



Water Quality

Wastewater
Technical
Review and
Guidance

Wastewater Treatment Facility Operation and Maintenance (OM) Manual Guidelines

Water/Wastewater/#7.00, February 2000

Facility Name

Date

Consulting Engineer

I. Introduction

The operation and maintenance (OM) manual is a very valuable tool in the operation and maintenance of every wastewater treatment facility. The OM manual serves two main functions; first, as a text to be used during start-up training by the consultant and second, to provide assistance to the operating staff in continuing standard operating and maintenance procedures after start-up.

Past studies have shown OM manuals often to be inadequate for operating personnel, a common problem being practicality and overall approach. If these manuals are to benefit treatment facility operation, they **must be oriented toward the treatment plant operators**. The OM manual must be written for the entire operating staff and contain information pertinent to the day-to-day operation of the treatment facilities.

II. Definitions/Requirements

A) OM Manual Definitions - The OM manual is referred to as either the "final" OM manual or the "revised final" OM manual.

The **final OM manual** is given to the project owner prior to the actual start-up of their facility. The **revised final** OM manual is the final OM manual after it has been revised as a result of the first year of operation.





- B) Final OM manual -The final manual will be reviewed for content and completeness and if found satisfactory will be approved as a final O & M manual. The final manual must be complete enough to be used as a textbook for the operators during start-up training. In other words, the final manual should be void of spelling and typographical errors and must include all diagrams, figures and tables, page numbers, all design data and parameters, etc. It must be essentially a complete manual except for very specific information that may not be available. The final manual must be submitted for approval at least 45 days prior to initiation of operation. **The actual date for initiation of operation will not be approved until the final manual has been approved.**
- C) Revised Final OM Manual - The revised final O & M manual must be submitted for review at least 30 days prior to the completion of the performance certification period (eleven months after initiation of operation). The revised final manual is an updated final manual that includes revisions based on actual plant operation. The revised final manual must be prepared by a cooperative effort between the Consultant and the treatment facility operating staff. To assure proper input by the operating staff, the revised final manual must be submitted with a cover letter that includes the signatures of the treatment plant superintendent and/or principal operator and the person(s) responsible for preparing the manual.

The project certification report will not be approved unless the revised final OM manual has been approved.

III. OM Manual Content

These guidelines present a suggested format for OM manual preparation. Consultants are encouraged to improve upon these guidelines to accommodate unique treatment plant requirements. It is not the intent of these guidelines to restrict or stifle initiative. Format other than these guidelines will be accepted. However, the chapters as presented in these guidelines must still be provided. The OM manual should not be written in this format just to satisfy the Minnesota Pollution Control Agency (MPCA) review. The overlying reason for writing the OM manual must be to provide OM instructions to the plant operator(s).

Operator input is required in development of the revised final OM manual. Operator input is also suggested in preparing the final manual as this will make the manual more amenable to the operator and easier to revise. For example, the operators may have certain procedures, records, lab forms etc., that they prefer which should then be incorporated in the final manual. The operations staff may prepare many parts of the OM manual. For example, when the operators implement their maintenance programs as per the OM manual instructions, they would be in a good position to also develop the table summarizing the maintenance schedule of all equipment for the revised final manual.

It is suggested that the OM manual be bound in 3-ring binders to facilitate easier revision at a later date.



A) STABILIZATION POND SYSTEMS (with or without land application)

All stabilization pond operation and maintenance manuals (with or without spray irrigation) must include a copy of the latest edition of the MPCA Stabilization Pond Manual along with the following additional information:

1. Description of pond system, including a flow diagram, design summary, and control structure diagrams.
2. Copy of the NPDES permit and plan/specification approval letter, including any special permit requirements.
3. Discussion on actual operation of the pond system.
4. Example of how to calculate discharge volumes (for various flow rates) specific to the pond system.
5. Discussion of NPDES permit requirements for “acceptable and problem discharge periods”.
6. Recommended qualifications, staffing recommendations, and operator certification.
7. Minnesota OSHA confined space entry requirements, along with how this applies to this system.

For the most efficient preparation of an OM manual for a pond system, we recommend that the MPCA pond manual be used verbatim as a base with specific information concerning the above items to be added on different colored paper to each chapter or consolidated at the end of manual. The OM manual should begin with an explanation page outlining manual organization used and explaining the difference between the MPCA pond manual and the specific sections of the OM manual.

B) MECHANICAL PLANTS

The following is only a recommended format. The consultant may improve upon it or may use any other format. However, all OM manuals must incorporate all of the chapters outlined in the following recommended guidelines.

The final manual should be complete enough to be used as a textbook for start-up training and plant start-up, including suggested operational criteria to be used as a guideline in attaining optimum treatment efficiency as soon as possible. The final manual should include design operating parameters such as unit efficiencies, operating criteria, suggested design or process control test ranges, etc. The operational areas should be a series of simplified instructions for plant personnel to follow. The revised final manual should include recommended operational values and modes of operation based on actual plant operation and data obtained during the one year performance certification period.

Chapters I, II, VII, IX and X of the final manual should be written in final form as little change is expected in these chapters between the final and revised final OM manuals. However, this does not preclude any necessary changes from being made. **The OM manual must be written to instruct the operations staff how to operate the treatment facilities. It should not be written just to follow this recommended format.**



The format recommendation is as follows:

CHAPTER I: INTRODUCTION

- Introduction
- Operation and maintenance responsibility described for the operators and for the city or governing body.
- General description of plant type and all units including flow diagram and plant layout with major piping included.
- Design summary of the overall treatment facility, including plant and unit influent design data, number of units, size (s), design and design peak loading, design performance data, etc. This information may be provided in Chapter III where each individual unit is discussed.
- Discussion of treatment requirements/NPDES effluent limitations.

CHAPTER II: PERMITS

- Reporting procedures for spills of raw or inadequately treated wastewater and toxic/hazardous wastes including NPDES permit requirements to report and explain effluent violations.
- Copy of the treatment facility plan and specification approval letter from the MPCA and discussion of any special requirements.
- Copy of the NPDES Permit, including discussion of any special requirements in the permit such as bypass authorization, special provisions, compliance schedule, pretreatment requirements, etc.

CHAPTER III: OPERATION AND CONTROL OF WASTEWATER TREATMENT

- Individually discuss each category of units and auxiliary systems associated with each unit such as bar screens, grit chambers, primary clarifiers, sludge pumps, auxiliary power, alarms etc. including the following information (if applicable):



NOTE: Many of these sections need not be very detailed, if reference can be made to other areas of the OM manual. For example, the control/lab tests and maintenance section may reference other chapters of the OM manual.

- a. Purpose of the equipment or unit(s), what does the unit do?
- b. Equipment or unit description, including schematics, how does it accomplish its purpose? The description should include sizes and dimensions and trace all flows (wastewater, sludge, recirculation, etc.) through the unit and comment on how the wastewater or sludge is altered by the unit. The theory behind how the process works should also be included if the process is not included in the MPCA Wastewater Treatment Technology manual. It is suggested that the MPCA Wastewater Treatment Technology manual be incorporated into the final OM manual.
- c. Relationship to adjacent units - discuss how the operation of each treatment process will affect or be affected by adjacent units.
- d. Operation - including start-up, normal operation, alternate modes of operation, seasonal operation, bypass operation, shutdown and draining procedures. Normal operation discussion should include initial operational parameters and a systematic approach to attaining these parameters with a detailed step-by-step procedure for making adjustments and receiving feedback through the use of control tests and physical measurements. Operator application of concepts and testing to process control must be emphasized. This section should also include valve positions for each mode of operation, when to use the unit or alternative mode of operation, flow rates, sludge concentrations, expected results or efficiencies, operation during industrial shock loads, I/I, etc.
- e. Controls - such as flow controls (flow to the unit, recirculation, air, or sludge), electrical controls and manual controls, alarms, etc.
- f. Unit or related equipment diagram or schematic(s) including valve location.
- g. Potential operational problems and solutions, such as a troubleshooting guide.
- h. Maintenance - specific maintenance may be discussed here in the revised final manual. Reference may also be made to manufacturer's manuals, if the manufacturer's manual is specific for that piece of equipment and can be referenced to the appendix.

CHAPTER IV: OPERATION AND CONTROL OF SLUDGE HANDLING

- Individually discuss each category of units involved with handling sludge such as sludge holding, thickening or treatment units, sludge pumps, sludge disposal, etc. including the following information if applicable:
 - a. Purpose of the unit



- b. Equipment description - the description should include schematics in addition to sizes and dimensions of the units and trace all flows through the unit and comment on how the character of the sludge is altered. Discussion of theory for aerobic or anaerobic digestion and land application of sludge will be provided through a chapter from the MPCA Wastewater Treatment Technology manual may be incorporated into the final OM manual. All other sludge treatment or handling processes must include a discussion of theory.
- c. Relationship to adjacent units - discuss how the operation of each treatment process being considered can affect other units.
- d. Operation including start-up, normal operation (design condition), alternate modes of operation, bypass operation, draining procedures. Each discussion should include valve positions, flow rates, sludge concentrations, expected results or efficiencies, use of control tests, etc.
- e. Controls such as flow controls (flow to unit, sludge flows, air rates, etc.), electrical controls and manual controls
- f. Unit diagram including valve locations
- g. Potential operational problems and solutions
- h. Maintenance

In addition, the sludge-handling chapter should contain a copy of the approved biosolids management plan or adequate information to instruct the operating staff to be able to develop a biosolids management plan. **A copy of the MPCA Land Application of Biosolids Manual must be included.**

CHAPTER V: PERSONNEL

- Outline manpower requirements and recommended qualifications of each such as training, experience, skills and certification eligibility requirements. The revised final manual should include any recommended staffing changes, training needs, and etc. based on the first year of actual operation.
- Discuss pertinent aspects of operator certification as they apply to this facility, including wastewater and waste disposal (land application of biosolids) certification requirements.



CHAPTER VI: PROCESS CONTROL AND LABORATORY TESTING

- In the past, OM manuals have been quite inadequate in the area of process control. One suggested method of presenting this information is to review each unit individually and discuss the laboratory tests and test results as they apply to that unit.
- Discuss testing requirements (control testing, NPDES requirements, etc.) and the purpose of testing; this should include control testing and taking physical measurements. Also discuss how to record tests for easy use such as trend charts.
- Discuss proper sampling procedure.
- Give instruction for conducting tests or taking physical measurements, **including interpretation of test results or measurements (i.e. expected range, what high or low values may indicate, etc.) for each application of the test and how the operator should apply the test results to process control.** When discussing test procedures, do not reprint "Standard Methods", but reference when applicable. Give instructions in the OM manual for only those tests not found in "Standard Methods" or other approved manuals.
- Outline quality control program for NPDES and control tests conducted on-site.
- Sample laboratory worksheets

CHAPTER VII: RECORDS

- Discuss and provide examples of records for daily operations, equipment, costs, personnel, lab, etc. that will be of use to the operations staff.
- **Discuss and provide example of MPCA monthly operation report requirements.**
- Discuss and provide example of an annual wastewater report and a budget.
- Discuss and provide example of biosolids landspreading annual report form.



CHAPTER VIII: MAINTENANCE

NOTE: The general discussion should be complete in the final manual including the instructions on developing a maintenance program. As a result of this chapter, the operating staff should be able to develop, implement and utilize a maintenance program including a system to schedule, conduct and record all maintenance. During the first year of operation, the maintenance program outlined in the final O M manual is implemented by the operations staff, with assistance from the consultant. The revised final manual then should include a table developed during start-up summarizing the maintenance schedule of all equipment on a weekly, monthly, etc. basis including the type of lubricant.

- **Outline purpose of maintenance program**
- Discuss basic features of maintenance program and management system to include:
 - a. Maintenance procedures
 - b. Equipment maintenance record system with instructions in starting and carrying out such a record system
 - c. Planning and scheduling, how to utilize the record system
 - d. Inventory system
 - e. Special tools and their use
 - f. Warranty provisions including specific dates when the warranties run out (to be in the revised final O M manual or incorporated into the maintenance record system).
 - g. Maintenance cost and budgeting system
 - h. Summary of maintenance schedule of all equipment on a weekly, monthly, etc. basis including the type of lubricant, etc. (to be in the revised final O M manual).

CHAPTER IX: EMERGENCY OPERATING AND RESPONSE PROGRAM

- Vulnerability analysis, an analysis of the treatment facility with respect to the emergency situations that would be most vulnerable to its operation, i.e. flooding, tornado, fire, personnel strike, power outage, etc.
- Recommend equipment list to handle emergency situations.
- Emergency operating plan for maintaining operation during the listed emergencies including mutual aid recommendations. Included also must be NPDES permit instructions for notification of the State Duty Officer.



CHAPTER X: SAFETY

- General safety discussion including hazards of sewers, mechanical equipment, explosion, bacterial infections, chlorine, oxygen deficiencies, lab, electrical etc.
- General discussion and use of safety equipment.
- **Safety relating to the specific areas and necessary safety equipment.**
- **Discussion of OSHA Confined Space Requirements.**

CHAPTER XI: APPENDICES

- The appendices should be a bound manual with Table of Contents, tabs or other indexing system, page numbers, etc., for easy reference. The appendices should include at least all the following applicable information:
 - a. schematics
 - b. valve indices
 - c. sample forms
 - d. NPDES Permit/plan and specification approval letter
 - e. List of manufacturers manuals: the manuals need not be included in the OM manual, but a list must be provided referencing their location.
 - f. Copy of the MPCA Discharge Monitoring Report forms and instructions
 - g. Copy of wastewater certification rules, biosolids rules, landspreading site approval form, biosolids landspreading annual report form.
 - h. List content of Reference Library



IV. SUBMITTING AN O&M MANUAL

One copy should be submitted for review purposes. Upon approval, two copies of the OM manual will be needed. One copy will be for the MPCA files and the other will be included with the approval letter.. The final manual should be submitted at least 45 days prior to the initiation of operation date The revised OM manual must be submitted for approval at least 30 days prior to the end of the one-year certification period (11 months after the initiation of operation date). If no revisions are needed, a letter must be submitted stated this.

As a reminder, the actual date for initiation of operation will not be approved until the final manual has been approved. Also, the project certification report will not be approved unless the revised final OM manual has been approved.

Should you have any questions, feel free to contact Gene Erickson at (800) 657-3864.