – Encompasses the cutting of grass and routine yardwork at a wastewater treatment plant, which is typically performed by plant staff.

N

Nitrification – An aerobic process in which bacteria change the ammonia and organic nitrogen in wastewater into oxidized nitrogen (usually nitrate).

O

Odor control – Systems or chemicals used to reduce the odor dispersed to the areas surrounding a wastewater treatment plant.

Oil and grease – Common term used to include fats, oils, waxes, and related constituents found in wastewater.

Oxidation ditch (w/o primary) – An extended aeration waste treatment process that occurs in an oval-shaped channel or ditch (also called a "race-track"), with aeration provided by a mechanical brush aerator.

Oxidation ditch w/BNR – Biological nutrient removal is the removal of nitrogen and phosphorus by biological reactions instead of chemical processes. Biological nitrogen removal is done in two steps. In the first step, ammonia is oxidized to nitrate (nitrification) and various process configurations are then employed to provide the nitrate as an electron acceptor for biological respiration so that it can be reduced to molecular nitrogen (denitrification). The removal of phosphorus by BNR requires the organisms to pass through an anaerobic stage in the absence of both nitrates and dissolved oxygen.

P

Phosphorus removal (Chemical/Physical) – The removal of phosphorus using treatment processes that are nonbiological in nature.

Phosphorus removal (Biological) – The removal of phosphorus by BNR requires the organisms to pass through an anaerobic stage in the absence of both nitrates and dissolved oxygen.

Plant reuse water – Using treated effluent for toilet flushing, cooling tanks, irrigation, and nonpotable purposes at a treatment plant.

Plate and frame press – A batch process dewatering device in which sludge is pumped through a series of parallel plates fitted with filter cloth.

Preliminary treatment – The removal of metal, rocks, rags, sand, egg shells, and similar materials that may hinder the operation of a treatment plant. Preliminary treatment is accomplished by using equipment such as racks, bar screens, comminutors, and grit removal systems.

Primary clarification – A sedimentation basin that precedes secondary wastewater treatment.

Primary treatment unit – A wastewater treatment process that takes place in a rectangular or circular tank and allows those substances in wastewater that readily settle or float to be separated from the water being treated.

Probes, instrumentation, calibration – The process of establishing the relationship between a measuring device and the units of measure. This is done by comparing a device or the output of an instrument to a standard with known measurement characteristics.

Process control testing – Wastewater treatment plants are unstable systems that require monitoring and adjustments. By sampling wastewater at various points during treatment and running basic lab tests, it can be verified quickly that the correct treatment steps are being made.

Pump estimates – Estimated time required to maintain all pumps at a plant for a year.

Pure oxygen facility – Variation of the activated sludge process using pure molecular oxygen for microbial respiration rather than atmospheric oxygen.

Pure oxygen facility w/BNR – Biological nutrient removal is the removal of nitrogen and phosphorus by biological reactions instead of chemical processes. Biological nitrogen removal is done in two steps. In the first step ammonia is oxidized to nitrate (nitrification) and various process configurations are then employed to provide the nitrate as an electron acceptor for biological respiration so that it can be reduced to molecular nitrogen (denitrification). The removal of phosphorus by BNR requires the organisms to pass through an anaerobic stage in the absence of both nitrates and dissolved oxygen.

R

Rotary press – Sludge is fed into a rectangular channel, and rotated between two parallel revolving stainless steel chrome plated screens. The filtrate passes through the screens as the flocculated sludge advances within the channel. The sludge continues to dewater as it travels around the channel, eventually forming a cake near the outlet side of the press. The frictional force of the slow-moving screens, coupled with the controlled outlet restriction, results in the extrusion of a very dry cake.

Rotating biological contactor (RBC) – A secondary biological treatment process for domestic and biodegradable industrial wastes. Biological contactors have a rotating "shaft" surrounded by plastic discs called the "media." The shaft and media are called the "drum." A biological slime grows on the media when conditions are suitable and the microorganisms that make up the slime (biomass) stabilize the waste products by using the organic material for growth and reproduction.

Rust removal – The removal of rust from tanks, walls, etc. (typically a responsibility of plant staff).

S

Sampling for contracted lab services – At plants where lab work is done by a contracted agency, operators are required to collect samples for testing.

Septage handling – The process whereby a wastewater treatment plants takes in septage from outside sources, i.e., septic tanks, campgrounds, other wastewater plants, etc.

Sequencing batch reactor – A variation of the activated sludge process where all the treatment steps and processes are combined into a single basin or tank. The operation of an SBR is based on a fill-and-draw principle, which consists of five steps —fill, react, settle, decant, and idle. These steps can be altered for different operational applications.

Snow removal – The removal of snow at a wastewater treatment plant (typically a responsibility of plant staff).

Solids: total, dissolved, and suspended – Total solids are the sum of dissolved solids and suspended solids in a water or wastewater (matter remaining as residue on evaporation at 103 to 105 degrees Celsius) sample. Total suspended solids are the measure of the amount of suspended solids found in a sample of wastewater effluent. After filtering a sample of a known volume, the filter is dried and weighed to determine the residue retained. Total dissolved solids are the sum of all volatile and nonvolatile solids dissolved in a water or wastewater.

Specific conductance – Rapid method of estimating the dissolved solid content of a water supply by testing its capacity to carry an electrical current.

Squircle clarifiers – Square clarifiers with a circular tank inside.

Stabilization pond – A lagoon that is sufficiently deep (i.e., 5 to 6 feet) where organic solids settle to the bottom as sludge and decay anaerobically; a liquid layer forms above the sludge where facultative and aerobic bacteria oxidize the incoming organics and products of anaerobic sludge decomposition.

Static dewatering – Simple process where a polymer is added to the sludge and pumped into a container (typically made of steel). The polymer helps to separate the liquid from the solids. The solids are held in the container by a filter screen while the free water drains out of the container by gravity. Once the container is full, a truck can haul the sludge cake away.

Subsurface disposal system – A subsurface land area with relatively permeable soil designed to receive pretreated wastewater from a septic tank or intermediate treatment unit, e.g., sand filter. The soil further treats the wastewater by filtration, sorption, and microbiological degradation before the water is discharged to groundwater. A typical soil absorption system consists of perforated piping and gravel in a field or trench, although gravel-less systems can also be used. Soil absorption systems are normally placed at relatively shallow depths, i.e., less than two feet. Excellent TSS, BOD, phosphorus, and pathogen removal is provided in the unsaturated soil that surrounds the infiltrative surfaces. Subsurface disposal systems are also known as soil absorption systems (SAS).

Sulfate – The sulfate ion is a polyatomic anion that consists of a central sulfur atom surrounded by four equivalent oxygen atoms in a tetrahedral arrangement.

Supervisory control and data acquisition (SCADA) – A computer-monitored alarm, response, control and data acquisition system used by operators to monitor and adjust a wastewater treatment plant's processes and facilities.

Surfactant – The active agent in detergents that possesses a high cleaning ability.

T

Telemetry – The process of transmitting measured data by radio to a distant station.

Temperature – A measure of the kinetic energy of a sample of matter. In this case, the matter is wastewater, and the temperature is measured in degrees Fahrenheit and degrees Celsius.

Total and dissolved phosphorus – The total phosphorous content of all material that will pass through a filter, which is determined as orthophosphate without prior digestion or hydrolysis.

Total nitrogen – The combination of organically bound nitrogen and ammonia in wastewater.

Total organic carbon (TOC) – The amount of carbon bound in an organic compound and often used as a non-specific indicator of water quality.

Toxicity – The relative degree of being toxic or poisonous. When present in wastes, toxicity will inhibit or destroy the growth or function of certain organisms.

Transported off-site for disposal – At wastewater treatment plants that do not handle sludge onsite, plant staff are responsible for transporting it to a disposal area.

Traveling bridge clarifier – A traveling bridge sludge collector is a machine mobilized by a high-torque, slow-speed drive system that is used mainly in rectangular basins.

Trickling filter – A treatment process in which wastewater trickles over media (rocks or other durable material) that provide the opportunity for the formation of slimes or biomass which contain organisms that feed upon and remove wastes from the water being treated.

Turbidity – A measure of the cloudiness of water.

U

Ultraviolet disinfection – In this process, high intensity lamps that emit ultraviolet light are submerged in wastewater or the lamps may surround tubes that carry wastewater. Disinfection occurs when the ultraviolet light damages the genetic material of the bacterial or viral cell walls so that replication can no longer occur. Care must be taken to keep the surface of the lamps clean because surface deposits can shield the bacteria from the radiation, thus reducing the performance of the system.

Utility customer information system (CIS) package – A package developed by a municipality or plant to give to citizens that contains information on the plant's treatment processes, contact phone numbers, hours of operation, etc.

V

Vehicle maintenance – The maintenance of vehicles at a wastewater treatment plant, i.e., washing, tire rotation, oil and grease, minor repairs, etc.

Vortex grit removal – A grit removal system that relies on a mechanically induced vortex to capture grit solids in the center hopper of a circular tank.

W

Water reuse – The restoration of wastewater to a state that will allow its beneficial reuse for some agricultural, industrial or municipal applications. This reuse occurs outside of the treatment plant.

Wet scrubbers – An air pollution control device used to remove particulates and fumes from air by entraining the pollutants in a water spray.

References

A literature review was conducted to obtain information on wastewater treatment plant staffing and operation and maintenance of wastewater treatment plants. Wherever practical, information was taken directly from the literature compiled under the review. Reference information is provided to allow users of this guidance document to obtain the source documentation in order to find additional and more detailed information.

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Please provide us feedback on this document. Submissions can be sent electronically, mailed, or faxed to:

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ATTN: Estimating Staffing Guide
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Tel: 978/323-7929
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mail@neiwpcc.org

Has this guide been useful in estimating staffing at your plant? Does it agree with your staffing needs?

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Brief description of error or omission:

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Suggested improvement:

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General comments:

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Can we contact you for additional information? If so please provide contact information:

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Please visit our NEIWPCC Technical Guides web page at *www.neiwpcc.org/technicalguides.asp* for the latest version and updates of *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants.*

Thank You.

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Using The Interactive Excel Application

The Advisory Committee for this project thought it would be beneficial to also offer *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants* on CD. Available here is the complete guide in Adobe Portable Document Format (PDF) as well as the charts in an interactive Excel format. This alternate version of the charts is user-friendly and eliminates the need for the user to make any mathematical calculations. Below are directions on getting started using the interactive staffing charts.

PC USERS:

Step 1 – Insert the CD in your computer's CD drive.

Step 2 – If the CD does not begin automatically:

- a. At your desktop, double-click on the "My Computer" icon.
- b. Double-click on the icon for your CD drive.
- c. Double-click on the file called "NEIWPCC Staffing Charts."

Step 3 – Depending on your version of Excel you must enable Macros by:

- a. Microsoft Office 2000-2007, click on the Tools Menu:
  - a. Go to Macros
  - b. Go to Security
    - i. Then click on Medium.
- b. Microsoft Office 2007 or newer:
  - a. Click on the pop up menu above the charts titled "Options"
    - i. Check the box enabling all Macros.

Step 4 – You are now able to start using the Interactive Staffing Charts. Click on the Instructions box to begin.

Note: When you click on "NEIWPCC Staffing Charts" this will open a new file each time, so that the original information will never be saved over. It is recommended when starting a new staffing report to go to "Save as" and rename your file. When using Microsoft Office 2007 or newer, save your workbook as an Excel Macro-Enabled workbook. When saving with an older version of Microsoft Office, save your workbook as a Microsoft Excel workbook (*.xls).

MAC USERS:

Due to the file containing Visual Basic macros, we regret that this file will not run properly on Mac computers. Please refer to the charts on page 21 for One Shift plants, page 33 for One-Plus Shift plants, or page 45 for 24/7 plants.